INFORMATION BROCHURE

SKUAST-J Common Entrance Test-2023

(SKUAST-J CET-2023)

For Admission to

Master's Degree Programme in veterinary Sciences (M.V.Sc.)

And

Doctoral Programme in all disciplines

Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu,
Chatha, Jammu, J & K 180 009, INDIA

Officers of the University

Prof. B.N. Tripathi
Hon'ble Vice Chancellor

Dr. R. K. Samnotra
Director Research

Dr. S.K. Gupta
Director Extension

Dr. S.E.H. Rizvi
Director Education/ Dean, F.B.Sc

Dr. Jyoti Kachroo
Director Planning & Monitoring

Dr. Sushil Kumar Gupta
Registrar and Dean, FoH&F

Dr. B. C. Sharma
Dean, FoA

Dr. M.S Bhadwal,
Dean, F.V.Sc. &A.H..

Dr. Rajesh Katoch
Dean Students Welfare

Dr. Jasvinder Singh Soodan
Dean, Faculty of Dairy Technology

Dr. Sushil Sharma
Dean, Faculty of Agricultural Engineering

Dr. A.K Sharma
Librarian Chatha

Dr. Rajinder Peshin
Controller of Examination

Dr. R.K. Salgotra
Coordinator, School of Biotechnology

Dr. Sanjay Guleria
Placement Cell

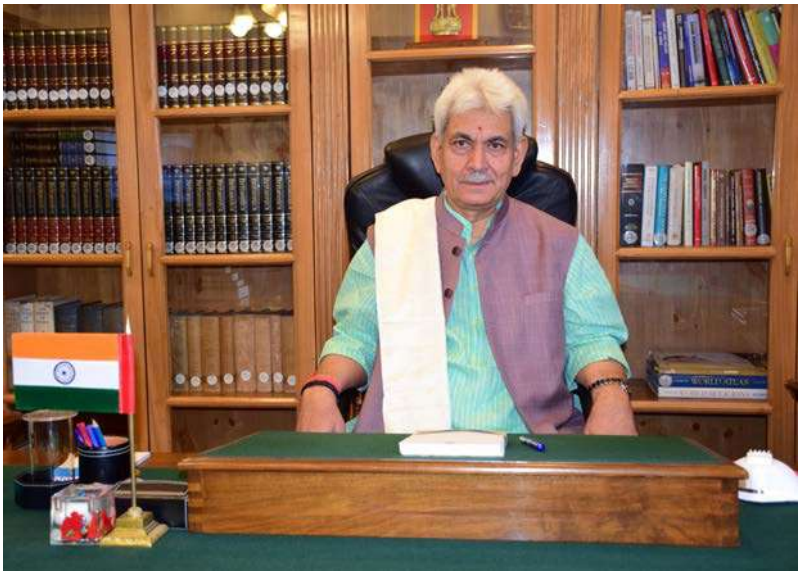
Dr. Bharat Bhushan
Joint Registrar (Academics)

Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu

Accredited by ICAR (Grade 'A')

Main Campus Chatha, Jammu (Jammu and Kashmir -180009

The Chancellor, SKUAST-Jammu



Sh. Manoj Sinha,
Hon'ble Chancellor and
Lieutenant Governor Union Territory of Jammu and Kashmir

Vice- Chancellor , SKUAST-Jammu

UNIVERSITY MAIN CAMPUS CHATHA

Faculties at SKUAST-J	**1.**	**Faculty of Agriculture**
	2.	**Faculty of Veterinary Sciences and Animal Husbandry**
	3.	**Faculty of Basic Sciences**
	4.	**Faculty of Dairy Technology**
	5.	**Faculty of Agricultural Engineering**
	6.	**Faculty of Horticulture & Forestry**
Schools at SKUAST-J	**1.**	**School of Biotechnology**
Administrative Offices	**1.**	**Vice- Chancellor's Secretariat**
	2.	**Directorate of Research**
	3.	**Directorate of Extension**
	4.	**Directorate of Education**
	5.	**Directorate of Planning & Monitoring**
	6.	**Registrar's Office**
	7.	**Comptroller's Office**
	8.	**Estates office**
	9.	**Office of the Dean Students welfare**

The Important features for inviting online applications for SKUAST-J CET (2023) M.V.Sc. & Ph.D Programmes are as under:	
Commencement of submission of online application forms	**04/12/2023 from 10.00 am (Monday)**
Last date for submission of online application forms	**03/01/2024 at 05:30 pm (Wednesday)**
Last date for submission of online application forms with late fee	**06/01/2024 at 05:30 pm (Saturday)**
Opening of Correction window for submitted Online applications forms	**07/01/2024 from 10:00 pm (Sunday) to 09/01/2024 at 05:30 pm (Tuesday)**
Date of Common Entrance Test (CET)	
• **Master's Programmes (M.V.Sc.)**	**19-01-2024 (Friday) 10.30 am**
Date & Time of Common Entrance Test (CET) Aptitudes and interview (Ph.D. Programmes)	**29-01-2024 (Monday) 10.30 am**
Date of download of Admit card	
• **Master's Programmes (M.V.Sc.)**	**13-01-2024**
• **Doctoral Programmes (Ph.D)**	**20-01-2024**
Test Centre	**SKUAST- Jammu**
Application fee for CET (Ph.D) 2023	**Rs. 2000/-**
Application fee for CET (M.V.Sc.) 2023	**Rs. 1800/-**
Late fee for late submission of online application form	**Rs. 1000/-**

HOW TO APPLY

Application Forms will be accepted **Online ONLY** through University website www.skuast.org.

INSTRUCTIONS/ PROCEDURE FOR FILLING UP ONLINE APPLICATION FORM

Candidates are advised to read carefully the following instructions before they fill in the admission form:-

1. Candidates have to log on to www.skuast.org to apply on line, and click the link ***SKUAST-J Common Entrance Test (CET) M.V.Sc. & Ph.D-2023***
2. The candidates must, in their own interest, download the Information Brochure and understand eligibility criteria and other requirements before filling the Application Form.
3. Application Form will be accepted Online ONLY through University website ww.skuast.org from 10.00 am of 04/12/2023 to 05:30 pm of 03-01-2024. However, duly filled application forms along with late fee of Rs. 1000/- will be accepted from 10:00 am of 04-01-2024 to 5:30 pm of 06-01-2024 to 5:30 p.m.
4. The name should be filled in BLOCK LETTERS and should be the same as given in the certificate of the last examination passed.
5. Before applying online, candidate must ensure that he/she has scanned image of his photograph, signature and thumb-impression in JPEG/JPG format saved on the computer; uploading all of these is MANDATORY. Candidate should also have his/her payment mode details handy.
6. Open the first link, and fill in Part-I of the on-line application form (personal details).

7. While filling up the application form, the candidates shall prefer to write his own contact No(s), email Id for receiving updates from time to time.
8. After submission of personal details at Part-I, you will be directed to second link and fill-in the Part II of application form (academic details).
9. After submitting Part-II, programme will automatically take you to Part III for uploading of Photograph, signature and thumb impression. Upload images of photograph, signature, and thumb impression in JPEG format.
10. Once successfully done, candidate will be shown his/her complete details as recorded at part-IV of the form. Candidate is required to thoroughly check all the details.
11. At the bottom of the page candidate will have the options of printing application form. Take a print out for your record.
12. Candidate can make online payment through any Credit Card/Debit Card/Net Banking.
13. Take print out of confirmation page(s) of online application format and preserve it for future reference.
14. Admission form incomplete in any respect shall be rejected.
15. Seeking admission on the basis of false identity, misrepresentation by submitting false certificates/ documents or suppression of any material fact is unlawful and will result in cancellation of admission at any point of time when discovered.
16. The applicant can check the status of his/her fee online (www.skuast.org) one week after depositing the fee.
17. In case the status remains unpaid even after one week, candidate can approach University Examination Cell, SKUAST-Jammu with the copy of their Confirmation page of online payment

For any assistance, please call 9419803486 / 09419226376.

Counselling for M.V.Sc. Programme:

Qualified candidates, as per merit, shall be called for counselling on a specified date and time for consideration of admission. The counselling will continue till the last seat in each discipline is filled-up. Merit list will be uploaded on the university website (**www.skuast.org).** The candidates are advised to see regularly the website of the University for counselling dates. No separate letter will be sent to the candidates. Counselling schedule will be notified in the newspapers as well as on the University website.

Venue of Counselling for M.V.Sc. Programme:

Counselling shall start at 10.30 am sharp. The candidates shall be called for counselling and preliminary verification of certificates as per the rank obtained in CET. The category wise cut off rank for each counselling shall be notified separately and placed on University website from time to time till last counselling. The candidate is required to record his/her presence for counselling by

signing on the designated register at the counselling hall. The aspirants shall be called for the counselling with descending rank one after the other and if a candidate called for counselling does not present him / herself before the committee his/her claim for any seat shall get forfeited. In case the candidate reports after his name is called for counselling but within stipulated time on the day of counselling the seat offered to that candidate shall be out of the unallocated seat available at the point of time when he/she reports before committee. A candidate reporting for counselling after 5.00 pm of the stipulated date shall not be allowed to mark their presence and shall not be entertained for counselling in any case. Accordingly candidates are advised to meet the deadline of cut off time on the day of counselling(s).

The candidates who are called for counselling must pay online counselling fee of Rs 1000/- before appearing on the scheduled date of counselling. The details for depositing online counselling fee and a payment link for the same shall be available on the university website www.skuast.org

Ph.D. Programmes:

The selection will be purely based on the marks secured in the SKUAST-J Common Entrance Test and a merit list will be drawn based on the score obtained in the test. In case there is tie in the merit of SKUAST-J CET (Ph.D.), candidate having higher marks in the Master's level shall be placed at higher rank. However, in case there is again tie in the master's programme, the candidate higher marks in graduation level shall be placed higher in the rank. Any subsequent vacancy cause by whatsoever reason in any category shall be filled from the waitlisted candidates.

The candidates scoring less than 50% marks in the CET shall not be considered for admission, and therefore shall not be included in the merit list.

Disclaimer

- The information contained in this brochure is of general nature for the candidates who aspire for admission in various programmes offered by the University. It is neither an exhaustive nor a legal document. The statements and all other information presented herein the brochure are believed to be correct at the time of publication. However, the University reserves the right to make additions or alterations in the regulations, conditions governing admissions, the code of conduct of students, requirements for the degree or the diploma, fees and any other information or statement/rule at any time without notice.

- University may delete any programme of studies at any time without notice or reduce or enhance the number of seats. No responsibility shall be accepted by the University for any hardship encountered or expenses incurred by the students or any other person for such changes, additions, omissions or errors, no matter how they are caused.

- The students are advised to refer to the Academic Regulations and other statutory/administrative provisions applicable on a particular point of time on various aspects, viz., system of education, residence in the University, Hostels, enrolment in NSS / NCC, award of scholarships, stipends, fellowships, medals, certificates of honour, and conduct in the premises of the University.

- The students should also note that the provisions of the Act, Statutes, Academic Regulations and other legal/administrative notifications, orders, instructions, and guidelines etc. can be changed by the Competent Authorities at any time without assigning any reason or prior notice.

- Though every effort and care is taken to stick and follow the instructions and schedule of dates given hereunder, yet under certain compelling circumstances, if there has to be any deviation, University shall not be responsible for any inconvenience, losses or ill consequences arising there from.

- Fees and other charges once paid at the time of admission shall not be refunded except for the refundable component (security deposits).

- Admission to the University entails acceptance of all provisions given in the University Act, Statutes, Regulations and admission policy and changes that are made from time to time there in.

Jurisdiction
Jurisdiction for any disputes is at Jammu city.

Prelude

The Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu (SKUAST-Jammu) has been established by the Government of Jammu and Kashmir on September 20, 1999 by promulgated vide SRO No 408 dated 20-09-1999 an amendment in the Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu and Kashmir Act of 1982 .

The prime mandate to the University is to produce competent human resource that can sustain and improvise the phenomenal growth of agriculture & allied sectors with an eye on maintenance of biodiversity and addressing the environmental concerns. Accordingly the faculty, students and scholars of the University are manning the frontier of life sciences, environmental sciences, food and energy system along with community and economic development. The University is also mandated to develop new, refine the existing and disseminate appropriate agricultural technologies to the stakeholders in the Union Territory in general and Jammu Division in particular. It also steers innovate, location specific and problem solving research in agriculture and allied sectors.

The University is having excellent facilities in terms of teaching, research, sports and other extracurricular activities. The University strives to provide congenial learning environment at graduate as well as at postgraduate levels to churn out the competent human resource in the realm of Agriculture Sciences, Veterinary Sciences, Animal Husbandry and Biotechnology, Food Science, Sericulture, Agricultural Engineering, Microbiology, MBA (Agri-business Management), Forestry and Basic Sciences. The University is having well qualified and trained faculty well known nationally /internationally and the quality education being imparted to the students by the University is fashioning them to get selected in the most coveted services like Scientists in the Universities and Research Organizations of repute both in and out of the Union Territory; Indian Administrative Services, Indian Forest Services, Kashmir Administrative Services, Public and Private Banking and others sectors besides, the primary sectors like Agriculture, Horticulture, Sheep & Animal husbandry.

ABOUT UNIVERSITY

Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu is a multi- campus University with its head quarter located at Chatha, Jammu at a distance of 8 km from Jammu-Pathankot NH-1A, 12 km from the Jammu Railway Station, 14 km from the General Bus Stand and 6 km from the Air Port, Jammu.

The University has extensive infrastructure within its jurisdiction and command. The main campus at Chatha is spread over 578 acres. The Faculty of Agriculture, Faculty of Basic Sciences, Faculty of Agricultural Engineering and Faculty of Horticulture & Forestry and a School of Biotechnology are located in it. Faculty of Veterinary Sciences & Animal Husbandry and Faculty of Dairy Technology at R.S.Pura has an extent of 84 acres. The total land possession with the University (including Research Stations/Sub-Stations and KVKs) is 1139.12 acres. There are 09 Research Station and Sub Stations. and nine KVKs in the University that are located in different agro-climatic zones of Jammu region for catering to location-specific needs of the farming community. University pursues high standard of location specific and problem-solving research through research projects funded by various central, state agencies & other funding agencies. At the faculty level the emphasis is on imparting of quality education by providing congenial atmosphere in the campus. The inception of high-tech infrastructure involving computer-based facilities, internet connectivity and modern administrative dispensation are vital characteristics of this University.

The University has highly structured infrastructure facilities in terms of buildings, laboratories, lecture rooms,

Faculty of Agriculture

Faculty of Veterinary Sciences & Animal Husbandry Agricultural

Faculty of Basic Sciences

Faculty of Dairy Technology

instructional and research farms, modern instruments/equipment's, farm machinery, transport and library facilities. It has distinguished and qualified faculty positioned at all the campuses and regional research stations. The faculty members and the post- graduate students of the University have won numerous national and international recognitions in the forms of awards, honours and fellowships awarded by the prestigious professional scientific bodies/societies.

Faculty of Agricultural Engineering

Faculty of Horticulture & Forestry

01 FACULTY OF AGRICULTURE

i. Division of Agronomy
ii. Division of Agricultural Economics and ABM
iii. Division of Agricultural Extension Education
iv. Division of Plant Breeding and Genetics
v. Division of Soil Science and Agril Chemistry
vi. Division of Plant Pathology
vii. Division of Sericulture
viii. Division of Entomology

02 FACULTY OF VETERINARY SCIENCES & ANIMAL HUSBANDRY

i. Division of Veterinary Clinical Complex
ii. Division of Veterinary Microbiology and Immunology
iii. Division of Livestock Production Management
iv. Division of Veterinary Anatomy
v. Division of Veterinary Physiology and Biochemistry
vi. Division of Animal Nutrition
vii. Division of Veterinary Animal Husbandry Extension Education
viii. Division of Livestock Products Technology
ix. Division of Veterinary Gynaecology and Obstetrics
x. Division of Veterinary Surgery and Radiology

xi. Division of Veterinary Medicine
xii. Division of Pharmacology and Toxicology
xiii. Division of Veterinary Parasitology
xiv. Division of Veterinary Pathology
xv. Division of Veterinary Public Health and Epidemiology
xvi. Division of Animal Genetics and Breeding
xvii. Division of Livestock Farm Complex
xviii. Division of Fisheries

03 FACULTY OF BASIC SCIENCES

I. Division of Statistics and Computer Science
II. Division of Biochemistry
III. Division of Microbiology
IV. Division of Plant Physiology

04 Faculty of Dairy Technology

i. Division of Dairy Technology
ii. Division of Dairy Engineering
iii. Division of Dairy Chemistry
iv. Division of Dairy Microbiology
v. DIVISION OF DAIRY BUSINESS MANAGEMENT

05 Faculty of Agricultural Engineering

i. Division of Farm Machinery and Power Engineering
ii. Division of Soil and Water Engineering
iii. Division of Processing and Food Engineering
iv. Division of Basic Engineering & Sciences

06 Faculty of Horticulture & Forestry

I. Division of Fruit Science
II. Division of Vegetable Science
III. Division of Post-Harvest Management
IV. Division Of Floriculture and Landscaping
V. Division of Silviculture & Agroforestry
VI. Division of Forest Biology and Tree Improvement
VII. Division of Forest Products and Utilization

SCHOOL OF BIOTECHNOLOGY

The School of Biotechnology, an integral part of Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu (SKUAST-J) came into existence in 2010 on self-sustainable basis with the sole aim to generate quality manpower with extensive knowledge, advanced technical know-how and outstanding academic potential in the subject. The School of Biotechnology is offering B.Tech (Biotechnology), M.Sc. and Ph.D. degree programmes to aspirants and admissions are made on the merit basis in all the degree programmes. The courses have been designed in such a way so as to provide ideal learning opportunities and hands-on practical's to the students to become qualified and skilled professionals in order to meet the needs of the growing industry. The course curriculum included courses from biotechnology and allied fields like plant, animal and microbial biotechnology. The course curriculum also includes nano-biotechnology and bioinformatics courses to keep the students abreast with latest technological know-how.

FACILITIES AT SKUAST-JAMMU

Facilities available for Sports/Cultural activities

It is instrumental in catering the need of regular games and sports activities for the students in all the Colleges. The university has a large playground and gymnasium, with the facilities of different games and sports. The students are encouraged to participate in state and inter-university competitions. Inter/intra-faculty sports competitions are also organized annually. The organization conducts programmes /competitions to identify best talents in literary and cultural activities. Students of SKUAST-Jammu have been regularly participating in All India Inter University Youth Festival – REVERIE being held at NDRI, Karnal since last many years and has bagged many awards.

Student Centre

Student Amenities

The Students' Welfare Section under the ambit of Directorate of Education of the University attends to the residential requirements, sports, cultural/co-curricular activities, NSS and medical care of the students. To make life comfortable for the students, common use facilities such as cafeteria, shopping centre, banks, post-office and transportation are available in the campus.

Hostel Facilities:

SKUAST-Jammu provides limited hostel accommodation to the students who are admitted in UG & PG courses. Separate hostel accommodation for boys and girls are available at Chatha and RS Pura campuses. There are five hostels (three for girls and two for boys). All the hostels have sufficient rooms with adequate furniture and fixture.

S.No.	***Name of the Hostel & Location***		***Warden***
1.	*LAKSHYA (Boys Hostel) R.S. Pura*		*Dr. Anil Kumar Pandey, Asstt. Professor, F.V.Sc & AH, R.S. Pura*
2.	*SANKALP (Boys Hostel) Chatha*		*Dr. Sudhakar Dwivedi, Professor, FoA, Chatha*
3	*UJALA (Girls Hostel) Chatha*		*Dr. Sehar Masud. Professor Fisheries, Chatha.*
4	*PRAGTI (Girls Hostel) R.S. Pura*		*Dr. Jafrin Ara Ahmed, Professor, F.V.Sc.& .A.H, R.S. Pura.*
5.	*UJALA (Girls Hostel) Chatha*		*Dr. Shilpa Sood,. Prof. F.V.Sc & AH, R.S. Pura*

Students are not allowed to use any four/two wheeler during the stay in the University campus.

UJALA Girls Hostel

SANKALP Hostel (Boys) Chatha

Health care Facilities:

The medical facilities are provided to all the students through University Health Centers located at Chatha and R S Pura campus. The University Health Centre has the staff strength of a medical officer, lady doctor, two pharmacists, lab technician and staff nurse. The medical facilities including ambulance services at R.S Pura and Chatha are available to all the students and residents round the clock. The facility of dental chair is also available.

Health Centre

Contact Details:

Dr. Anil Kumar Gupta, Medical Officer
Dr. Sushma Gupta, Medical Officer
SKUAST-J, Main Campus, Chatha – 180009

University Library

Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu (SKUAST-Jammu) comprises of Central Library at Faculty of Agriculture (FOA), Main Campus, Chatha and Faculty Library at R.S. Pura. Both the libraries have open access and are housed in their respective modern and spacious buildings. The Central Library is a modern three storey glazed building having 5382 sq. meter area and has come up at the construction cost is Rs. 945 lacs. It was inaugurated by the then Chief Minister of J&K, Sh. Ghulam Nabi Azad, on 12th November, 2007. The Faculty Library at R.S. Pura, has an area of 2937 sq. meter area. In both the libraries the collection comprises of documents in the field of Agricultural, Veterinary and allied sciences. Online Library system consisting of network terminals for providing access to e-journals, e-books, internet and other e-reference resources are provided to the scientists, scholars, students and staff. Library functions and requirements have been kept in view while planning and equipping it. Both the libraries contribute and support the University in building an internationally top ranked academic and research driven institution by establishing a knowledge hub. Library services are witnessing radical changes world over and accessibility and instant retrieval of information is the main focus.

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Central Library, Chatha

Contact Details:

Prof. A.K. Sharma, University Librarian

Central Library, FOA, Chatha

University Librarian Central Library, Main Campus, Chatha – 180009

Phone: 0191-2262037

Fax: 01912262037 , E-mail: clskuastj2@gmail.com

Examination Cell

The examination cell of the University was established in November 2012, to conduct and regulate the examinations smoothly, as well as to set up a confidential communication channel with external examiners.

THE UNIVERSITY EXAMINATION CELL CONDUCTS AND REGULATES

- SKUAST-J Common Entrance Test for admissions to various undergraduate and postgraduate degree programmes.
- The external end term examinations of Undergraduate programmes.
- The annual board examinations (theory and practical) of undergraduate programme in veterinary sciences.
- The End-term examinations of post-graduate programmes in agriculture, veterinary and allied sciences.
- The final examinations of Basic Agricultural and Horticultural Training Programmes

Contact Details:

Prof. Rajinder Peshin
Controller of Examination, SKUAST-Jammu, Main Campus Chatha-180009
Contact no. 9419226376 (M)
Email : examinationcellskuastj@gmail.com

M.V.Sc. Programmes-2023

(A) ELIGIBILITY REQUIREMENTS AND INTAKE M.V.Sc. PROGRAMME.

- Candidate not below 19 years of age, as on 31-12-2023, is eligible to appear in the examination. No relaxation is admissible regarding the minimum age limit.
- The candidate must have passed B.V.Sc. & A.H degree examination securing Grade point average (OGPA) at least:
  - ✓ **General category**: 6.00/10.00 on ten point scale, 3.00/4.00 on four point scale. In other cases where grade points are not awarded and only marks are awarded, the candidate must have secured at least 60% marks.
  - ✓ **Reserved Categories**: 5.50/10.00 on ten point scale/ or at least 55% marks where grade point is not awarded.
- Candidate must have passed or due to appear at the final examination and likely to get awarded the degree on or before the date of counselling.

The subject wise eligibility requirements are given below:

S.No	Programme / Discipline	Feeder Stream
1.	M.V.Sc. Animal Genetics and Breeding	B.V.Sc. & A.H
2.	M.V.Sc. Animal Nutrition	
3.	M.V.Sc. Livestock Production & Management	
4.	M.V.Sc. Livestock Products Technology	
5.	M.V.Sc. Veterinary Anatomy	
6.	M.V.Sc. Veterinary Extension Education	
7.	M.V.Sc. Veterinary Biochemistry	
8.	M.V.Sc. Animal Reproduction Gynaecology & Obstetrics	
9.	M.V.Sc. Veterinary Medicine	
10.	M.V.Sc. Veterinary Microbiology	
11.	M.V.Sc. Veterinary Parasitology	
12.	M.V.Sc. Veterinary Pathology	
13.	M.V.Sc. Veterinary Pharmacology & Toxicology	
14.	M.V.Sc. Veterinary Physiology	
15.	M.V.Sc. Veterinary Public Health & Epidemiology	
16.	M.V.Sc. Veterinary Surgery and Radiology	

Seat Matrix under open merit and reserved category seats (% age):

Category	Codes	Percentage of Reservation
Open Merit (OM)	01	57%
Scheduled Caste (SC)	02	8%
Schedule Tribe	03	10%
Weak and under privileged classes (Social Castes)	04	4%
Resident of area adjoining Actual Line of Control /International Border(IB)	05	4%
Resident of Backward Area (RBA)	06	10%
Pahari Speaking People	07	4%
Economically Weaker Section(EWSs)	08	10%
Physically Challenged persons	09	NA
Candidate possessing outstanding proficiency in sports	11	2%
Children and Defense Personal and Paramilitary Forces and State Police Personal	13	2%

Total no. of seats available for PG Programme in Veterinary Sciences 2023-24

S. No	Discipline	Total seats	Open Merit and reserved seats	Self Financing Seats*		Govt. Nominee
				UT of J&K and UT of Ladakh Domicile	All India Basis	
1.	M.V.Sc. Animal Genetics and Breeding	05	01 OM 01 ST	01	01	01
2.	M.V.Sc. Animal Nutrition	05	03 OM + 01 EWS	01	01	Nil
3.	M.V.Sc. Livestock Production Management	05	01 ALC 01 CDP	01	01	01
4.	M.V.Sc. Livestock Products Technology	01	01-RBA	Nil	Nil	Nil
5.	M.V.Sc. Veterinary Anatomy	03	01 OM 01 PSP	01	Nil	Nil
6.	M.V.Sc. Veterinary Extension Education	05	01 SC 01 ST 01 Social caste	01	01	Nil
7.	M.V.Sc. Veterinary Biochemistry	04	03 OM + 01 EWS	01	Nil	Nil
8.	M.V.Sc. Animal Reproduction Gynaecology & Obstetrics	05	02 OM 01 RBA	01	01	Nil

9.	M.V.Sc. Veterinary Medicine	08	02 OM 01 SP 01 ST 01 SC	01	01	01
10.	M.V.Sc. Veterinary Microbiology	02	02 OM + 01 EWS	Nil	Nil	Nil
11.	M.V.Sc. Veterinary Parasitology	06	02 OM 01 RBA	01	01	01
12.	M.V.Sc. Veterinary Pathology	04	01 OM 01 PSP	01	01	Nil
13.	M.V.Sc. Veterinary Pharmacology & Toxicology	04	01 OM 01 ST	01	01	Nil
14.	M.V.Sc. Veterinary Physiology	05	01 OM 01 SC 01 ALC-IB+ 01 EWS	01	01	Nil
15.	M.V.Sc. Veterinary Public Health & Epidemiology	04	01 OM 01 Social caste	01	01	Nil
16.	M.V.Sc. Veterinary Surgery and Radiology	10	05 OM 01 ST 01 RBA	01	01	01
	Total	**76**	**45 + 4 EWS****	**14**	**12**	**05**

Note: * Seats falling vacant under any category shall be filled based on merit of CET under self-financing category.

* **The reservation to M.V.Sc. programme is given as per SO 127 dated 28/04/2021 amendments in Jammu & Kashmir Reservation Act, 2005.**

** ***In addition to above 10% of seats over and above be filled from the candidates of Economically Weaker Sections (EWSs) in each degree course.***

* **Candidates admitted under Self-financing seats have to deposit an additional fee as per category & course over and above normal fee.**

* **Seats may be increase subject to the availability of eligible Faculty/Teachers.**

B.) AUTHORITIES COMPETENT FOR ISSUING RESERVED CATEGORY CERTIFICATES

S. No.	Category	Authorized Officers to issue certificates
1.	Residents of Backward Area (RBA)	Revenue Officer not below the rank of Tehsildar.
2.	Scheduled Castes (SC)	Revenue Officer not below the rank of Tehsildar
3.	Scheduled Tribe	Revenue Officer not below the rank of Tehsildar
4.	Residents of Area Adjoining Actual Line of Control / International Border (IB)	Revenue Officer not below the rank of Tehsildar
5.	Weak and under Privileged Classes (OSC)	Revenue Officer not below the rank of Tehsildar
6.	Pahari Speaking People	Revenue Officer not below the rank of Tehsildar
7.	Candidates possessing outstanding proficiency in sports (SP)	Secretary, J&K Sports Council

8.	Children of State Police Personnel/ Para-military Forces	DIG concerned / Commanding Officer of the unit not below the rank of DIG
9.	Economically Weaker Section(EWSs)	Revenue Officer not below the rank of Tehsildar
10.	Physically Challenged Person	Medical officer/ Medical Board

Admission guidelines for SKUAST-J in-service candidates and in-service State Govt. Nominee:

- For admission of SKUAST-J In-Service Employees' and In-service state Govt. Nominee, only those applications with the prior permission from their employer shall be entertained. All Such candidates have to appear in SKUAST-J CET M.V.Sc. The admission to such candidates shall be granted only after the submission of the "permission letter of their employer" at the time of counselling.
- The admission of the In-service J&K UT Government Nominees shall also be made on the basis of SKUAST-J CET M.V.Sc.

C.) GENERAL INFORMATION

I. The candidates seeking admission to SKUAST-J through common entrance test are advised to:
   - go through this information brochure carefully and acquaint themselves with all the requirements, rules and regulations
   - satisfy themselves about the eligibility criteria prescribed for appearing in the entrance examination.
   - adhere strictly to the last date of submission of application form .
   - Write complete address with Postal Index No, Telephone No., Mobile No, e-mail address, in the application form.

II. Since University is neither an appellate authority nor an investigating agency, the complaints against credibility of certificates, including those of reserved categories, will not be entertained.

III. No representation will be entertained for rejected forms and forms received after the prescribed cut-off date of receipt of the forms. The candidates fulfilling the eligibility criteria will have to appear in the SKUAST-J Common Entrance Test.

IV. Permission of candidates to appear in '**SKUAST-J Common Entrance Test**' shall be provisional and subject to fulfilment of all prescribed eligibility requirements for admission to course(s) applied for on the date of first counselling.

V. Syllabus for the entrance examination is appended in the Information Brochure along with sample questions.

VI. **Ragging is banned in the University and any culprit shall be dealt and punished as per standing rules of the University.**

VII. Some of the records shall be destroyed as under:
   a. The unused question booklets and OMR answer sheets shall be destroyed after three months of the declaration of the result.
   b. The used answer sheets shall be destroyed after one year of the declaration of the results
   c. The counselling forms on which the candidates have indicated their choice at the time of counselling for admission to a particular course will be destroyed after one year.

(D.) INSTRUCTIONS

Instruction for photographs

Candidates must ensure that:

a. latest coloured photograph of passport size required to be uploaded must not have been taken before 31-12-2023 with a placard-indicating name of candidate (as in application form) and date of taking photograph.

b. the name of the candidate and date of taking of the photograph must be clear and legible in the photograph.

(E.) SELECTION PROCEDURE

- The selection and allotment of M.V.Sc stream will be purely based on the rank secured in the SKUAST-J Common Entrance Test and option made at the time of counselling.
- There will be a separate merit list for each category as listed in the Information Brochure.
- All the selections made by the University to M.V.Sc. programmes shall be provisional till final verification of eligibility of the candidates by the University.
- The University shall have the power to review and reframe the provisional selection list in case of any bonafide error, lapse, mistake, fraud, misrepresentation or inadvertently crept injustice that might have occurred and comes to the notice of the university before completion of the selection process or after the selection/admission process. Mere figuring in the selection list does not confer any right to admission of the candidate to a university programme if he/she is otherwise not found to be eligible on detection of an error/ mistake/ fraud/ misrepresentation/ impersonation at any stage during the degree programme.
- The recommendation of the candidates by the selection committee for admission in the university in all the categories shall be subject to production of all the relevant certificates in original at the time of counselling.

(F.) ADMIT CARD

- Only for those candidates who fulfill the prescribed requirements for the programme, to which they have applied, will be issued the photo Admit Cards depicting roll no, name of Centre of Examination, date and timing of the test. The Admit Card can be downloaded from the University web site www.skuast.org.
- If Admit Card is not downloaded two days before the date of the Entrance Test, the candidate may contact the office of the University Examination Cell, SKUAST Jammu, Chatha, with a photograph same as uploaded on e-form for obtaining Duplicate Admit Card.
- No Admit Card, in any case will be issued on the day of the Entrance Test.

(G.) EVALUATION OF ANSWER SHEETS

i. The University shall make the answer key available on its website the following day of the examination.

ii. Objection regarding the key, if any, with authenticated proof from standard quality text books shall be entertained through email for two days up to 12'^{O} clock mid night after uploading of key.

iii. The updated key (with modifications, if any) shall be made available on the web site of the university.

iv. Where a question has ambiguous language, which conforms to more than one answer among the given options, all such answers, shall be considered correct and if a student had responded with any one of the correct answers he/she will be given a mark for that question.

v. Where none of the option given to a question is correct, the question will not be considered in evaluation and one mark will be given to all the candidates whether they have attempted this question or not.

vi. The evaluation of the answer sheet is carried out mechanically so there is no chance of any mistake. The result declared after the machine marking shall be final and not open to any manual check. The students must avoid making faint marks or ambiguous impressions or incomplete marks on the OMR Sheet, which may result in errors in evaluation. It is therefore in the interest of the candidates to fill up OMR answer sheet carefully as shown in this Information Brochure. The re-evaluation of the answer sheets manually is not allowed, as that will infringe upon the rule of equality, which calls for a uniform treatment given to all the students.

(H.) DETERMINATION OF MERIT

- The merit list for each course shall be prepared on the basis of inter-se merit and option/choice of the candidates in the SKUAST-J CET in the descending order for Open Merit Category and for each Reserved Category, separately.
- Any subsequent vacancy caused by whatsoever reason in any category shall be filled from amongst the candidates of that particular category strictly according to merit. In the event of non-availability of eligible candidates from that reserved category, the relevant vacancies shall be filled through self-financing category as the case may be.
- In case two or more candidates obtain equal marks, the inter-se merit of such candidates shall be determined as per the order of preference as under.
  a. Candidates obtaining higher marks at graduation level
  b. Candidates older in age to be preferred if points as per (i) are equal

(I.) DECLARATION OF RESULT

i. No intimation, whatsoever about non-selection will be sent individually and no correspondence in this regard shall be entertained. The result will be posted at the University website, www.skuast.org

ii. Candidates, whose result of the qualifying examination is not declared by the time of counselling, will not be considered for admission.

iii. Selection of the candidates in all the categories shall be subject to production and verification of all the relevant certificates in original at the time of counselling.

(J.) COUNSELLING FOR ALLOTMENT OF DISCIPLINE

i. The candidates must come for counselling along with all documents in original, a set of attested copies of all documents, admit card issued by SKUAST-J and a counselling fee of Rs 1000/= (non-refundable).

ii. Candidate must mark his/her attendance by putting his/her full signature at the time of counselling.

iii. The candidates called for counselling must produce one set of original and one set of attested copies of following certificates along with duly filled in option form.

- Domicile certificate
- Date of birth certificate (Matriculation certificate)
- Marks certificate of qualifying examination
- Category certificate, if applicable

Note: No under process certificate shall be entertained at the time of counselling

i. After payment of prescribed admission fee, the candidates are advised for registration on scheduled date, failing which admission shall get automatically cancelled and fees deposited shall be forfeited.

ii. The candidate who has deposited the counselling fee once, need not to deposit fee in the succeeding counselling(s), in case such situation is warranted. However, candidate has to produce receipt of the same at the time of subsequent counselling.

iii. The candidates must appear in-person for counselling. However, in case of unavoidable reason a candidate is not able to appear in-person, he/she may send his/her authorized representative with authority letter duly signed by the candidate in original, admit card, admission fee and all other documents required for admission(refer item no. iii & iv)

iv. If a candidate or his/her representative fails to appear for counselling on the specified date but intends to appear on next date or any date during subsequent notified counselling schedule, he/she will be allowed for such counselling after depositing Rs. 1500/-(non refundable) as counselling fee. Further, the candidate shall be considered for seat in a course available at that point of time. Such candidates cannot stake any claim whatsoever on any other seat already allotted despite their merit.

v. Candidates shall have to join the course after allotment of discipline within the specified time period. Where a candidate fails to join the course within the stipulated time period, his/her selection shall be cancelled and the seat so vacated shall be allotted to the next candidate in merit.

vi. In case some seats remain vacant even after last round of counselling, the University shall call all candidates who have appeared in SKUAST-J CET for walk-in counselling and the selection shall be made on the merit of SKUAST-J CET among the candidates appearing in the walk-in counselling.

vii. If a candidate or his authorized representative fails to appear for counselling during the entire notified period of counselling schedule, he/she will forfeit all claims for admission.

(K.) FEE STRUCTURE FOR M.V.Sc. PROGRAMME

(a) At the time of 1st admission

S. No	Particulars	Postgraduate Programmes (Rs.)
1.	Admission fee	7500
2.	University Registration fee	6250
3.	Caution/Security Money for Library (refundable)	3750
4.	College Laboratory Development charges	1250
5.	College Laboratory Development charges	1000
6.	Tuition fee	5000
7.	Examination fee	1250
8.	Extra-Curricular Activities fee	625
9.	Medical Examination fee	250
10.	Magazine fund (per annum)	250
11.	Identity card	125
12.	Placement and counselling fund	0
13.	Educational Tour	0
14.	Alumni Fee	500
Total (A)		**Rs. 27750**
Hostel Charges		
1.	Hostel Charges (Room rent) **Per Semester**	
i.	Single Seater	4375
ii.	Dormitory	3125
iii.	NRI Rooms	6250
2.	Hostel Security (refundable) for fresh admission	5000
3.	Mess security in case of Hostel inmates for fresh admission (refundable)	5000
4.	Hostel maintenance fund per Semester	625
5.	Utensils crockery breakage fund	190
6.	Common Room Fund (Hostellers)	375
7.	Electricity charges Per semester	2500
8.	Generator charges Per Semester per Students	3750
Total B		
i.	Single Seater	**Rs. 21815**
ii.	Dormitory	**Rs. 20565**
iii.	NRI Rooms	**Rs. 23690**
G Total (A + B) =		
i.	Single Seater	**Rs. 49565**
ii.	Dormitory	**Rs. 48315**
iii.	NRI Rooms	**Rs. 51440**

(b) Recurring Semester Fee (per semester)

S. No	Particulars	Postgraduate Programmes (Rs.)
(A)		
1.	Semester Registration fee	1000
2.	Tuition fee	7500
3.	Examination fee	1250
4.	Extra-Curricular Activities fee	1500
5.	Medical Examination fund/fee	250
6.	Magazine fund (per semester)	125
7.	Amalgamated fund	750
8.	Library Fee	375
9.	Infrastructure development fund	625
10.	Student Welfare Fee	625
11.	Water Charges	125
	Total (A)	**Rs. 14125**
(B)	Hostel Charges (Room rent)	
1.	Single Seater	4375
	Dormitory	3125
	NRI Rooms	6250
2.	Hostel maintenance fund	625
3.	Utensils crockery breakage fund	190
4.	Common Room Fund	375
5.	Electricity charges	2500
6.	Generator charges	3750
	Total (B)	
	Single Seater	**Rs. 11815**
	Dormitory	**Rs. 10565**
	NRI Rooms	**Rs. 13690**
	G. Total (A+B)	
	Single Seater	25940
	Dormitory	24690
	NRI Rooms	27815
(C).	***OPTIONAL CHARGES (Per Semester) (Rs.)**	
1.	Refrigerator in room	1000
2.	Air Cooler	3125
3.	Electric Blower	3125
4.	Air Conditioner	15000

**University shall not provide any of the above-mentioned appliances.*

Hostel Accommodation:

Limited hostel facilities are available. The University will provide accommodation to the extent possible. Students cannot claim hostel accommodation as a matter of right on their admission to PG programme. University reserves the right to provide/deny hostel accommodation to the student.

(L.) Fee structure for Self-Financing seats in addition to normal fee.

S. No.	Programme	Category	Fees (Rs.)
1.	M.V.Sc.	Self Financing	Rs. 45,000

M.) Medical & Accidental Insurance (Tentative)

S. No.	Insurance	M.V.Sc.
1.	Medical & Accidental Insurance on annual basis during the degree programme	Rs. 1050/-

Note: **The candidates have to deposit the prescribed amount in full at the time of admission and subsequently at each academic year.**

Refund of Fee: If a Student withdraws from a course after admission, the fee deposited by the Student shall be refunded after deduction of Rs 1000/- (One thousand only) as processing fee in case the candidate withdraws from the programme before the date of next counselling but not later than the start of the course (i.e registration date), whichever is earlier.

(N.) GENERAL INSTRUCTIONS FOR TEST

- Entrance Examinations will start at 10:30 AM sharp and will be for 2.30 hrs. The candidates must reach the Centre of Examination at 10:00 AM sharp.
- The candidates must reach the Centre of Examination at 9:00 AM sharp.
- Candidate must get seated to respective seats 30 minutes before start of examination.
- 15 minutes before start of actual examination OMR sheet shall be provided to candidate.
- Question papers shall be distributed sharp at 09.25 am
- Candidates arriving late by more than half an hour will not be permitted to appear in the test.
- Calculator, log tables, pager, mobile phone, notebook or written notes, pamphlets, slide rules, protractors, rulers, highlighters dictionary etc. are not allowed inside the Examination Hall. Any violation would amount to disqualification of candidature.
- Use of correcting fluid / eraser/ ink remover including use of blade on OMR Answer sheet is strictly prohibited and any discrepancy in the evaluation on account of ignoring this caution shall be the sole responsibility of the candidate.
- The candidates are expected to behave responsibly while appearing in the entrance examination and shall not adopt any unfair/ fraudulent/ mischievous means. The candidates herein are sternly warned not to resort to any unfair/fraudulent means or act of impersonation. In case a candidate is found resorting to such acts during the test, criminal proceedings shall be initiated under rules.
- Any candidate who creates disturbance of any sort during the test or otherwise misbehaves in or around the Examination Centre or exchanges his/her seat with any candidate will be expelled from the test.
- Any candidate having in his/her possession or in his/her access any paper/book or note which may have potential of providing assistance, or copying from any paper/book or note or allowing any other candidate to copy from his/her answer sheet or found writing on any other paper, or using or attempting to use any other unfair means will be expelled from the test.

- The decision of the Centre Superintendent/Coordinator/Controller of Examinations to expel a candidate from the examination centre shall be final.
- If a candidate puts any identification mark on the OMR sheet, the same shall be cancelled. The decision of the university in this regard will be final.
- Disabled students shall be granted an extra time @ 20 minutes per hour in entrance tests.

(O.) INSTRUCTIONS FOR ATTEMPTING PAPER

- Read the given instructions on the question paper carefully.
- Write your roll number only in the space provided on the question paper and OMR sheet and nowhere else.
- The candidates are required to follow the correct procedure while attempting the question paper. Darken the oval pertaining to the most appropriate answer on the OMR sheet. If you darken more than one oval, your answer will be treated as wrong. Incorrect marking will also be taken as wrong answer. For example, if you think that the answer given against choice (B) for question number 1 is the most appropriate, then darken the oval (B) given against 1 (the number of that question) as follows on the OMR sheet:

Correct Method Wrong Method Wrong Method Wrong Method

- Do not use any other mark except to darken the oval.
- The candidates will not be allowed to leave the examination hall within first 60 minutes of commencement of the examination and during the last 30 minutes.
- Each correct answer will carry one mark and each wrong answer shall fetch minus 0.25 (-0.25) marks per question.
- There will be no re-evaluation of the answer sheets.

Examination Schedule

Duration: 2½ hours. Time 10 30 a.m to 12.30 pm

Major subjects

There will be six major subject groups as given in the table below. Candidate shall have to appear in one major subject group.

Major Subject Group		Code
Veterinary Sciences		06

a. The examination shall have one question paper each for concerned major subject group. The questions will consist of 150 multiple choice objective type questions, each with four options.

b. In each major subject group, 150 multiple choice, objective type questions would be serially numbered from 1-150 and will carry one mark each.

c. Candidate will be required to choose the correct answer and mark in the OMR answer Sheet by darkening the corresponding circle/ bubble against the serial number of the question with black/ blue ink ball-point pen.

d. For correct answer 1 mark will be given and for incorrect answer -¼ mark will be deducted.

(P.) CANDIDATES MUST BRING

•Two ball point pens (blue/ black ink).

•Admit card issued by the University.

•Valid Identity such as Aadhar / Election Card

SYLLABI FOR SKUAST-JAMMU ENTRANCE EXAMINATION FOR ADMISSION TO M.V.Sc. DEGREE PROGRAMMES

(Q.) SYLLABUS for SKUAST-J (CET) M.V.Sc. PROGRAMME -2023

Code 06: Major Subject Group- Veterinary Sciences

1. M.V.Sc. Veterinary Medicine **(10 marks)**

Clinical examination and diagnosis, Etiology, epidemiology, symptoms, diagnosis, prognosis, treatment and control of diseases affecting different body systems of various species of domestic animals,. Deficiency diseases, metabolic diseases, metabolic disorders

2. M.V.Sc. Veterinary Surgery & Radiology **(10 marks)**

Asepsis-antisepsis, management of shock, haemorrhage. Symptoms, diagnosis and management of wound, abscess, tumors, cyst, haematoma, necrosis, gangrene. Introduction to anaesthesia, preanaesthetics, local analgesia, General anaesthesia & anaesthetic agent (barbiturates, dissociative agents). Anaesthetic emergencies and their management. Interpreting X-ray films, Classification of radiographic lesions. Introduction to contrast radiography, radiation hazards and their prevention principles of ultrasonography. Sinusitis, pus in the sinus. Horn affection, irregular molars, shear mouth, sharp teeth, wave form mouth, step formed mouth dental tartar and dental caries, bishoping. Salivary, cysts, salivary fistula. Ear haematoma, chronic otorrhoea. Entropion, ectropion, conjunctivitis, glaucoma, keratitis, corneal ulcer, cataract, worm in the eye. Choke. Hernia. Pyloric stenosis , gastric torsion, ruminal impaction, traumatic reticulitis, diaphragmatic hernia, abomasal displacement, omasal impaction, intestinal obstruction, intussusceptions, rectal prolapse, rectal tear, hyderadenitis, atresia-ani et-recti et-coli. Urolithiasis. Surgical affections of udder and teat. Caesarean, spaying, castration. Lameness, definition, classification and diagnosis. Sweeny, bicipital bursitis, capped elbow, radial paralysis, hygroma of knee, contraction of digital flexors, splints, ringbone, quitter, side bone, navicular disease, pyramidal disease. Laminitis, sand crack. Canker, thrush and corn, Upward luxation of patella, stringhalt, bog spavin, spavin. DJD, intervertebral disc protrusion, hip dysplasia, fracture and dislocation, principles of physiotherapy.

3. M.V.Sc. Veterinary Anatomy **(10 marks)**

Gross anatomy of bones, different joints of the animal body & their classification, muscles, heart & blood vessels, nervous system, body cavities, visceral organs and sense organs in principal domesticated animals and birds, biomechanics, structure of cell and its organelles, basic tissues of the body, different types of epithelium, histology of different body system, gametogenesis, fertilization, blastulation, gastrulation, development of uro-genital, digestive and cardiac systems.

4. M.V.Sc. Animal Nutrition **(10 marks)**

History of Animal nutrition ; proximate principles and fibre fractions, digestion and metabolism of carbohydrates, proteins and fats in ruminants and non-ruminants, energy partitioning in body, measures of protein quality, general functions of minerals and vitamins and associated disorder, classification of feedstuffs, Common anti-nutritional factors and unconventional feedstuffs, Hay and silage making, improvement of poor quality roughages, Nutritional disorder of livestock.

5. M.V.Sc. Veterinary Physiology **(10 marks)**

Blood composition & functions. Haemostatis. Morphological characteristics of heart, conduction system, cardiac cycle. Electero- physiology of heart & regulation of cardiac functions. Haemodynamics, circulatory control & regional circulation. Functional morphology of nephrone, urine formation & concentration mechanism. Electrolyte & Water balance, acid-base balance. Structure and functions of skeletal & smooth muscle, properties, neuromuscular junction and transmission. Neuron structure, classification, synapse, receptors, properties of nerve fibres, reflexes, ANS, higher function of neuron. Structure & functions of monogastric & polygastric digestive system. Funtional morpholoigy of respiratory system. Transport of gases, control of respiration. Endocrine glands. Hormones & their functions. Male & female reproduction, in-vitro fertilization synchronization superovalation, cloning, sperm sexing. Lactation, mamogenesis, galatoposis, milk ejection, composition of milk, colostrums. Growth & animal behaviour. Influence of environment of growth, production & reproduction. Thermoregulation & climatology.

6. M.V.Sc. Veterinary Biochemistry **(10 marks)**

Scope & importance of biochemistry in animal sciences , cell structure and functions. Chemistry and biological significance of carbohydrates, lipids, proteins, nucleic acids, vitamins & hormones. Enzymes chemistry, kinetics & mechanism of actions & regulation. Metabolic inhibitors with special reference to antibiotics and insecticides. Biological ocidation, energy metabolism of carbohydrates, lipids, amino acids & nucleic acids. Colorimetry, spectrophotometry, chromatography and electrophoresis methods.

7. M.V.Sc. Livestock Product Technology **(10 marks)**

Structure, composition and nutritive value of milk, meat and egg, preservation and packaging of milk, meat and egg, processing of livestock products, legal standards of milk and meat products, sensory evaluation of livestock products, layout and management of abattoir, slaughtering techniques, ante mortem and post mortem examination, conversion of muscles to meat, utilization of glandular and non glandular by products, fraudulent substitution of meat and its recognition, grading and processing of wool

8. M.V.Sc. Animal Genetics & Breeding **(10 marks)**

History of Animal Breeding, classification of breeds, Economics characters of Livestock and poultry and their importance, Breeding/Selection techniques for optimal production, Selection: Response to selection and factor affecting it, Bases of selection individual, pedigree, family, sib, progeny and combined, Indirect selection and Multitrait selection, Classification of mating system, Inbreeding and out-breeding, Genetic and phenotypic consequence viz. Inbreeding depression, and heterosis, Systems of utilization of heterosis Selection for combining ability, Breeding methods for the improvement of dairy cattle and buffaloes crossbreeding, sine evaluation, field progeny testing, Open nucleus breeding system (ONBS), Sheep, goat, swine and poultry breeding programmes in the state and country . History of Genetics, Chromosome nos. And types in diff. Sp including poultry, Mitosis, Meiosis & Gametogenesis Overview of Medallion Principles, Modified Mendallion inheritance Mutation, Chromosome aberration & Cytoplasm Inheritance, Gene Interaction, Epistasis, Multiple alleles, Lethals, Sex limited, Sex linked , & Sex influenced traits, Linkage & Crossing Over, Gene concept- Classical and Molecular, Population Genetics, Genetic structure of population , Gene frequency, Genotype frequency, Hardy- Weinberg law d its application, Forces(Mutation, Migration, Selection & Drift) changing, Gene & genotype frequencies, Quantitative genetics, Nature & Properties, Values & Means-Pop mean, Average effect, Components of phenotypic & Genotypic variance, Concept of genotype and environmental interaction, Resemblance b/w relatives & heritability, Repeatability, genetic & phenotypic correlation.

9. M.V.Sc. Veterinary Pharmacology & Toxicology **(10 marks)**

Source and nature of drugs, pharmacokinetics, drugs acting on different body systems. Antimicrobial agents-their mechanism, therapeutic indication, toxicity & resistance. Toxicity & treatment of importance metals, non-metals, poisonous plants, agro chemicals and mycotoxins.

10. M.V.Sc. Veterinary Pathology **(10 marks)**

Introduction, history and scope of pathology. Predisposing factors, intrinsic and extrinsic factors. Disturbances of circulation / haemodynamic derangements. Pigment metabolism, pathological calcification / ossification. Degenerative changes. Inflammation, healing. Immunopathology, immune mediated tissue injury, hypersensitivity reactions. Genetic abnormalities. Disturbance in cell growth, neoplasms. Posmortem examination, histopathology, histochemistry. Histoenzymology, electron microscopy. Clinical laboratory examination of complete blood hemogram, serum enzymology, bone marrow examination, urine, skin scrapings stools, CSF and milk for pathological constituents and interpretation of results. Pathology of cardiovascular, haemopoietic, respiratory, digestive, urinary, genital, nervous and musculoskeletal systems, endocrine glands, organ of special senses i.e, eye, ear, skin, appendages. Pathology of bacterial, mycotic, viral, mycoplasmal, rickettsial, chlamydial and parasitic diseases. Diseases caused by prions. Pathology of nutritional deficiency disease. Etiopathology of common diseases of laboratory, wild and aquatic animals.

11. M.V.Sc. Livestock Production and Management **(10 marks)**

General concepts of livestock production and management, status of dairy and poultry industry, impact of livestock farming in Indian Agriculture. Livestock housing, production and reproduction management, lactation management, breeding programmes for livestock and poultry. Composition, quality and preservation of livestock products, method of processing and storage livestock products. International trade/WTO/IPR issues related to livestock products.

12. M.V.Sc. Veterinary Parasitology **(10 marks)**

General classification, morphology, life cycle, epidemiology, symptoms, pathogenesis, diagnosis, immunity and control of important parasitic diseases (Helminths, Protozoa and Arthropods) of Veterinary importance.

13. M.V.Sc. Veterinary Microbiology **(10 marks)**

Classification and growth characteristics of bacteria, important bacterial diseases of livestock and poultry, general characters, classification of important fungi. Nature of viruses, morphology and characteristics, viral immunity, important viral diseases of livestock and poultry. Viral vaccines. Antigen and antibody, antibody formation, immunity, allergy, anaphylaxis, hyper sentivity, immune globulins, complement system.

14. M.V.Sc. Veterinary Public Health and Epidemiology **(10 marks)**

Zoonotic diseases through milk and meat, Zoo animal health. Epidemiology-aims, objectives, ecological concepts and applications.

15. M.V.Sc. Veterinary Extension Education **(10 marks)**

Concept of sociology, differences between rural, tribal and urban communities, social change, factors of change. Principles and steps of extension education, community development-aims, objectives, organizational set up and concept evolution of extension in India, extension teaching methods. Role of livestock in economy. Identifying social taboos, social differences, obstacles in the way of organizing developmental programmes. Concept of marketing, principles of cooperative societies, animal husbandry development planning and programme, key village scheme, ICDD, Gosadan, Goshalla, role of gram panchayat in livestock development. Basics of statistics, data analysis and computational techniques.

Ph. D. Programmes-2023

(A.) ELIGIBILITY REQUIREMENTS AND INTAKE Ph.D PROGRAMME.

- Master's degree in respective/related subjects with 6.50/10.00 or equivalent OGPA/equivalent percentage (65%) of marks at Master's Degree, and 6.00/10.00 or equivalent OGPA/equivalent percentage (60%) of marks at Master's Degree for SC/ST/PH category.

- For Ph.D programme in Microbiology, the eligibility shall be M.Sc. (Ag) Microbiology / M.Sc. Microbiology / Biotechnology / Environmental Science / Molecular Biology and Biotechnology /Life Sciences /Plant Pathology (with specialization in Microbiology)/Soil Microbiology.

DISCIPLINE WISE INTAKE CAPACITY

A.	**Ph.D. Agriculture and Allied Sciences**	
1.	Ph.D. Agricultural Economics	**04**
2.	Ph.D. Agricultural Extension Education	**04**
3.	Ph.D. Agronomy	**06**
4.	Ph.D. Entomology	**04**
5.	Ph.D. Genetics and Plant Breeding	**03**
6.	Ph.D. Plant Pathology	**06**
7.	Ph.D. Sericulture	**01**
8.	Ph.D. Soil Science	**05**
9.	Ph.D. Molecular Biology & Biotechnology	**06**
10.	Ph.D. Agri-Business Management	**02**
B.	**Ph.D. Basic Sciences**	
1.	Ph.D. Biochemistry	**02**
2.	Ph.D. Agricultural Statistics	**01**
3.	Ph.D. Plant Physiology	**03**
4.	Ph.D. Microbiology	**02**
C.	**Ph.D. Veterinary Sciences**	
1.	Ph.D. Animal Genetics and Breeding	**02**
2.	Ph.D. Animal Nutrition	**02**
3.	Ph.D. Livestock Production & Management	**03**

4.	Ph.D. Livestock Products Technology	**03**
5.	Ph.D. Veterinary Anatomy	**02**
6.	Ph.D. Veterinary Biochemistry	**02**
7.	Ph.D. Animal Reproduction Gynaecology & Obstetrics	**03**
8.	Ph.D. Veterinary Medicine	**04**
9.	Ph.D. Veterinary Microbiology	**01**
10.	Ph.D. Veterinary Parasitology	**04**
11.	Ph.D. Veterinary Pathology	**04**
12.	Ph.D. Veterinary Pharmacology & Toxicology	**02**
13.	Ph.D. Veterinary Physiology	**03**
14.	Ph.D. Veterinary Public Health & Epidemiology	**03**
15.	Ph.D. Veterinary Surgery and Radiology	**05**
16.	Ph.D. Veterinary Extension Education	**02**
D.	**Ph.D. Horticulture & Forestry**	
1.	Ph.D. Post-Harvest Management	**03**
2.	Ph.D. Silviculture and Agroforestry	**03**
3.	Ph.D. Fruit Science	**04**
4.	Ph.D. Vegetable Science	**03**
5.	Ph.D. Floriculture and Landscaping	**03**
E.	**Ph.D. Agricultural Engineering**	
1.	Ph.D. Farm Machinery and Power Engineering	**02**

Note:

•One supernumerary seat in each discipline is reserved for in-service teachers of SKUAST-J.

•Candidates should have completed their Masters' degree.

(B) GENERAL INFORMATION AND INSTRUCTIONS

It is expected that the candidates shall behave responsibly while appearing in the entrance examination and shall not adopt any unfair / fraudulent /mischievous means. The candidates, therefore, are sternly warned not to resort to any unfair / fraudulent means or act of impersonation. In case a candidate is found resorting to such acts, criminal proceedings shall be initiated against him /her, besides debarring him /her permanently from appearing in the entrance examination in future.

The candidates seeking admission to SKUAST-J common entrance test are advised to:

i. Go through this information brochure carefully and acquaint themselves with all the requirements, rules and regulations

ii. Satisfy themselves about the eligibility criteria prescribed for appearing in the entrance examination.

iii. Strictly adhere to the last date of submission of application form.

iv. Write complete address with Postal Pin Code, Telephone No. Mobile No, e-mail address, in the application form.

(C.) SKUAST-J employees' admission: All employees of SKUAST-J shall have to appear & qualify the entrance test for admission to Ph.D. programme.

For in-service teachers of SKUAST-J, there is one supernumerary seat in each division. However, they have to apply for admission in pursuance to this advertisement and should qualify the examination as envisaged in the brochure.

Admission of employees other than the teachers in SKUAST-J, who do not fulfill the conditions under FIP, shall be considered as per J&KCSR norms. But, they have to earn seat through prescribed norms of SKUAST-J CET (Ph.D.) 2023 after seeking prior permission from the employer.

Teachers/other than Teachers who do not qualify w.r.t. the length of service as elucidated SKUAST-J Statutes/J&KCSR can be considered for deputation to pursue Ph.D. without salary. But they have to earn the seat through prescribed norms of SKUAST-J CET (Ph.D.) 2022 after seeking prior permission from the employer.

INSPIRE, GATE, SRF and other fellowship holders are exempted for appearing in CET 2023 and would be admitted against supernumerary seat up to the extent of 01 in each discipline in case there are more than one candidate under this category in a stream, the merit obtained at the Master's level degree shall be considered for selection. However, they have to apply for admission in pursuance to this advertisement.

The recommendation for selection of the candidates in all the categories shall be subject to production of all the relevant certificates in original by the candidates and the verification of the University. The selection made by SKUAST- J to a course shall be provisional till final determination of eligibility of the candidates.

The University shall have the right to review the provisional selection list at any time, not with standing the fact that the selected candidate has completed his /her admission formalities. Mere appearing of name in selection list does not confer any right to admission of the candidate if he /she is otherwise found ineligible.

Since University is neither an appellate authority nor an investigating agency, the complaints against certificates, including those of reserved categories, will not be entertained.

Responsibilityforsubmissionofcompleteandproperdocumentsbytheprescribeddateshallbewiththec andidate. Non-submission of documents by the due date or non-production of original documents at the time of counseling shall make a candidate ineligible for admission. No representation will be entertained for rejected forms and forms received after the due date.

The candidates applying for admission, if found eligible, will be required to appear in the 'SKUAST-J Common Entrance Test' at their own expenses. No candidate will be allowed to sit in the 'SKUAST-J Common Entrance Test' without valid admit card in original issued by the University. In case the candidates do not receive the admit cards two days before the entrance examination, they should contact I/c Examination Cell, SKUAST-J for issuing the duplicate admit card. Permission of candidates to appear in 'SKUAST-J Common Entrance Test' shall be provisional, subject to their being eligible for admission to the course(s) applied for. Complaints relating to certificates, particularly those of reserved categories will not be entertained, as University is not an appellate authority or an investigating agency.

(D.) The criteria for SKUAST-J CET for Ph.D. shall be as follows:

A. Written:

(i) MCQ—subject specified	*=70 Marks*
(ii) MCQ—Research Methodology	*=10 Marks*
B. Interview:	*=20 Marks*
Total	*100 Marks*

Minimum marks required for admission to Ph.D. Programme= 50 % (Written + Interview)

For any assistance please call 9419226376 / 9419803486

Syllabus for the entrance examination is appended in the Information Brochure.

Ragging is banned in the University

(E.) ADMISSION PROCEDURE AND DETERMINATION OF MERIT

The candidates fulfilling the eligibility criteria will have to appear in the SKUAST-J Common Entrance Test. The selection will be purely based on the marks secured in the SKUAST-J Common Entrance Test and a merit list will be drawn based on the score obtained in the test. However, the candidates scoring less than 50% marks in the CET shall not be considered for admission, and therefore shall not be included in the merit list. All the selections made by the University to Ph.D programme shall be provisional till final determination of eligibility of the candidates by the University authority. In case there is tie in the merit of SKUAST-J CET (Ph.D.), candidate having higher marks in the Master's level shall be placed at higher rank. However, in case there is again

tie in the master's programme, the candidate higher marks in graduation level shall be placed higher in the rank. Any subsequent vacancy cause by what so ever reason in any category shall be filled from the waitlisted candidates.

The University shall have the power to review the provisional selection list in case of any bona fide error, lapse, mistake, fraud, misrepresentation or glaring injustice that occurs or is brought to its notice before completion of the selection process or after the selection / admission process, the selection list shall be amended accordingly. Mere figuring in the selection list does not confer any right to admission of the candidate if he /she is otherwise not found to be eligible on detection of an error / mistake /fraud /misrepresentation /impersonation.

(F.) ADMIT CARD

Only for those candidates who fulfill the admission requirements for the programme, to which they have applied, will be issued the photo Admit Cards depicting roll no, name of Centre of Examination, date and timing of the test. The Admit Card can be downloaded from the University web site www.skuast.org. No admit card shall be sent by post. If Admit Card is not downloaded two days before the date of the Entrance Test, the candidate may contact the office of the Assistant Registrar, Examination Cell, SKUAST Jammu, Chatha,

(G.) DECLARATION OF RESULT

The University shall make available the answer key on its website next day after the examination. No intimation, whatsoever about non-selection will be sent individually and no correspondence in this regard shall be entertained. The result will, however, be available in the office of the Registrar, SKUAST-Jammu. The result will also be available on University website, www.skuast.org.

Fee Structure for Ph.D. Programmes In Rupees (Rs.)		
S. No.	**Particulars**	**Ph.D. Fee In (Rs.)**
A.	**At the time of Ist admission**	
1.	Admission fee	10000
2.	University Registration fee	7500
3.	Caution/Security Money for Library (refundable)	3750
4.	College Laboratory Development charges	1250
5.	Semester Registration fee	1250
6.	Tuition fee	6250
7.	Examination fee	1250
8.	Extra Curricular Activities fee	625
9.	Medical Examination fee	250
10.	Medical Insurance	**1050***
11.	Magazine fund (per annum)	250

12.	Identity card	125
13.	Placement and counseling fund	Nil
14.	Educational Tour	Nil
15.	Alumni Fee	500
Total (A)		**Rs. 34050/-**
B	**Hostel Charges**	
	Hostel Charges (Room rent) Per Semester	
1.	Single seater	4375
2.	Dormitory	3125
3.	NRI Rooms	6250
4.	Hostel Security (refundable) for fresh admission	5000
5.	Mess security in case of Hostel inmates for fresh admission (refundable)	5000
6.	Hostel maintenance fund per Semester	625
7.	Utensils crockery breakage fund	190
8.	Common Room Fund (Hostellers)	375
9	Electricity charges Per semester	2500
10	Generator charges Per Semester per Students	3750
	Total (B)	
	Single Seater	21815
	Dormitory	20565
	NRI Rooms	23690
	G Total (A+B)	
	Single Seater	55865
	Dormitory	54615
	NRI Rooms	57740
Optional Charges (Per Semester)		
a	Refrigerator in room	1000
b	Air Cooler	3125
c	Electric Blower	3125
d	Air Conditioner	1500
C. Recurring Semester Fee (Per semester)		
(A)	Recurring Semester fee	
1	Semester Registration fee	1250
2	Tuition fee	10000
3	Examination fee	1250
4	Extra-Curricular Activities fee	1875
5	Medical Examination fund/fee	250
6	Magazine fund (per semester)	125
7	Amalgamated fund	750
8	Library Fee	375
9	Infrastructure development fund	625

10	Student Welfare Fee	625
11	Water Charges	125
Total (A)		**Rs.** 17250
(B)	Hostel Charges (Room rent)	
1	Single Seater	4375
	Dormitory	3125
	NRI Rooms	6250
2	Hostel maintenance fund	625
3	Utensils crockery breakage fund	190
4	Common Room Fund	375
5	Electricity charges	2500
6	Generator charges	3750
	Total (B)	
	Single seated	Rs. 11815
	Dormitory	Rs. 10565
	NRI Rooms	Rs. 13690
G. Total	**(A + B)**	
	Single Seated	Rs. 29065
	Dormitory	Rs. 27815
	NRI Rooms	Rs. 30940

Hostel Accommodation:

Limited hostel facilities are available. The University will provide accommodation to the extent possible. Students cannot claim hostel accommodation as a matter of right on their admission to Ph. D programme. University reserves the right to provide/deny hostel accommodation to any student.

(H.) Fee structure for Self-financing seats in addition to normal semester fees

S.No	Programme	Category	Semester fee	Self-financing fee per Semester	Total fee of 1st Semester
1.	Ph.D (Biotechnology)	Self Financing	**Rs. 34050/-**	**Rs. 45000/-**	**Rs. 79050/-**
2.	Ph.D.(Microbiology)	Self Financing	**Rs. 34050/-**	**Rs. 45000/-**	**Rs. 79050/-**
3.	Ph.D Agri. Business Management	Self Financing	**Rs. 34050/-**	**Rs. 45000/-**	**Rs. 79050/-**
** Health & Accidental (Medical) insurance (tentative) shall be paid annually*					

Refund of Fee: If a Student withdraws from a course after admission, the fee deposited by the Student shall be refunded after deduction of Rs 1000/- (One thousand only) as processing fee in case the candidate withdraws from the programme before the date of next counselling but not later than the start of the course (i.e registration date), whichever is earlier.

(I.) GENERAL INSTRUCTIONS FOR TEST

i. Entrance Examinations will start at **10:30 am sharp** and will be for ninety minutes duration. The candidates must reach the Centre of Examination at **10:00 am sharp.**

ii. Candidates arriving late by more than half an hour will not be permitted to appear in the test.

iii. Calculator, log tables, pager, notebook or written notes, pamphlets, slide rules, protractors, rulers, highlighters dictionary etc. are not allowed inside the Examination Hall. Any violation would amount to disqualification of candidature.

iv. Mobile phones are not allowed inside the examination hall. The candidates will be responsible for safekeeping of their mobile phones.

v. Any candidate who creates disturbance of any kind during the test or otherwise misbehaves in or around the Examination Centre or changes his/her seat with any candidate will be expelled from the test.

vi. Any candidate having in his /her possession or accessible to him / her papers / books or notes which may possibly before providing assistance, or copying from any paper /book or note or allowing any other candidate to copy from his/her answer sheet or found writing on any other paper, or using or attempting to use any other unfair means will be expelled from the Test.

vii. The decision of the Centre Superintendent/Coordinator/Controller of Examinations to expel a candidate from the examination center shall be final.

viii. If a candidate puts any identification mark on the answer sheet, the same shall be cancelled. The decision of the Controller of Examinations in this regard will be final.

ix. If impersonation in the Entrance Test is detected, the candidature will be cancelled and a case will be registered with the police.

x. Disabled student shall be granted an extra 20 minutes time in the entrance test.

(J.) CANDIDATES MUST BRING

i. Two ball point pens (**black/blue colour**)

ii. Admit card issued by the University

The criteria for Ph.D-2023. shall be as follows:

A. Written:

(i) MCQ—subject specified	*=70 Marks*
(ii) MCQ—Research Methodology	*=10 Marks*
B. Interview:	*=20 Marks*
Total	*100 Marks*

Minimum marks required for admission to Ph.D. Programme= 50 % (Written + Interview)

(K.) SYLLABUS for SKUAST-J (CET) Ph.D. 2023

Agriculture & Allied Sciences

Subject: Ph. D. AGRICULTURAL ECONOMICS:

Unit 1: Economic Theory

Nature, Scope and methods of economics-Economic systems- Basic economics concepts in economics- Theory of consumer behaviour –cardinal utility approach-ordinal utility approach- indifference curve analysis-income and substitution effect-derivation of demand – applications of indifference curve analysis- revealed preference hypothesis- elasticity of demand and determinants-consumer surplus- Neo-classical theory of Production- Production function – Isoquants – Properties – homogenous production functions and Returns to scale - Technical progress– definition and types. -Profit maximization –Neoclassical theory of costs – Derivation of various types of cost curves- Cost minimization vs. profit maximization. Modern theory of costs-Derivation of supply and lay of supply-producer's surplus.

Market classification-pure and perfect competition. Characteristics and price determination under perfect and imperfect markets (monopoly, oligopoly and monopolistic competition)--Theory of income distribution and factor shares- General Equilibrium theory- Pareto optimality- Social welfare function- National income-concepts and measurement methods-Theory of employment- classical. Keynesian and post Keynesian theories of income determination. Consumption, Investment and saving functions-Concept of multipliers and accelerators- general equilibrium of product and money markets-IS and LM framework-inflation-types and control measures, Monetary and fiscal policies-instruments and effectiveness.

Unit 2: Economic and Agricultural Development

Concept of economic development and economic growth-indicators and measurement-Criteria and characteristics of developing nations-economic and non-economic factors of economic growth-, stages and theories of economic development- economic growth models-classical and neo-classical growth models, role of state, markets and civil society in economic development, institutions and economic development, international development institutions Objective and processes for economic planning in India, economic and trade reforms in India.

Role of agriculture in economic development, theories of agricultural development, agricultural policies (price, land, credit, R&D, trade, subsidy, etc.)-agricultural development issues-poverty, inequality, unemployment and environmental degradation-agricultural development programmes in India, issues of water, energy, environment, food and nutrition security, agro-eco -regional planning, assessment of ecosystem services, farm-non-farm linkages.

Unit 3: Public Finance and International Economics

Public Finance: Public and private finance. General principles of public finance. Principle of maximum social advantage. Public revenue. Incidence of tax and financial policies. Public expenditure and economic development. Balanced and unbalanced budgets. Limitations of fiscal policies. Fiscal policy as an instrument of development. Structure of development taxation. Public debt policy and economic development, international Economics: Principle of Comparative advantage. Factor endowment theory, Balance of payments. Trade with many goods and countries; Leontief paradox; human skills; technological gaps; the product cycle Trade policy: Protection; tariff and non-tariff measures; trade and market structure; trade liberalization; factor mobility and movements; role of multinational enterprises. National competitive advantage – Porter's diamond Problems of international

monetary systems, Foreign trade and foreign capital. Export promotion and input substitution. Past experiences and future strategies.

Unit 4: Farm Management Economics

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

Unit 5: Agricultural Production Economics

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

Unit 6: Agricultural Finance and Co-operation

Role of credit in agriculture and rural development. Estimates of agricultural credit requirements-investment, production, marketing and consumption. Role of public and private section banks and cooperatives in development financing. Classification of agricultural credit. Rural credit structure. Principles of agricultural finance and financial management. Agricultural finance as a part of public finance. Nexus between commercial banks and cooperative credit institutions. Recent innovations in extension of credit to agriculture. Rural credit supply and credit gap. Multiagency approach and coordination of credit structure at different levels. Agriculture credit policy. Principles and practices of cooperation. Success and failure of cooperative sector in India. Credit and non-credit institutions. National federations of cooperative organizations. Review of reforms in cooperative structure. Single window approach in agricultural input supply and output marketing. Bureaucracy and cooperatives. Management of cooperative institutions. Professionalization and revitalization of cooperatives. Role of cooperatives under new economic policy 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.

Unit 7: Agricultural Marketing

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

Unit 8: Agricultural Project Analysis

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

Unit 9: Research Methodology and Econometrics

Agricultural economics research, steps and themes, collection and analysis of data, scientific report writing. econometric and statistical methods, sampling methods, probability theory. Multiple regression analysis, ordinary and generalized least squares estimators, BLUE, multicollinearity, heteroscedasticity, auto correlation, dummy variables. Simultaneous equation methods

Subject: Ph.D. AGRICULTURE EXTENSION EDUCATION:

Unit 1: Fundamentals of Extension Education and Programme Planning

Extension Education – Meaning, objectives, concepts, principles and philosophy. Adult Education and Distance Education. Steps in Extension Teaching-Teaching Learning process and Extension approaches of ICAR. Pioneering Extension efforts and their implications in Indian Agricultural Extension –ICAR and SAU, State Departments Extension system and NGOs. Community development and Poverty Alleviation Programmes – SGSY, SGRY, PMGSY, DPAP, DDP, CAPART – Employment Generation Programmes – NREGP, Women Development Programmes – ICDS, MSY, RMK, Problems in Rural Development. National level agricultural development programmes - NADP, NMAE&T, NFSM, Prime Minister seven point strategies for doubling the income of farmers and ARYA. Extension efforts and Rural Development Programmes in pre-independence era (Sriniketan, Marthandam, Firka Development scheme, Gurgaon Experiment, Sevagram, IVS,GMFC) Post – independence era(Etawah pilot project, Nilokheri Experiment, CDP, NES, IAAP, IADP, HYVP, MCP, IRDP, ICDS, DWCRA, TRYSEM, IAY, JRY, SFDA, MFAL). Ongoing development programmes in Agriculture/ Rural/ Animal Husbandry launched by ICAR/Govt. of India (T & V System, BBES, KVK, ATIC, ATMA, NAAP, NATP, NARP, NAIP, NADP, SADP, MGNREGS, PM Kisan,
ARYA, NMAET, PMFBY).Different Approaches in Extension- PRA, RRA, PTD, PLA, FAR, PAME, AEA, FSRE, Market – Led – Extension, Farmers' Field School, Kisan Call Centers and ATMA. Programme Planning –Steps, Principles. Monitoring and Evaluation- Steps, Keys and Principles

Unit 2: Extension Methods & Farm Journalism

Extension Methods – Definition, Individual, group and mass approaches in extension, audio-visual aids- classification, selection, use and production. Traditional media for communication

in development programmes. Modularized communication- concept, approach, need, process of designing instruction for transfer of communication. Basics of agricultural journalism, types of publications – bulletins, folders, leaflets, booklets, newsletters, popular and scientific articles. Selection, planning and use of different extension teaching methods like demonstration, exhibition, farmers fairs, field days, tours, extension literature, etc. Preparation and presentation of different projected and non-projected audio-visual aids. Public speaking. Preparation of radio/video script. Principles of photography and its use in extension.

Unit 3: Information & Communication Technologies and Development Communication

Communication – models, types, elements, characteristics and barriers, Modern extension approaches(Private Extension, PPP, Market and Farmer led Extension, Group approaches – FIGs, CIGs, FPOs and ICT enabled extension), Transfer of Technology – Models, Development Communication– Theories. ICT and Development Communication – Role in abridging Digital divide. Concept of ICT and its role in agriculture and rural development. ICT tools- print and electronic media- Satellite Radio, Community Radio, Internet Radio, Television, Interactive Television, Newspapers, e-publications, e-mail, Internet, Multimedia, Mobile phony, Video and teleconferencing, computer-assisted instructions, web technologies – Web portals, Mobile apps and Social Media tools,e-learning- information resources, information kiosks, sharing and networking. Types of network – PAN, LAN, WAN. AGRISNET, AKIS, Indian National Agricultural Research database. ICT programmes in agriculture and allied sectors - Problems and prospects. Artificial Intelligence in Agricultural Extension- Expert system, Decision Support System.

Unit 4: Training and Human Resource Development

Human Resource Development – Meaning & importance. Steps in HRD- Recruitment, Induction Staff Training and Development, Career planning; Social and Organizational Culture: Indian environment perspective. Organizational and Managerial values and ethics, organizational commitment; Motivation- Theories – Maslow's hierarchy of needs, techniques & productivity. Job description, Job analysis and Performance appraisal. Human Resource management: Collective bargaining, Negotiation skills, Human Resource Accounting (HRA): Information Management for HR.: Collective behaviour, learning, and perception; Stress and coping mechanisms. Communication and Feedback and Inter personal processes & interpersonal styles. Organizational communication, Team building Process and functioning, Conflict management, Collaboration and Competition. HRD & role of supervisors: Task Analysis, Capacity Building, Counseling and Mentoring; Role of a Professional Manager. Task of a Professional Manager. Managerial skills and Soft Stills required for Extension workers. Decision Making: Decision making models, Management by Objective. Leadership styles – Group dynamics. Training – Meaning, types, models, methods and evaluation, techniques for trainees' participation.

Unit 5: Research Methodology in Extension Education

Science – Four methods of knowing things. Research – Meaning, importance, Types and methods of Research – Fundamental, Applied and Action research, Exploratory, Descriptive, Diagnostic, Evaluation, Experimental, Analytical, Historical, Survey and Case Study. Different steps in scientific research– selection of problem, hypothesis, review of literature, objectives, variables and types, different data collection tools, Sampling techniques and different statistical analysis. Measurement – Meaning, postulates and levels of measurement, Steps in test construction, Item writing and Item analysis. Research Designs– types, MAXMINCON Principle. Meaning and Types of Reliability & validity, Rating scales, Observation, Case studies. Social survey – Meaning, objectives, types and steps. Data processing – meaning, coding, preparation of master code sheet, Analysis and tabulation of data – Parametric and Non- Parametric statistical tools. Report writing – Meaning, guidelines to be followed in scientific report writing, References in reporting.

Unit 6: Diffusion and Adoption of Innovations

Diffusion – Elements, Innovation- Development process; Adoption – Process, Stages; Innovation

decision process- Types of innovation decision-Optional, collective and authoritative and contingent; Consequences of innovation decisions- Desirable or undesirable, direct or indirect, anticipated or unanticipated consequences. Innovativeness – concept and types; Adopter categories- Characteristics of adopter categories, Attributes of innovation, Rate of adoption of innovation and barriers in adoption process, Factors influencing rate of adoption; Diffusion effect, Over adoption, Re-invention; Opinion leadership- Measurement and characteristics of opinion leaders- Monomorphic and polymorphic opinion leadership. Models and theories of diffusion- One step flow model, Hypodermic Needle model, Multi-step flow of innovation. Concept of homophily and heterophily and their influence on flow of innovation, Decision making- Meaning, definition and theories , Process and steps and factor influencing of decision making- Role of Change Agents.

Unit 7: Management in Extension

Management – Meaning, concept, nature and importance, Approaches to management, Levels of management, Extension Management - Concept, Importance, Principles and functions of management, Planning – Concept, Nature, Importance, Types. Change Management- Decision making – Concept, Types of decisions - Steps in Decision Making Process, Organizing - Meaning of Organization, Concept, principles, Span of Management, Departmentalization, Authority and responsibility, Delegation and decentralization, line and staff relations

Management by Objective (MBO) and Total Quality Management (TQM). Logical Frame Working (LFW) and Project Management Techniques. Personal management, scope of Agribusiness Management and Institutions - National Institute of Agricultural Extension and Management (MANAGE). Indian Institute of Plantation Management (IIPM), NIRD, EEl and NAARM. Monitoring, evaluation and impact analysis of extension programmes. Critical analysis of organizational set up of extension administration at various levels.

Unit 8: Entrepreneurship Development

Entrepreneurship – Concept, characteristics, Approaches, Theories and Need. Agri – entrepreneurship – Concept, characteristics, Nature and importance for Sustainable Livelihood. Traits of entrepreneurs. Leadership, Decision making, Planning, Organizing, Coordinating and Marketing, Types of Entrepreneurs. Stages of establishing enterprise, steps to be considered in setting up an enterprise, Project Management and Appraisal – Market, Technical, Financial, Social Appraisal of Projects. Micro enterprises – Profitable Agri- enterprises in India – Agro Processing, KVIC industries. Micro financing – meaning, Sources of Finance, Banks, Small scale industries development organizations. Marketing for enterprises – Product sales and promotion.

Unit 9: Market-Led Extension

Agricultural marketing- Concept. Market led extension – Dimensions, emerging perspectives issues and challenges. Development of a marketing plan, pricing concepts and pricing strategy; Consumer behaviour; Market Intelligence, Supply Chain Management, Marketing communication and promotional strategies; Marketing research process; Agricultural trade liberalization and its impact; International marketing opportunities; Implications of AOA, TRIPS and IPR agreements on agriculture; Agreement on SPS and TBT. Commodity features marketing. Public private linkages in market led extension; FPOs and SHG in market led extension; Contract farming.

Unit 10: Gender Sensitization and Empowerment

Gender concepts, Gender roles, gender balance, status, need and scope; Gender analysis – Tools and Techniques. Gender development policies of Govt. of India – The historical evolution. Developmental programmes for women; Gender mainstreaming in agriculture and allied sectors. Gender budgeting. Women empowerment – Dimensions; Women empowerment through SHG approach; Women entrepreneurship and its role. Public Private Partnership for the economic

empowerment of women; Building rural institution for women empowerment; Women rights, issues and development.

Subject: Ph. D. AGRONOMY:

Unit 1: Crop Ecology and Geography

Principles of crop ecology; Ecosystem-concept and determinants of crop productivity; Physiological limits of crop yield and variability in relation to ecological optima; Crop adaptation; Climate shift and its ecological implication; Greenhouse effect; Agro-ecological and agro climatic regions of India; Geographical distribution of cereals, legumes, oilseeds, vegetables, fodders and forages, commercial crops, condiments and spices, medicinal and aromatic plants; Adverse climatic factors and crop productivity; Photosynthesis, respiration, net assimilation, solar energy conversion efficiency and relative water content, light intensity, water and CO2 in relation to photosynthetic rates and efficiency; Physiological stress in crops, detection and indices; Remote sensing: Spectral indices and their application in agriculture.

Unit 2: Weed Management

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

Unit 3: Soil Fertility and Fertilizer Use

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

Unit 4: Dryland Agronomy

Concept of dryland farming; dryland farming Vs rainfed farming; History, development, significance and constraints of dryland agriculture in India; Climatic classification and delineation of dryland tracts; Characterization of agro-climatic environments of drylands; Rainfall analysis and length of growing season; Types of drought, effect on plant growth, drought resistance, drought avoidance, drought management; Crop Planning including contingency, crop diversification, varieties, cropping systems and mid-season corrections for aberrant weather conditions; Techniques of moisture conservation in-situ to reduce evapotranspiration, runoff and to increase infiltration; Rain water harvesting and recycling concept, techniques and practices; Summer ploughing, seed hardening, pre-monsoon sowing, weed and nutrient management; Concept and importance of watershed management in dryland areas.

Unit 5: Crop Production

Crop production techniques for cereals, millets, pulses /grain legumes, oilseeds, fiber crops, sugarcane, tobacco, fodder and pasture crops including origin, history, distribution, adaptation, climate, soil, season, modern varieties, seed rate, fertilizer requirements, crop geometry, intercultural operations, water requirement, weed control, harvest, quality components, industrial use, economics and post-harvest technology. Package of practices in the respective locations.

Unit 6: Agricultural Statistics

Frequency distribution, standard error and deviation, correlation and regression analyses, co-efficient of variation; Tests of significant test, F test and chi-square (x2); Data transformation and missing plot techniques; Design of experiments and their basic principles, completely randomized, randomized block, split plot, strip-plot, factorial and simple confounding designs; Efficiency of designs; Methods of statistical analysis for cropping systems including intercropping; Pooled analysis.

Unit 7 : Sustainable Land Use Systems

Tillage - Concept, types, tilth, tools and implements; Modern concepts of tillage and conservation agriculture; Land capability classification, Alternate land use and Agro forestry systems; Types, extent and causes of wasteland; Shifting cultivation; Concept of sustainability; Sustainability parameters and indicators; Agricultural and agro-industrial residues and its recycling.

Unit 8: Soil-Plant-Water Relationship

Importance of water in agriculture; Hydrological cycle; runoff and infiltration, factors affecting infiltration; Soil water relations, water retention by soil, soil moisture characteristics, field capacity, permanent wilting point, plant available water and extractable water; Soil irritability classifications, Determination of soil water content, computation of soil water depletion, soil water potential and its components; Movement of soil water-saturated and unsaturated water flow; Evapotranspiration (ET), PET, AET and its measurements. Crop co-efficient; Plant water relations: Concept of plant water potential, its components; Methods of moisture estimation in plants. Soil and water conservation – measures – agronomical, mechanical and agrostological.

Unit 9: Irrigation Water Management

History of irrigation in India; Major irrigation projects in India; Water resource development; Crop water requirements; Concepts of irrigation scheduling, Different approaches of irrigation scheduling; Concept of critical stages of crop growth in relation to water supplies; Methods of irrigation viz. surface, subsurface and pressurized irrigation methods, merits and demerits; Measurement of irrigation water, application and distribution efficiencies. Conjunctive use of water; Interaction between irrigation and fertilizers.

Unit 10: Management of Problematic Soils and Crop Production

Problem soils and their distribution in India, acidic, saline, waterlogged and mined- soils; Response of crop to acidity, salinity, excess water and nutrient imbalances; Reclamation of problem soils, role of amendments and drainage; Crop production techniques in problem soils – crops, varieties, cropping system and agronomic practices; Degraded lands and their rehabilitation. Management strategies for flood prone areas; Drainage for improving water logged soils for crop production; Crop production and alternate use of problematic soils and poor quality water for agricultural.

Unit 11: Cropping and Farming Systems and Organic Farming

Cropping system – Definition, principles, classification; Cropping system for different ecosystem; Interaction and indices; Non-monetary inputs and low cost technologies. LEIA, HEIA and LEISA; Farming systems – type – natural, bio-dynamic, bio-intensive, response, precision, biological and

organic farming; organic and bio inputs, Soil health and organic matter and Integrated organic farming systems; IFS – concepts, models for different ecosystem, resource recycling and evaluation.

Subject: Ph.D. ENTOMOLOGY:

Unit 1: Systematics

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

Unit 2: Morphology

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

Unit 3: Embryology, Internal Anatomy and Physiology

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

Unit 4: Ecology

Concept of ecology, Environment and its components-biotic and abiotic factors and their effects on growth, development, diapause, population structure and dynamics, distribution and dispersal. Principles of biogeography and insects biodiversity. Assessment of diversity indices. Biotic potential and environmental resistance. Climate change and adaptations. Ecosystems, agroecosystem analyses, ecological niche, their characteristics and functioning. Intra and inter specific relationship; competition, predator-prey and host-parasitoid interactions. Food chain, food web and trophic relations. Life table studies, population models. Arthropod population monitoring, pest forecasting. Causes of pest out breaks.

Unit 5: Biological Control

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

Unit 6: Chemical Control and Toxicology

History, scope and principles of chemical control. Insecticides, classification and mode of action - Conventional and IRAC. Formulations of insecticides. Penetration of insecticides. Physical, chemical and toxicological properties of different groups of insecticides. rodenticides, insect

growth hormones. Insecticide induced resurgence. Combination insecticides. Pesticide hazards and environmental pollution. Safe use of pesticides, precautions, first aid treatments and antidotes. Insecticides Act 1968, Functions of CIB & RC, registration and quality control of insecticides. Evaluation of toxicity, methods of toxicity testing, determination of LD 50, LT 50, RL 50 etc. Pesticide residues in the environment and their dynamics of movements, methods of residue analysis. Good laboratory practices. Pharmacology of insect poisons. Metabolism of insecticides; detoxification enzymes and their role in metabolism. Selectivity of insecticides insecticide resistance; mechanism, genetics and management of insecticide resistance.

Unit 7: Host Plant Resistance

Principles of HPR. Basis of resistance (Antixenosis, Antibiosis, Tolerance). Host plant selection by phytophagous insects. Biophysical and biochemical bases of defense against phytophagous insects. Genetics of Resistance: vertical resistance, horizontal resistance, oligogenic resistance, polygenic resistance. Biotype development and break down of resistance. Tritrophic interactions, induced resistance. Breeding for insect resistant crops and evaluation techniques. Biotechnological approaches and development of transgenic insect resistant plants, its advantages and limitations. Case histories. Insect resistance to transgenic plants and its management.

Unit 8: Novel Approaches in Pest Control

Behavioural control: semiochemicals pheromones-types and uses, advantages and limitations. Hormonal control: types and function of insect hormones, insect hormone mimics, advantages and limitations. chemosterilants, antifeedants, attractants, repellents; their types, method of applications, advantages and limitations. Genetic control: concepts and methods, case histories, advantages and limitations. Genetic improvement and genetic engineering of bio control agents. Pest management in organic agriculture. Pest management in precision agriculture.

Unit 9: Integrated Pest Management

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

Unit 10: Pesticide Application Equipment

Types of appliances: sprayers, dusters, fog generators, smoke generators, soil injecting guns, seed treating drums, flame throwers, etc. Types of nozzles, international classification, their uses, spray patterns, particle size, measurement, drift and non target effects of pesticides. Maintenance of appliances. Aerial application-principles, guidelines, factors affecting the effectiveness, systems, advantages and disadvantages.

Unit 11: Pests of Field Crops and their Management

Distribution, host range, biology and bionomics, nature of damage and management of arthropod pests of cereals, millets, nutricereals, oilseeds, pulses, fibre crops, green manures, sugarcane and tobacco. Pests of importance: locusts, termites, hairy caterpillars, cut worms white grubs and invasive alien pests. Vertebrate and molluscan pests.

Unit 12: Pests of Horticultural Crops and their Management

Distribution, host range, biology and bionomics, nature of damage and management of arthropod pests of vegetables, fruits, plantation crops, spices, condiments, medicinal and aromatic crops, ornamentals, underutilized and exotic fruits. Pest management under protected cultivation. Pests of mushrooms. Vertebrate and molluscan pests.

Unit 13: Pests of Stored Products and their Management

Principles of grain storage. Storage structures, bulk storage and bag storage their merits and demerits. Grain drying methods and aeration. Storage losses, sources of infestation, factors influencing losses. Insect pests in storage, biology, and nature of damage. Non-insect pests (rodents, birds, mites) and their nature of damage. Management methods: Physical, Mechanical, Chemical, Biological, Behavioural, Legal and special storage methods. Microflora in storage environment and their control. Regulated and quarantine pests. Integrated management of storage pests.

Unit 14: Insect and mite vectors of Plant Diseases

History of vector pathogen interactions, important vectors of plant diseases, ecology of vector pathogen interaction Common insect and mite vectors viz., aphids, leaf hoppers, plant hoppers, whiteflies, thrips, psylids, beetles, weevils, flies, and mites and their relationship with the plant pathogenic fungi, bacteria, viruses, mycoplasma. Mechanism of pathogen transmission: Active mechanical transmission, biological transmission. Toxicogenic insects, mites and phytotoxemia. Some important arthropod vector transmitted diseases and their epidemiology in India. Management of vector and its effect on control of diseases. Role of climate change in vector borne diseases.

Unit 15: Honey Bees and Bee-keeping

History of bee-keeping. Honey bees and their economic importance. Bee products. Bee species, their behaviour, habit and habitats. Bee Keeping: bee pasturage, hives and equipments, seasonal management. Bee poisoning. Bee enemies including diseases and their management. Quality analysis of honey. Pollinators and their role in production of various crops. Conservation of pollinators.

Unit 16: Silkworms and Sericulture

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

Unit 17: Lac Insect

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

Unit 18: Helpful and Useful Insects

Pollinators and their role in production of various crops. Conservation of pollinators. Pollinators, insects as food, soil fertility improving agents, scavengers. Use of insects and insect products in medicines. Insects as bio-indicators. Usefulness of insects in scientific investigations

Unit 19: Statistics and Computer Application

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

Subject: Ph. D. GENETICS AND PLANT BREEDING:

Unit 1: General Genetics and Plant Breeding

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

Unit 2: Economics Botany and Plant Breeding Methods

Origin, distribution, classification, description and botany of cereals (wheat, rice, maize, sorghum, pearl millet, small millets); pulses (pigeonpea, chickpea, black gram, green gram, cowpea, soybean, pea, lentil, horse gram, lab-lab, rice bean, lathyrus, lima bean; oilseeds (groundnut, sesamum, castor, rapeseed mustard, sunflower, safflower, niger, linseed); fibre and sugar crops, fodder and green manures; Breeding methods for self-pollinated, cross-pollinated and asexually propagated crops. Combination, recombination and transgressive breeding. Single seed descent. Populations, their improvement methods and maintenance, Hybrid breeding and genetic basis of heterosis. Ideotype breeding. Mutation breeding, Concept of tree breeding. Speed breeding methods, Pre-breeding, Reverse Breeding.

Unit 3: Genome Organization and Cytogenetics of Crop Plants

Chromosome number, structure, function and replication. Sex determination & sex linkage. Recombination and crossing over. Molecular and cytological mechanism of crossing over. Karyotype analysis.Chromosomal theory of inheritance. Cell cycle and its regulation. Banding techniques. In situ hybridization. GISH and FISH Special types of chromosomes. Chromosomal interchanges, inversions, duplications and deletions. Polyploids, haploids, aneuploids, their utility and their meiotic behaviour. Wide hybridization and chromosomal manipulations for alien gene transfer. Pre-and post- fertilization barriers in wide hybridization. Genome organization and Cytogenetics of important crop species- wheat, maize, rice, sorghum, Brassica, groundnut, cotton, Vigna, potato and sugarcane. Cytogenetic techniques for gene location and gene transfer, Construction and use of molecular marker based chromosome maps.

Unit 4: Quantitative and Biometrical Genetics

Quantitative characters. Multiple factors inheritance. Genetic control of polygenic characters. Genetic advance and types of selection their effects on population mean and variance. Metric characters under natural selection. Repeatability and asymmetry of response. Breeding value. Dominance and interaction deviations. Hardy Weinberg law and changes in gene frequency due to migration, mutation and selection. Linkage disequilibrium. Genetic load. Polymorphism. Breeding value, heritability. Response to selection, correlated response. Estimates of variance components and covariance among relatives. Mating designs with random and inbred parents. Estimation of gene effects and combining ability. Effects of linkage and epistasis on estimation of genetic parameters. Maternal effects. Genotype-environment interactions, stability of performance and stability analysis. Heterosis and its basis (Genetic, biochemical and physiological). Mating system and mating design- diallel, line X tester, NC-I NC-II and NC-III designs, approaches to estimate and exploit components of self and cross pollinated crops. . GGE biplot analysis, Principal component analysis, AMMI and GGI analysis.

Unit 5: Genetic Engineering and Biotechnological Tools in Plant Breeding

Somatic hybridization, micropropagation, somaclonal variation, in vitro mutagenesis. Anther culture. Cryopreservation. Genetic and molecular markers, generation of molecular markers and their application in genetic analyses and breeding. Molecular markers in genetic diversity analysis and breeding for complex characters. Gene tagging, QTL mapping, MAS, MARS and MABB. Vectors. DNA libraries, DNA fingerprinting, DNA sequencing. Nucleic acid hybridization and immunochemical detection. Chromosome walking, Recombinant DNA technology, Gene cloning strategies. Gene transfer methods. Artificial synthesis of gene. Genetic transformation, transgenics and cisgenics. Antisense RNA, RNAi and micro RNA techniques in crop improvement. Genome editing using CRISPER/cas, Genomic selection, RNA Seq analysis,

Unit 6: Plant Breeding for Stress Resistance and Nutritional Quality

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

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

Plant exploration, germplasm introduction, exchange, conservation, evaluation and utilization of plant genetic resources. Types of genetic resources. Centres of diversity of cultivated plants. Genetic erosion and genetic vulnerability. Convention on Biological Diversity and International Treaty on Plant Genetic Resources for Food and Agriculture. Intellectual Property Rights and its different forms for protection of plant genetic resources. Biodiversity Act. Protection of Plant Varieties and Farmers' Rights Act and its features. System of variety release and notification. Types of seeds and seed chain. Maintenance breeding- nucleus and breeder seed production. Seed production and certification.

Unit 8: Statistical Methods and Field Plot Techniques

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

Subject: Ph.D. PLANT PATHOLOGY:

Unit 1: History and Principles of Plant Pathology

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

Unit 2: Laboratory and Analytical Techniques

Preparation and sterilization of common media. Methods of isolation of pathogens and their identification. Preservation of microorganisms in pure culture. Methods of inoculation. Measurement of plant disease.

Detection and Diagnosis of pathogens in seeds and other planting materials: Nucleic acid probes, Southern, Northern and Western hybridization, ELISA, ISEM and PCR. Nucleic acid probes,

Southern, Northern and Western hybridization, ELISA, ISEM and PCR. Laboratory equipment and their use: autoclave, hot air oven, laminar flow, spectrophotometer, electrophoresis, light and electron microscopy, incubator, ultracentrifuge, ELISA Reader, Freeze dryer, Nano drop, GC-MS, HPLC, Thermocycler.

Unit 3: Physiological and Molecular Plant Pathology

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

Unit 4: Mycology

Classification of fungi (According to the Classification – Kirk et al., 2008). Life cycles of important phytopathogenic fungi. Economic mycology, edible fungi and entomogenous fungi. Mycorrhizal associations. Cell organelles, their morphology, functions and chemical composition.

Unit 5: Plant Bacteriology

Identification and classification of bacteria. morphology, ultrastructure and chemical composition of prokaryotic cell in relation to function. Growth curve, nutrition and auxotrophic mutants. Resting cells in elementary bacterial genetics and variability: transformation, conjugation, transduction. Biology of extra chromosomal elements: plasmid borne genes and their expression.

Bacteriophages: lytic and lysogenic cycles. Prokaryotic inhibitors and their mode of action. Economic uses of prokaryotes. Morphology, biochemical characteristics, reproduction and life cycle of phytoplasma and other fastidious prokaryotes.

Unit 6: Plant Virology

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

Unit 7: Plant Disease Epidemiology

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

Unit 8: Phanerogamic Parasites and Non-parasitic Diseases

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

Unit 9: Fungal Diseases of Crop Plants

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

Unit 10: Bacterial and Viral Diseases of Crop Plant

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

Unit 11: Management of Plant diseases

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

Subject: Ph.D. SERICULTURE:

Unit 1: Mulberry Crop Production

Mulberry genetic variability and distribution–varieties–Soil suitability–Climatic requirements and constraints – Propagation methods – Planting methods – inter cropping - population geometry – growth analysis - Soil fertility – fertilizer recommendation – integrated nutrient management – organic farming - Water management – Weed management -Problem soils and management – Rain fed mulberry - Chawki garden maintenance – Training and pruning –Leaf quality-concept and assessment–preservation–Sericulture in integrated farming system–Resource management in mulberry crop production–Mechanization-machineries in sericulture-Pests, diseases and nematodes of mulberry and their management.

Unit 2: Mulberry and Silkworm Breeding

Germplasm-collection-conservation-evaluation and utilization-choice of parental genotypes for selection and hybridization –inter varietal and interspecific hybridization and polycross-clones-clonal Selection-Breeding for quality-genetic relationship between mulberry and silk worm genotypes-environmental interactions. Biotic and abiotic stresses- selection of suitable host genotypes for stability and responsiveness across the environments – selection for different situations like drought and salinity-breeding for tree types-selection of genotypes-responsive to pruning - innovative breeding approaches - tissue culture/micro propagation of mulberry plants-contribution of National and International Institutes - Distinguishing characters of released varieties- production of nucleus and breeders planting materials. Silkworm - present status of silkworm breeding - establishing a silkworm breeding programme - introduction of exotic gene source. In breeding techniques-crossbreeding techniques for hybridization-different methods-mutation- convergent crossing-diallel selection-selection of good inbred combiners. Selection for single trait and multi traits-breeding for tolerance to pathogens, early maturity, high temperature, post cocoon characters–breeding for biochemical parameters and sex-limited characters–recent advances in silkworm breeding.

Unit 3: Silkworm Biology

Position of sericigenous insects in class insecta-silkworm integument-moulting process–exoskeleton–structure and Function-Body regions-head and its appendages in silkworm-mouth Parts-Types of antenna and mouth parts in silkworm and other insects–Cephalic glands. Thorax and its appendages-modification of legs in silkworm and in other insects-type of wings and venation in Bombycidae and Saturnidae - Abdomen and its appendages - male and female genitalia in silk moths–male–female reproductive system–spermatogenesis–oogenesis– unusual types of development. Morphology and anatomy of eggs of silkworm–Diapause–physiology of diapause–biochemical changes - stages of development in diapausing and non-diapausing eggs - principles underlying breaking diapause and cold storage. Structure and function of silk gland-protein requirement in silkworm–composition of amino acids in silk gland-transamination-chemistry of fibroin, sericin and P25-biosynthesis of silk-role of food supplementation on silk yield. Structure and function of digestive system–circulatory system-respiratory system–excretory system – endocrine system - role of JH and anti JH analogues/ phytohormoens in cocoon production.

Unit 4: Silkworm Protection

Insect pathology–history–Concepts-Silkworm diseases-pathogenicity-kinds of infection-symptoms and pathologies associated with various diseases-classification of non-infectious and infectious diseases-poisoning due to gases-tobacco poisoning–nutritional and genetic diseases. Silkworm viruses-resistance of silkworm breeds against viral infection-role of antiviral and viral inhibitory factors- non-inclusion viruses. Miscellaneous flacherie diseases - Bacterial diseases – etiology – epizootology – bacterial toxicosis- symptoms - management of bacterial diseases. Protozoan diseases-biodiversity-symptoms–detection–monitoring and management-silkworm mycoses – types of fungal diseases –- symptoms and management - disinfection and hygiene – disinfectants – mode of action. Pests of silkworm-uzifly-external morphology, biology, symptoms and management practices– pests of grainage-non-insect pests-mite-nematode- rodents' symptoms and management practices.

Unit 5: Silkworm Nutrition

Insect nutrition-nutritional requirements of silkworm larva-nutritional composition of mulberry leaves-feeding physiology of silkworm. Carbohydrate requirement - carbohydrate metabolism - lipid metabolism - synthesis of fatty acid in Bombyx mori – Amino acid requirement. Transamination – silk proteins physio-chemical properties - fibroin and sericin synthesis-supplementation of nutrients for high silk yield. Role of water soluble and lipid soluble vitamins-growth factor–role and requirement of minerals- larval excretion. Dry matter economy–intestinal flora of silkworm–Artificial diet–nutrient management through food supplementation.

Unit 6: Non-Mulberry Sericulture

Status of vanya silk industry in India–History–Types of non-mulberry silkworms–Distribution and eco races of non-mulberry silkworms- Maintenance of germplasm of non-mulberry silkworms – Eri silkworm-morphology and voltinism–and their host Plants-Castor for dual purpose. Tasar silkworm-food plants and cultivation practices–large scale Plantations-Terminalia arjuna and Terminaliato mentosa-Pests and diseases on food plants and their Management- Rearing of different non-mulberry Silkworms-Pests and diseases of non-mulberry silkworms– Management practices. Muga silkworm-food plants and cultivation practices–Pests and diseases on food plants and their management - Rearing technology – Economics of rearing–Marketing System-Silk reeling techniques—Recent advances in non-mulberry silk industry–Biotechnological approaches.

Unit 7: Silk Reeling Technology

Cocoon marketing–price fixation–sorting, mixing, drying and stifling–Cocoon cooking– principle and methods. Types of reeling machines. Comparative output of each device – advantages and

disadvantages of different reeling devices. Reeling water quality. Silk throwing and weaving-processes involved in winding, doubling, twisting, rewinding for warp and weft- hank Making-Wet processing–degumming and bleaching by alkali and enzyme methods-dyeing- different dyes - warping and weaving - printing - block, hand screen tables Grading of silk– standards–silk exchange- by products and its uses.

Unit 8: Silkworm Seed Cocoon and Egg Production

Status and strategies of silkworm egg production - Morphology - Embryology – Biochemical changes in Eggs-Seed cocoon-preservation-selection-sorting-sex separation-cocoon melting. Moth emergence-sexing-pairing and depairing-egg Laying-Handling of eggs-embryological tools-diapausing and non-diapausing eggs - Acid treatment -preservation schedule - incubation/Black boxing technique- bivoltine seed production. Seed crop monitoring-agencies- seed Organization-Seed Acts-licensing procedures-pests of grainage – pebrine diagnosis and management- cocoon melting – seed acts.

Subject: Ph.D. SOIL SCIENCE:

Unit 1: Pedology

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

Unit 2: Soil Physics

Significance of soil physical properties. Soil texture – Stoke's Law- textural classes. Soil structure – classification, soil aggregation and significance, soil consistency, bulk density and particle density of soils and porosity, their significance and manipulation. Soil water- retention and potentials. Soil moisture constants. Movement of soil water- saturated and unsaturated flow-Darcy's law - hydraulic conductivity - infiltration, percolation, permeability, drainage and methods of determination of soil moisture. Thermal properties of soils, soil temperature. Soil air-composition, gaseous exchange, influence of soil temperature and air on plant growth. Soil physical constraints affecting crop production and their management strategies.Methods of soil analysis - particle size distribution, bulk and particle density, moisture constants. Soil erosion - types, effects,. Rain erosivity and soil erodibility. Runoff - methods of measurement, factors and management. Soil conservation measures. Characterization and evaluation of soil and land quality indicators; Causes of land degradation; Management of soil physical properties for prevention/restoration of land degradation; management of waste lands; Concept of watershed – its characterization and management.

Unit 3: Soil Chemistry

Chemical composition of soil; Soil colloids - structure, composition, constitution of clay minerals, amorphous clays and other non-crystalline silicate minerals, oxide and hydroxide minerals; Charge development on clays and organic matter; pH-charge relations; Buffer capacity of soils. Inorganic and organic colloids- surface charge characteristics, diffuse double layer, zeta potential. Soil organic matter fractionation, humus formation and theories clay-organic

interactions. Cation exchange – Hysteresis-definition. Nitrogen, potassium, phosphorus and ammonium fixation in soils and management aspects.

Unit 4: Soil Fertility

Essential elements in plant nutrition; Nutrient cycles in soil; Transformation and movement of nutrients (Macro and micro nutrients) in soil; Manures and fertilizers; Fate and reactions of fertilizers in soils; Slow release fertilizers and nitrification retarders- Soil fertility evaluation- Concepts and approaches ;. FCO Soil fertility evaluation – soil testing, plant and tissue tests and biological methods; Common soil test methods for fertilizer recommendation; Nutrient Management concepts- INM, IPNS, SSNM- Soil test-crop response correlations; Fertilizer application methods- Nutrient use efficiency- Macro and micronutrients. Nature, properties and development of acid, acid sulphate, saline and alkali soils and their management; Lime and gypsum requirements of soils; Irrigation water quality - EC, SAR, RSC. Fertility status of soils of India. Pollution: types, causes, and management. Carbon sequestration and carbon trading. Modern methods of soil, plant and fertilizer analysis; Flame photometry and inductively coupled plasma optical emission spectroscopy; Spectrophotometry - visible, ultra-violet and infrared; Atomic absorption spectrophotometry; Potentiometry and conductimetry; X-ray diffractometry; Mass spectrometry.

Unit 5: Soil Microbiology

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

Unit 6: Statistics

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

Subject: Ph.D. MOLECULAR BIOLOGY & BIOTECHNOLOGY:

Unit 1: Cell Structure and Function

Prokaryotic and eukaryotic cell architecture, Cell wall, plasma membrane, Structure and function of cell organelles: Nucleus, vacuoles, mitochondria, plastids, Golgi apparatus, ER, lysosomes, peroxisomes, glyoxisomes. Cell cycle-Regulation of cell cycle. Cell division, growth and differentiation. Protein secretion and targeting. Transport across cell membrane, Cell signaling, Developmental biology of plants, programmed cell death (apoptosis), Cell renewal and cancer, stem cell applications.

Unit 2: Biomolecules and Metabolism

Structure and function of carbohydrates, lipids, proteins and nucleic acids, Synthesis of carbohydrate, glycolysis, HMP, Citric acid cycle and metabolic regulation, Oxidative phosphorylation and substrate level phosphorylation, Vitamins, plant and animal hormones. Functional molecules, antioxidants, nutrient precursor, HSPs, anti-viral compounds.

Unit 3: Enzymology

Enzymes, structure conformation, classification, assay, isolation, purification and characterization, catalytic specificity, mechanism of action, active site, regulation of enzyme

activity, multienzyme complexes, immobilized enzymes and protein engineering, immobilized enzymes and their application.

Unit 4: Molecular Genetics

Concept of gene, Prokaryotes as genetic system, Prokaryotic and eukaryotic chromosomes, methods of gene isolation and identification, Split genes, overlapping genes and pseudo genes, Organization of prokaryotic and eukaryotic genes and genomes including operon, exon, intron, enhancer promoter sequences and other regulatory elements. Mutation – spontaneous, induced and site-directed, recombination in bacteria, fungi and viruses, transformation, transduction, conjugation, transposable elements and transposition.

Unit 5: Gene Expression

Expression of genetic information, operon concept, Transcription – mechanism of transcription in prokaryotes and eukaryotes, transcription unit, regulatory sequences and enhancers, activators, repressors, co-activators, Co-repressors in prokaryotes and eukaryotes, inducible genes and promoters, Transcription factors post transcriptional modification and protein transport, DNA- protein interaction, Genetic code. Mechanism of translation and its control, post translational modifications. Epigenetic control of gene expression; Regulatory RNA in gene regulation - Small RNAs, RNA interference and its applications.

Unit 6: Molecular Biology Techniques

Isolation and purification of nucleic acids. Nucleic acids hybridization: Southern, northern and western blotting hybridization. Immune response monoclonal and polyclonal antibodies and ELISA, DNA sequencing. Construction and screening of genomic and C-DNA libraries. Gel electrophoretic techniques. Spectroscopy,Polymerase chain reaction, real time PCR, RT-PCR, ultracentrifugation, chromatography, FISH, RIA, etc. Next generation genome sequencing techniques, basic bioinformatics, microarray, etc. Proteomics, 2D and protein sequencing, metabolomics.

Unit 7: Gene Cloning

DNA manipulative and modifying enzymes-restriction enzymes and their uses. Salient features and uses of most commonly used vectors i.e. plasmids, bacteriophages, phagemids, cosmids, BACs, PACs and YACs, binary vectors, expression vectors. Gateway cloning vectors. Gene cloning and sub-cloning strategies, chromosome walking, genetic transformation, Basis of animal cloning. Gene pyramiding and gene fusion, ribozyme technology. Biological risk assessment and IPR.

Unit 8: Molecular Biology

Genome complexity-C value and C-value paradox; DNA re-association kinetics. Analysis of repetitive sequences. Molecular events in DNA replication, transcription and translation. RNA processing and Post transcriptional modifications. Ribosome structure and function. Protein biosynthesis in prokaryotes and eukaryotes. Post-translational modification. Gene regulation, DNA damage-types and repair mechanisms. Bioprospecting. Non coding RNA.

Unit 9: Plant Molecular Biology

Photoregulation and phytochrome regulation of nuclear and chloroplastic gene expression. Molecular mechanism of nitrogen fixation. Advances in conversion of C3 to C4 pathway. Molecular biology of various stresses, viz. abiotic stresses like drought, salt, heavy metals and temperature; and biotic stresses like bacterial, fungal and viral diseases. Signal transduction and its molecular basis, molecular mechanism of plant hormone action, Hormone regulatory pathways, mitochondrial control of fertility, structure, organization and regulation of nuclear gene concerning storage proteins and starch synthesis. Crop genome sequencing projects.

Unit 10: Tissue Culture

Basic techniques in cell culture and somatic cell genetics. Clonal propagation. Concept of cellular totipotency. Androgenesis and gynogenesis, somaclonal and gametoclonal variations. Hybrid embryo culture and embryo rescue, somatic hybridization and cybridization. Application of tissue culture in crop improvement. Secondary metabolite production. In vitro mutagenesis, cryopreservation and plant tissue culture repository. Synthetic seeds, Virus indexing.

Unit 11: Plant Genetic Engineering

Isolation of genes of economic importance. Gene constructs for tissue-specific expression. Different methods of gene transfer to plants, viz. direct and vector-mediated. Molecular analysis of transformants. RNAi technology. Cisgenesis. Molecular pharming, bioremediation. GM detection methods. Resistance management strategies for target traits. Potential applications of plant genetic engineering for crop improvement, i.e. insect-pest resistance (insect, viral, fungal and bacterial disease resistance), abiotic stress resistance, herbicide resistance, storage protein quality, increasing shelf-life, oil quality, biofortification, Genetic engineering for pollination control, Induction of male sterility in plants. Current status of transgenics, biosafety norms and controlled field trials and release of transgenics (GMOs). IPR, genome editing technique.

Unit 12: Molecular Markers and Genomics

DNA molecular markers: Principles, type and applications; restriction fragment length polymorphism (RFLP), randomly amplified polymorphic DNA sequences (RAPD), amplified fragment length polymorphism (AFLP), Simple sequence repeats (SSR), Single nucleotide polymorphism (SNP), DaRT, SRAP, TRAP markers. Structural and functional genomics, gene mapping, genome mapping-GWAS and Genomic selection, gene tagging and comparative genomics and application of genomics. TILLING and ECOTILLING applications. Development of mapping population and types of mapping populations-RILs, NILs, F2, BILs, DH, MAGIC, Mutant populations. Linkage mapping. Association mapping, Molecular mapping of complex traits and Marker Assisted Selection and other applications of markers: MABC, MARS and Genomic Selection. DNA fingerprinting and barcoding. Phylogeography, conservation genetics. DNA chips and their use in transcriptome analysis; Mutants and RNAi in functional genomics; Proteomics, Metabolomics and bionomics.

AGRI.BUSINESS MANAGEMENT

Subject: Ph.D. AGRI-BUSINESS MANAGEMENT:

Unit 1: Basics of management &Organizational Behavior

Management – Nature, Scope and Significance of Management - Evolution of Management Thought - Classical School of management, Hawthorne studies, Modern theories of management Approaches to Management- Functions of management – Planning, organising, staffing, directing (motivation, supervision, communication, leadership) controlling.

Models of organizational behavior. Micro organizational behavior-Personality, perception, attitude. Motivational theories. Leadership styles& theories. Group dynamics - Stages of group development, types of teams. Conflict management.

Unit 2: Human Resource Management

Human Resource planning- Job analysis- Job designing. Recruitment and selection – Training - orientation, Types of training, management development - Performance appraisal. Promotions and Transfers – Types, separation, absenteeism. Wage and salary administration- Types of wages, employee benefits. Employee welfare -Industry relations- Collective bargaining. Quality of work life - Grievance handling.

Unit 3: Financial Management & Managerial Accounting

Financial management objectives & functions – Financial statement analysis - balance sheet, income statement, cash flow statement - Capital Structure, Determinants of size and composition of Capital Structure, Capital Structure Theories; Long term financing and Cost of Capital- Working Capital Management, Determinants of Size and Composition of Working Capital, Cash and receivables management, Working Capital Management Theories,Financing of Working Capital- Financial planning and Forecasting, proforma statements - mergers & acquisition, Capital Budgeting, Undiscounted and Discounted methods of Investment Appraisal (Internal Rate of Return (IRR), Benefit Cost (B-C) ratio analysis); Hybrid finance and lease finance - Indian Financial Institutions, markets and intermediaries, Dividend decision - venture capital financing and its stages, micro finance

Importance of agricultural finance; rural credit structure-demand, supply, sources and forms - reforms in agricultural credit policy; innovations in agricultural financing - microfinance, Kisan credit cards - role of institutions in agri-finance - public and private sector banks; cooperatives, micro- finance institutions (MF1s), SHGs;

Financial Accounting- Meaning, Need, Concepts and Conventions -Management Accounting- Meaning, Functions, Scope, Utility, Limitations and Tools of Management Accounting - Cost Accounting – Nature, Significance of Cost Accounting; Classification of Cost, Marginal Costing and cost volume profit Analysis- Its Significance, Uses and Limitations -Budgeting and Profit Planning, Different Types of Budgets and their Preparations, Sales Budget, Purchase Budget, Production Budget, Cash Budget, Flexible Budget, Master Budget, Zero Based Budgeting.

Unit 4: Marketing Management and International Marketing of Agri-products

Agricultural marketing; interventions by institutions, regulated markets, buffer stock operations, price stabilization measures and policies, Forward trading and futures market; contract farming; cooperative and collective farming, Farmer Producer Organizations. Marketing of agricultural inputs, role of private sector in input and output marketing; Rural marketing.

The Concepts of Marketing Management; Marketing Environment; Marketing Mix, Strategic Marketing, Market Segmentation, Targeting, and Positioning; Market Competition Analysis - Consumer buying behavior - Marketing Information System - Marketing potential and demand forecasting, Classification of Products; Product Life Cycle; New Product Development; Product Line and Product Mix; Branding, Packaging and labeling -Factors affecting prices; Pricing Policies and Strategies; Pricing Methods-Types of Distribution Channels; Functions of Channel Members; Channel Management Decisions - Promotion Mix; Introduction to Advertising, Personal Selling, Sales Promotion, Publicity and Public Relations; managing integrated marketing promotion, Customer Relationship Management. Direct & E-marketing and cause related marketing.

International Marketing: Meaning, nature and importance; International marketing environment. International Marketing Segmentation, targeting and Positioning: Screening and selection of markets; International marketing entry strategies. International Product and Pricing Strategies: Product standardization vs. adaptation; product life cycle, Factors affecting International price determination; Managing International Distribution and Distribution channel strategy. International promotion strategies: communications across countries, international promotion mix. International marketing decision making, implementation and control; ecological concerns and international marketing ethics. WTO, agri-exports, procedures for export; analysis of export markets, export promotion organizations, tools and techniques for optimizing the export functions.

Unit 5: Operations Management

Nature and Scope of Production and Operations Management; Its relationship with Other Systems in the Organization -Facility location, capacity planning and Layouts, Types of Manufacturing Systems - Process design-Types of process and operations systems: continuous, custom, job shop, batch processing, assembly line. Process - product matrix. Production Planning and Control-Forecasting - Aggregate production planning – Production strategies-Level, chase and mixed strategy. Master production scheduling. Work study- Method and Time study, Maintenance management - Overview of Materials Management, Purchase Management, Determination of Material Requirement, Material Planning, MRP, MRP II - Enterprise Resources Planning. Inventory management, JIT, Pull and Push Systems, Kanban system. Quality Assurance, Acceptance Sampling, Statistical Process Control, Total Quality Management, BIS, ISO and AGMARK quality standards, HACCP procedure, Productivity Variables and Productivity Measurement, Reengineering, value engineering, Value Analysis, Waste and lean Management

Logistics – Introduction, Scope, Functions and Objectives, Role of Logistics in competitive strategy, E- Logistics – Structure and Operation, Reverse logistics. 3 PL and 4 PL. Warehousing functions, Types- Material Handling and Storage Systems- Distribution Management – Strategies, Transportation system –Infrastructure, Networks and Transport economies. Packaging
– Consumer and Industrial packaging. Supply chain – Fundamentals, Drivers - Decisions in Supply Chain. Supply chain coordination, Current Trends in Supply Chain Management – E business. IT Applications in SCM and value chain management

Unit 6: Managerial economics

Scope of managerial economics, objective of the firm and basic economic principles; Consumer theory. Demand analysis - meaning, types and determinants of demand; demand function; demand elasticity; demand forecasting-need and techniques. Production, cost and supply analysis- production function, least-cost input combination, factor productivities and returns to scale, cost concepts, cost-output relationship, Pricing-determinants of price-pricing under different market structures. Price discrimination- Factor prices-pricing under different market structures, government policies and pricing. National income; circular flow of income: consumption, investment and saving: money-functions, demand & supply; inflation; economic growth; business cycles and business policies; Recent developments in the national and international economic and agricultural scenarios.

Unit 7: Research methods

Objectives, types, and process of research; Problem formulation; formulation of hypothesis and testing - Scales of measurement; Sampling design, Types of sampling - Probability and non-probability sampling techniques, sample size determination, sampling and non-sampling errors. Role and uses of quantitative techniques in business decision making, Data collection methods – sources of data – Data editing, coding tabulation – data analysis – statistical methods- Univariate and multivariate techniques - Report writing.

Unit 8: Operations research

Linear Programming: Objective, Assumptions, Formulation of Linear Programming Problem, Graphic Method, Simplex method; Transportation and Assignment Problems; Inventory control Models, Costs Involved in Inventory Management, Types of Inventory; Waiting Line Models: Waiting Line Problem, Characteristics of a Waiting Line System; Decision making under Risk and uncertainties, Decision tree ; Game Theory- Two -Person Zero-Sum Game; Simulation; Network analysis - Markov Chains.

Unit 9: Agribusiness Environment and Policy

Role of agriculture in Indian economy; problems and challenges related to farm supplies, farm production, agricultural finance, agro-processing, agricultural marketing, etc. in the country.

Agribusiness - definition and nature, components of agribusiness management, changing dimensions of agribusiness. Micro and Macro environment in Agribusiness. Structure of Agriculture - Linkages among sub-sectors of the Agribusiness; economic reforms and Indian agriculture; impact of liberalization, privatization and globalization on Agri-business sector. Emerging trends in production, processing, marketing and exports; policy controls and regulations relating to the industrial sector with specific reference to agro-industries.

Agribusiness policies- concept and formulation - Foreign investment policy in India: Types, advantages and disadvantages of FDI -Emerging trends in production, processing, marketing and exports.

Unit 10: Strategic Management

Corporate strategy, mission and objectives. Values, ethics, corporate social responsibility, corporate governance and strategy. Environment, competitor, industry and internal analysis - Generic strategies, vertical integration and capacity expansion, entry into new business and - growth and diversification strategies - Strategies during industry maturity and decline Strategy in fragmented industries - Strategy implementation. Strategy and managing change. Evaluation of corporate strategy – control, motivation, criteria, corrective action.

Unit 11: Project Management and Entrepreneurship Development

Concept, Characteristics of projects, types of projects, project identification, and Project's life cycle - Project feasibility- market feasibility, technical feasibility, financial feasibility, and economic feasibility, social cost-benefit analysis, project risk analysis - Network Methods: Meaning, Network Analysis, Requirements for Network Analysis, Critical Path Method (CPM), Programme Evaluation and Review Technique (PERT), Project scheduling and resource allocation Financial appraisal/evaluation techniques- Project implementation, Project control and information system.

Entrepreneurship, Significance of entrepreneurship in economic development and qualities of entrepreneur.

Entrepreneurship for Micro, Small and Medium Scale Enterprises (MSME); Innovation – sources and roles. Entrepreneurial Competencies; Steps involved in setting up of MSME. Establishing MSME Enterprises: Opportunities, Scanning-Choice of Enterprise; Market Assessment for MSME; Choice of Technology and Selection of Site. Enterprises-Getting organized: Financing New enterprises; sources and issues, preparation of business plan; ownership structure and organizational framework. Financial management; Technology and Business incubation process and services in India. Government policy for promotion of agribusiness entrepreneurship. Commercialization of technologies, Intellectual Property Rights – Types, and legislations. Management issues in MSMEs; Management Performance assessment and control; Strategies for stabilization and growth; Managing family enterprises.

BASIC SCIENCES

Subject: Ph.D. BIOCHEMISTRY:

Unit 1: Basic Biochemistry and Biomolecules

Scope and importance of biochemistry and molecular biology in plants. Structural and functional organization of prokaryotic and eukaryotic cells, viruses and bacteriophages, cell organelles

function and their fractionation. Chemical bonding in biological systems, pH and buffers. Thermodynamics and bioenergetics- concept of entropy, and free energy changes in biological reactions, Redox reactions, Role of high energy phosphates. Biomembranes. Classification structure, chemistry, properties and function of carbohydrates, proteins, lipids and nucleic acids. Components of immune system, Prostaglandins.

Unit 2: Intermediary Metabolism

Anabolism, catabolism and their regulation. Metabolism of carbohydrates – glycolytic pathway, HMP pathway, TCA cycle, glyoxylate pathway and gluconeogenesis. Biological oxidation- electron transfer and oxidative phosphorylation. Lipid metabolism, degradation and biosynthesis of fatty acids, ketogenesis and causes of ketosis. Biosynthesis of sterols and phospholipids.Protein degradation by proteases and ubiquitin-Proteasome System, Amino acid metabolism – catabolism of amino acids, transamination and deamination, urea cycle, biosynthesis of amino acids. Conversion of amino acids into bioactive compounds. Metabolism of nucleic acids-degradation and biosynthesis of purines, pyrimidines and nucleotides. Integration of carbohydrate, lipid and amino acid metabolism. Signal transduction mechanisms. Role of G-proteins, cyclic nucleotides and calcium in transduction. Disorders of lipid, carbohydrate, nucleic acid, amino acid metabolism. Inborn errors of metabolism. Secondary metabolites,Alkaloids, Phenolics and Isoprenoids, biotransformation and over expression. Role of oligosaccharides and polysaccharides in cellular metabolism.

Unit 3: Enzymes, Vitamins and Hormones

Major classes of enzymes, general properties, kinetics, active site and its mapping, activation energy and transition state. Mechanisms of enzyme action, inhibition and activation. Coenzymes and cofactors. Isoenzymes and immobilized enzymes. Abzymes, pseudoenzymes, bifunctional enzymes and enzyme promiscuity. Regulation of enzyme activity, allosteric regulation. Multi substrate reactions, kinetic experiments to determine the mechanism of multi substrate reactions. Isolation, purification and measurement of enzyme activity. Enzyme units. Enzyme engineering. Role of enzymes in agriculture, industry, and medicine. Structure, mode of action and metabolic functions of vitamins. Deficiency diseases associated with vitamins. General description of nature hormones and disorders associated with endocrine glands, viz. pituitary, thyroid, adrenal, pancreas and gonads. Peptide and steroid hormones. Phytohormones – auxins, gibberellins, cytokinins, ethylene, abscisic acid and new plant bio-regulators like SA, Brassinosteroids. Molecular mechanism of plant hormone action.

Unit 4: Molecular Biology

Structure of DNA and RNA Replication, transcription and translation. Post-transcriptional and translational modifications. Transcriptional and translation control of prokaryotes and eukaryotes. Features of genetic code in prokaryotes and eukaryotes. Gene expression - operon model, induction and repression, control of gene expression in prokaryotes and eukaryotes. Chloroplast and Mitochondrial genomes. Replication of viruses. Mutagens, oncogenes and carcinogenesis. General principles of recombinant DNA technology, restriction enzymes. Methods of gene transfer-plasmid and viruses as vectors, DNA and protein sequence analysis, oligonucleotide synthesis, genomic and cDNA library construction, site-directed mutagenesis, transposon tagging, chromosome walking. Basics of genome organization. Computer application in molecular biology, primer designing, sequence analysis and phylogenetic analysis. Benefits of gene manipulation in agriculture, nanobiotechnology, bio-chips.

Unit 5: Techniques in Biochemistry

Principles of optical, phase contrast, fluorescence and electron microscopy, spectrophotometry, UV and VIS, fluorimetry, turbidometry and atomic absorption spectrophotometry. Radioisotopic techniques – scintillation counters and autoradiography and their application in biological sciences. Electrophoresis - general principles and application, gel electrophoresis, isoelectric

focusing, pulsed field gel electrophoresis, immunoelectrophoresis. Chromatographic techniques - paper, thin layer, column chromatography, GC and HPLC. Centrifugation - principles of sedimentation in various rotors, differential centrifugation, density gradient centrifugation and ultracentrifugation. PCR, Quantitative PCR and application of RFLP, RAPD, AFLP, microsatellite and mitochondrial and ribotyping techniques.. Southern, Northern and Western blotting, ELISA. Microarray and DNA chips. MALDI-TOF and metabolite profiling techniques such as ICP-MS. X-ray diffraction, IR, NMR, FTIR, GC-MS, LC-MS. Preliminary methods of statistical analysis as applied to agricultural data – standard deviation, standard error, ANOVA, correlation and regression.,

Unit 6: Biochemistry of Food-grains, Fruits and Vegetables

Fundamentals of nutrition, concept of balanced diet. Nutritional quality of protein and its evaluation. Dietary fibre. Vitamins- biochemical functions and deficiency diseases. Fats and lipids-types of fatty acids and their significance in health. Biochemical composition and food value of various food grains (including cereals, pulses, oil seeds), fruits and vegetables. Biochemistry of fruit ripening, Biochemical aspects of post-harvest technology, storage and preservation of cereals, pulses, oilseeds, fruits and vegetables. Food enzymes. Biochemical basis of quality improvement of food grains, vegetables and fruits. Antioxidants, nutraceuticals. Food toxins and anti-metabolites, food additives, storage proteins. Processability of food grains. Bioavailability of nutrients and effect of food matrices, storage and processing on the functionality and bioavailability of nutrients.

Unit 7: Photosynthesis

Photosynthesis – photosynthetic pigments, light reactions, photosystems. Photophosphorylation, dark reactions: C3, C4 and CAM pathways. Conversion of C3 to C4 plants. Regulation of Rubisco. Chemisomotic coupling. Carbon cycle and its regulation, Ion fluxes and conformational changes during photosynthesis. Photorespiration. Relationship between photosynthesis, photorespiration and crop productivity. Chloroplasm morphology, structure and biochemical anatomy. Cytosolic and organelle interactions. Nature and exchange of metabolites through translocators. Seed reserve biosynthesis.

Unit 8: Plant Metabolic Processes

Uptake and metabolism of mineral nutrients in plants. Sulphur metabolism. Nitrogen cycle, nitrate and nitrite reduction, denitrification, symbiotic and non-symbiotic nitrogen fixation. Biochemical and physiological role of hydrogenase. Chemoautrotrophy in rhizobia and nitrifying bacteria. Cell cycle. Growth regulation in plants. Role of oligosaccharides and polysaccharides in cellular metabolism. Metabolism of cyanogenic glycosides and glucosinolates.

Unit 9: Plant Molecular Biology

General organization of nuclear, mitochondrial and chloroplast genomes. Genomics and functional genomics. Transcriptomics and Proteomics. Tissue specific expression of genes. Molecular biology of various stresses – drought, salinity and temperature. Signal transduction and its molecular basis: Structure, organization and regulation of nuclear genes. Genes involved in photosynthesis and nitrogen fixation. Regulation of chloroplast gene expression. Mitochondrial control of fertility. Molecular markers in plants and their uses.

Unit 10: Plant Biotechnology/Genetic Engineering

Totipotency, application of tissue culture for plant improvement, cryopreservation. Protoplasm fusion. General principles of gene cloning. Isolation and characterization of plant genes and promoters. Different methods of gene transfer –direct and vector mediated. Gene silencing. Site directed mutagenesis. Molecular analysis of transformants. Potential applications of plant genetic engineering for crop improvement – nutritional and processing quality improvement, shelf life enhancement, insect-pest resistance (insect, viral, fungal and bacterial diseases),

abiotic stress tolerance and herbicide resistance, Biosafety and IPR issues. Genome editing techniques and tools.

Subject: Ph.D. AGRICULTURAL STATISTICS:

Unit 1: Statistical Methods I

Descriptive statistics. Elements of probability theory, conditional probability, Bayes' theorem. Random variable-discrete and continuous. Mathematical expectation. Moment generating and characteristic functions. Laws of large numbers. Central limit theorem. Discrete probability distributions: binomial, Poisson, negative binomial, geometric, multinomial and hypergeometric. Continuous probability distributions: normal, rectangular, Cauchy, exponential, gamma and beta. Sampling distributions: chi-square, t, and F. Bivariate normal distribution: conditional and marginal.

Point estimation: unbiasedness, consistency, efficiency, sufficiency. Completeness. Minimum variance unbiased estimator. Cramer-Rao Inequality. Rao-Blackwell theorem and Lehman-Scheffe theorem. Methods of point estimation like Maximum likelihood, Moments, Minimum chi-square. Confidence interval estimation. Testing of hypotheses - two types of errors, level of significance and power of a test. Neyman-Pearson Lemma. Uniformly most powerful tests and their construction. Unbiased test, Likelihood ratio test. Tests of significance based on Z, t, chi-square and F distributions.

Unit 2: Statistical Methods II

Correlation, rank correlation, correlation ratio, intra-class correlation. Simple and multiple regression analysis, partial and multiple correlation. Examination of residuals. Model-adequacy, Selecting best regression. Compound and truncated distribution, Order statistics. Non-parametric tests: run, sign, rank, Wilcoxon, Kruskal-Wallis, Mann-Whitney, Cochran and Friedman's tests. Contingency tables. Log linear models. Sequential analysis, sequential probability ratio test. Components of time series. Multivariate normal distribution: estimation of mean vector and dispersion matrix. Wishart distribution, Hotelling T2, multivariate analysis of variance, principal component analysis, factor analysis, discriminant analysis, cluster analysis. Linear Programming: formulation and graphical solution, simplex method, duality, transportation and assignment problems.

Unit 3: Statistical Genetics

Statistical analysis of segregation, detection and estimation of linkage. Gene and genotypic frequencies. Random mating and equilibrium in large populations. Disequilibrium due to linkages for two pairs of genes and for sex linked genes. Selection, mutation and migration. Equilibrium between forces in large population. Polymorphism. Fisher's fundamental theorem of natural selection. Polygenic systems for quantitative characters, Concepts of breeding value, dominance, average effect of gene and epistatic interactions. Genetic variance and its partitioning. Correlation between relatives. Regular system of inbreeding, effects of inbreeding. Genotype and environment interaction, stability parameters. Estimation of heritability, repeatability and genetic correlation. Path coefficient analysis. Heterosis, concepts of general and specific combining abilities. Diallel crosses and line × tester analysis. Response due to selection. Prediction of response to individual, family and combined selections. Construction of selection index.

Unit 4: Design of Experiments

Linear models: Random, fixed and mixed effects. Nested and crossed classifications. Gauss-Markoff theorem. Analysis of variance. Principles of design of experiments. Uniformity trials. Completely randomized design. Randomized complete block design. Latin square design. Factorial experiments: 2n and 3n series and asymmetrical factorial experiments, confounding in

2n and 3n experiments, split and strip-plot designs, crossover designs. Multiple comparison procedures. Missing plot techniques. Analysis of covariance. Variance stabilizing transformations. Analysis of general block design. Balanced incomplete block designs: construction and analysis. Partially balanced incomplete block designs with two associate classes, lattice designs. Youden square design. Groups of experiments.

Unit 5: Sample Surveys

Sampling versus complete enumeration. Concept of probability sampling. Simple random sampling. Stratified sampling, allocation in stratified sampling, choice of strata, construction of strata boundaries and collapsing of strata. Use of auxiliary information in sample surveys, ratio and regression methods of estimation. Systematic sampling. Cluster and multi-stage sampling with equal probability. Sampling with unequal probabilities with and without replacement, sampling schemes with inclusion probabilities proportional to size. Double sampling, sampling on successive occasions. Non-sampling errors: sources and classification. Randomized response techniques, imputation methods. Design and organization of pilot and large scale surveys. National sample surveys. Agricultural statistics system in the country-land use statistics, crop estimation surveys, livestock and fishery statistics.

Subject: Ph.D. PLANT PHYSIOLOGY:

Unit 1: Cell Organelles and Water Relations

Cell organelles and their physiological functions Structure and physiological functions of cell wall, cell inclusions. Cell membrane structure and functions. Water and its role in plants, properties and functions of water in the cell, water relations, water potential of plant cells. Mechanism of water uptake by roots transport in roots, movement of water in plants, water loss from plants, energy balance, solar energy, input energy dissipation at crop canopy level. Evapotranspiration, plant factors influencing transpiration rate. Stomata, structure function - Mechanism of stomatal movement, antitranspirants. Physiology of water high temperature and salinity stress in plants. Influence of water stresses at cell, organ, plant and canopy levels. Indices for assessment of drought resistance.

Unit 2: Metabolic Processes and Growth Regulation

Energy and work, free energy and chemical potential, redox reactions and electrochemical potential. Enzyme classification and mechanism of action, factors affecting enzyme action. Gene expression and protein turnover. Photosynthesis, translocation and respiration as key processes regulating carbon metabolism and plant growth. Photosynthesis and bioproductivity. Photochemical process-Chloroplast, its structure, CAM plants and their significance. Rubisco structure and regulations, Photorespiration and its significance, CO2 fixation as a diffusive process, effect of environmental factors on photosynthetic rates. Synthesis of sucrose, starch, oligo and polysaccharides. Translocations of photosynthates and its importance in sink growth. Mitochondrial respiration, growth and maintenance respiration, cyanide resistant respiration and its significance. Nitrogen metabolism. Inorganic nitrogen species (N2, N03, NH3) and their reduction, protein synthesis, nucleic acids. Sulphate uptake and reduction. Lipid metabolism-storage, protective and structural lipids. Secondary metabolites and their significance in plant defence mechanism. Growth and differentiation, hormonal concept of growth and differentiation, plant growth hormones (auxins, gibberellins, cytokinins, ABA, ethylene, etc.), biosynthesis of growth hormones and their metabolism, synthetic growth regulators, growth retardant, apical dominance, senescence, fruit growth, abscission, photo-morphogenesis, photo-receptors, phytochrome, physiology of flowering, photoperiodism and vernalisation.

Unit 3: Crop Productivity and Modelling

Role of crop physiology in agriculture, crop growth and productivity, crop growth models describing yield (Duncan/Passioura), phenology-crop productivity, growth factors related to

biomass - concept of growth ratescanopy photosynthesis (leaf area and net assimilation rates as determining factors). Light interception as a major function of leaf area-index, LAD canopy architecture- Light extinction coefficient relative growth rate. Net assimilation rate. Biomass and yield relations. Assimilate partitioning, yield and yield structure analysis. Concept of source and sink, factors influencing source and sink size and productivity. Environmental factors determining crop growth. Light, temperature and VPD, effect of photoperiod and thermoperiod on duration of growth stages. Ideotype concept-selection- indices for improving crop productivity.

Unit 4: Abiotic Stress Responses in Plants

Abiotic stresses affecting plant productivity. Basic principles of a crop improvement programme under stress, interactions between biotic and abiotic stresses. Drought 21 characteristic features, water potential in the soilplant-air continuum. Development of water deficits, energy balance concept, transpiration and it's regulation – stomatal functions/VPD. Physiological process affected by drought. Drought resistance mechanisms: Escape, dehydration postponement (Drought avoidance), Dehydration tolerance, and characteristics of resurrection plants. Osmotic adjustment Osmoprotectants, stress proteins. Water use efficiency as a drought resistance trait. Molecular responses to water deficit stress perception, expression of regulatory and function genes and significance of gene products. Stress and hormones-ABA as a signaling molecule – Cytokinin as negative signal. Oxidative stress: reactive oxygen species (ROS) – role of scavenging systems (SOD, catalase etc.). High temperature stress: tolerance mechanisms- role of membrane lipids in high temperance tolerance. Functions of HSPs chilling stress; effects on physiological processes. Crucial role of membrane lipids. Salinity: species variation in salt tolerance. Salinity effects at cellular and whole plant level, tolerance mechanisms. Breeding for salt resistance. Heavy metal stress: aluminum and cadmium toxicity in acid soils. Role of phytochelatins (heavy, metal binding proteins).

Unit 5: Plant Growth Regulators and Plant Development

Plant growth regulators – Hormones, endogenous growth substances and synthetic chemicals. Endogenous growth regulating substances other than hormones. Brassinosteriods, triacontanol, phenols polyamines, jasmonates, concept of death hormone. Classification, site of synthesis, biosynthetic pathways and metabolism and influence on plant growth and development by auxins, gibberellins, cytokinins, abscisic acid and ethylene. Concept of hormone action - hormone receptors and signal transduction Hormone mutants. Hormonal regulation of gene expressions at various developmental stages of plant-flowering, seed maturity, seed dormancy. Action of hormones on cellular functions: Auxins- cell elongation, retardation of abscission of plant parts, gibberellins – stem elongation, germination of dormant seeds, cytokinins-cell division, retardation of senescence. Abscisic acidstomatal closure and induction of drought resistance, ethylene- fruit ripening, acceleration of senescence of leaves. Interaction of hormones in regulation of plant growth and development processes. Synthetic growth regulators, growth retardants, apical dominance, senescence, fruit growth, abscission. Growth and differentiation, hormonal concept of growth and differentiations. Rooting of cuttings- flowering- physiological and molecular aspects of control of reproductive growth. Apical dominance, senescence and abscission. Fruit growth and development, physiological and molecular aspects of ripening processes and improving post- harvest life of fruits. Induction and breaking dormancy in seeds and buds. Synthetic growth regulators. Practical utility in agriculture and horticulture. Herbicides, classification and their mode of action.

Unit 6: Mineral Nutrition

Importance of mineral nutrition in plant growth. Classification and essentiality criteria. General mechanisms - concept of apparent free space and nature of bio-membranes. Dual mechanism and other concepts of ion uptake. Short distance transport-pathway from external solution (Apoplasm) to sieve across the root cortical cells-factors contributing to xylem loading. Long distance transport in xylem and phloem, xylem unloading in leaf cells. Uptake and release of

mineral nutrients by foliage. Rhizosphere and root biology, root growth, influence of microorganism in nutrient acquisition, release and uptake by plant roots. Yield and mineral nutrition-concept of nutrient use efficiency, Mineral nutrition under adverse soil situations-drought, salinity, acidity etc. Heavy metal toxicity and concept of phytoremediation. Interaction of phytohormones and nutrients. Molecular aspects- uptake and transport, role of transporter genes, genetics of nutrient uptake, identification and transfer of genes for tolerance to nutrient deficiencies, etc. Soil less culture – Hydroponics - Role of Macro, Micro and beneficial nutrients-Identification of nutrient deficiencies and toxicities.

Unit 7: Climate and Climate Change

Climate-Analytical methods to determine long term changes in environment- Tree ring, cellulose, stable carbon isotope discrimination, stable 18O discrimination for hydrological changes. Likely changes in climate in future and its impact on crop and ecosystems. The greenhouse gases and global warning. CO2 as an important greenhouses gas, global carbon deposits, fluxes in the sinks and sources. Approaches to contain atmospheric CO2 level. Effect of elevated CO2 on plant growth and development. Methane as a greenhouse gas. Prediction on global warming, GCA models, effects on climate and biota. High temperature and CO2 interaction on plant growth and productivity, ionising radiation UV-B chlorofluoro carbon (CFC)– their impact on ozone layer-ozone hole and alteration in UV-B radiation. Effects of UV-B radiation on plant ecosystem, repair and acclimation to UV-B damage. Carotenoids and their role in membrane stabilization. Air pollution, SO2, NO, methane, ozone, peroxy acetyl nitrate and their effect on ecosystem. Industrial and domestic effluent-their effect, on aquatic ecosystem, plant growth and development.

Unit 8: Seed Physiology

Structure of seeds and their storage. Seed development patterns and source of assimilates for seed development. Pathway of movement of assimilates in developing grains of monocots and dicots. Chemical composition of seeds. Storage of carbohydrates, proteins and fats in seeds. Hydration of seeds. Physiological processes. Seed respiration, mitochondrial activity Mobilization of stored resource in seeds. Chemistry of oxidation of starch, proteins and fats. Utilization of breakdown products by embryonic axis. Control processes in mobilization of stored reserves. Role of embryonic axes. Gibberellin and?-amylase and other hydrolytic activity. Seed maturation phase and desiccation damage, role of LEA proteins. Seed viability. Seed dormancy. Means to overcome seed dormancy.

Unit 9: Physiology of Flowering and Reproduction

Evolutionary history of flowering plants (angiosperms). Semelparous and iteroparous reproduction, monocarpic and perennial life etc. Flowering phenomenon, effect of plant age, juvenility- transition to flowering. Flowering nature and classification of plants. Photoperiodic responses and the mechanisms in short and long day plants. Theories related to flowering. Endogenous substances and flowering. Gene expression in flowering. Control of flowering. Thermoperiodism - photo and thermo-period interactions. Vernalization-mechanism. Photomorphogenesis, photoreceptors, phytochrome, cryptochrome, physiology of flowering, photoperiodism and vernalization. Optimization in flowering response-to environmental features (light, temperature, stress) etc. plant reproductive physiology. Mating strategy in plants, molecular techniques to understand mating patterns, selfincompatibility responses, physiological processes mediating fertilization (pollen-stigma interactions), seed and fruit development, seed and fruit abortion and means to overcome it. Molecular biology of seed development, physiological basis of cytoplasmic male sterility and fertility restoration. Physiology of heterosis.

Unit 10: Physiology of Horticultural and Plantation Crop Species

Growth and development of horticultural and plantation crop species. Juvenility, shoot growth, types of shoots, patterns of shoot growth, cambial growth and its regulation. Physiological aspects of pruning and dwarfing. Growth measurements. Water relations of tree species. Water uptake and transport. Concepts of transpiration rate and water use efficiency. Sexual and asexual propagation. Rootstock and scion interactions. Physiology of flowering in perennial species, photoperiodism and thermoperiodism. Physiological aspects of fruit crops: mango, banana, grapes, citrus, papaya and pineapple etc. Physiological aspects of plantation crops: tea, coffee, cardamom, coconut, and black pepper. Physiological constraints and remedial measures of horticultural and plantation crops.

Unit 11: Post-Harvest Physiology

Senescence and ageing in plants. Ethylene – the senescence hormone, leaf senescence. Monocarpic plant senescence. Biochemistry and molecular biology of flower senescence. Gene expression during senescence. Concept of physiological maturity of seeds - post harvest changes in biochemical constituents in field crops - loss of viability, loss of nutritive value, environmental factors influencing post-harvest deterioration of seeds. Physiological and biochemical changes during fruit ripening and storage. Senescence and post-harvest life of cut flowers. Physical, physiological and chemical control of post - harvest deterioration of fruits, vegetables and cut flowers and its significance during storage and transport. Molecular approach in regulation of fruit ripening. Transgenic technology for improvement of shelf-life. Edible vaccine.

Unit 12: Morphogenesis, Tissue Culture and Plant Transformation

Morphogenesis; the cellular basis of growth and morphogenesis; polarity in tip growing cells and diffusive growing cells. Control of cell division and differentiation, phyto-chromes, different forms, physiological effects and gene regulation, and cellular totipotency, physiology and biochemistry of differentiation, in organ cell, tissue and cultures, micropropagation strategies, application of tissue culture in agriculture, horticulture, forestry and industry: plant transformation; transformation vectors, concept of selectable and scorable markers. Agrobacterium mediated transformation, binary vectors, biolistics. Electroporation, selection of putative transgenic plants, genetic analysis. PCR, Southern analysis evaluation of transgenic plants.

Unit 13: Phenomics

Phenotyping methods, phenotyping under different abiotic stress like drought, High temp., salinity etc. Image based phenotyping traits, Use of UAV in phenotyping and trait dissection under field conditions

Subject: Ph.D. MICROBIOLOGY:

Unit 1: History of Microbial World

Microbial world, History of microbiology and types of micro-organisms, Prokaryotic and eukaryotic cell, Classification and major characteristics of different microbial groups.

Morphological characteristics, Internal structures and their functions in bacteria, archaea, algae, cyanophages, viroids, prions, fungi, actinobacteria, mycoplasma, rickettsias, chlamydia, viruses, bacteriophages.

Basics of microbial growth and reproduction, Bacterial communication, Environmental and nutritional requirements for microbial growth, Pure cultures, Control of microorganisms: Principles, methods including radiation, Chemicals, Antibiotics etc.

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

Unit 2: Basic Microbiological Techniques

An introduction to laboratory instruments, Safety rules in laboratory, Handling of different glassware. Methods of sterilization and disinfection. Handling of autoclave, Hot air oven, BOD incubator, Laminar flow, Colony counter, pH meter, Biological filters; Spectrophotometer.

Isolation and preservation of different types of microorganisms; Microscopy: Light, Compound, Dark field, Phase Contrast, Fluorescent, EM, TEM, SEM ; Wet mount, Hanging drop technique, Stains and staining techniques.

Types of culture and culture media, Inoculation techniques, Isolation of pure culture, Proof of purity of cultures, Maintenance and preservation of pure cultures, Culture collections.
Identification of bacteria using biochemical tests, Introduction and importance of Bergey's Manual, Bioassay techniques, Antibiotic sensitivity of bacteria.

Isolation of Genomic DNA and PCR amplification in bacteria and cyanobacteria, RAPD and RFLP, Isolation of plasmids, Protein profiling by SDS-PAGE.

Unit 3: Microbial Physiology

Microbial growth, Requirements for growth; Bacterial division, growth kinetics, Energetics of growth; Types/modes of growth - Batch culture, Synchronous growth, Continuous growth, Chemostat and Turbidostat, Growth characteristics, Measurement of microbial growth: Plate counts, Filtration, The Most Probable Number (MPN) method, Direct microscopic count, Indirect methods ; Growth yield and its significance. Energy yielding pathways in microorganisms, Catabolic and anabolic reactions – Aerobic respiration: Glycolysis, Substrate level phosphorylation, Electron transport chain and oxidative phosphorylation , Hexose mono-phosphate pathway (HMP), Entner – Doudoroff Pathway (ED pathway), Tricarboxylic acid cycle (TCA cycle) and other mechanisms, Chemiosmotic mechanism of ATP generation, Obligate anaerobes, Aerotolerant anaerobes, Catabolism of other kind of organic substrates, Anaerobic respiration, Dissimilatory and assimilatory reductions, Types of fermentation, Fermentation balances.

Microbial photosynthesis, Diversity, Chlorophylls and bacterio- chlorophylls, Accessory pigments,

Light-dependent reactions and light independent reactions, Carbon dioxide assimilation in prokaryotes, Bacteriorhodopsin and Halorhodopsin and their significance, Classification and taxonomy of photosynthetic organisms: Microalgae (cyanobacteria, green algae) and bacteria, Major characteristics of different groups, Photosynthetic eubacteria: Introduction, Characteristics of important genera of photosynthetic eubacteria. Physiology of chemooligotrophs.

Enzymes and chemical reactions, Enzyme specificity and efficiency, Classification, Enzyme components, Mechanism and Factors influencing enzymatic activity: Temperature, pH, substrate concentration, Inhibitors, Feedback inhibition, Ribozymes, Coenzymes.

Cell wall and its biosynthesis; Polysachharide biosynthesis, Lipid biosynthesis, Biosynthesis of nitrogenous compounds- Amino acid and proteins, Purine and pyrimidines, Nucleic acids. Proteins break down by microorganisms, Deamination, Transamination, Assimilation of complex carbohydrates- Cellulose, Hemicellulose, Starch, Pectin and Chitin, Nitrogen fixing micro-organisms, Requirements of nitrogen fixation, Mechanism of nitrogen fixation, Nitrogenase enzyme, Biochemistry of hydrogenase enzyme and hydrogen assimilation. Secondary metabolism, Primary and secondary metabolites and their significance, Physiological response of microorganisms to salinity, alkalinity, UV, drought and heavy metals, adaptive mechanisms employed to cope with stress.

Unit 4: Microbial Genetics

Principles of microbial genetics; Gene organization in bacteria, Archeae, Eukaryotes and viruses; Gene regulation and expression in these organisms; Plasmids and their inheritance; Transposons and insertion sequences; DNA replication; Mutations and DNA repair mechanisms; Gene and genetic code; Nucleic acid synthesis and Protein synthesis: Transcription, Translation and Post Translational modifications; Genetic recombination in bacteria: Transformation, Conjugation, Transduction; Restriction enzymes; vectors; Virus multiplications and Genetics analysis of bacteriophages and cyanophages.; Genome and gene editing. Introduction to gene cloning.

Unit 5: Soil Microbiology

Role of microorganisms in soils, Major microbial indicators of soil health and their significance, Direct and indirect methods of studying soil microorganisms and their activities. Soil microbial interactions: Types and significance. Carbon cycle: Biodegradation of starch, Cellulose, Hemicellulose, Pectin and lignin in soil, Decomposition of organic matter, Humus and fulvic acid, Quantity and distribution of organic matter in soil, role of microorganisms in decomposition of soil organic matter, Dynamics of microorganisms during different stages of OM decomposition, Humus and its fractions, contribution of humus to soil quality. Nitrogen cycle: Ammonification, Nitrification, Denitrification, Non-symbiotic and symbiotic nitrogen fixation through bacteria and nitrogen assimilation. Environmental influences on microorganisms, Effect of temperature, aeration, moisture, osmotic pressure, pH. Recent development on the role of microbial communities and role in nutrient cycling. Transformation of phosphorus, Sulphur, Iron, Manganese, Magnesium, Copper, Mercury and Arsenic.

Soil microbial biomass, microbial interactions, unculturable soil biota. Microbiology and biochemistry of root-soil interface. Phyllosphere. Soil enzymes, origin, activities and importance. Biofertilizers – definition, classification, specifications, and role in crop production.

Unit 6: Microbial diversity and Ecology

Molecular approaches for measuring the microbial diversity: RISA,TGGE, DGGE, T-RFLP, BIOLOG, FAME analysis. Plant-microbe interactions, Endophytic and pathogenic interactions, Rhizosphere, Rhizoplane, Spermosphere and phyllosphere, Root exudates, Quorum-sensing in bacteria, Flow of signals in response to carbon substrates. Legume –Rhizobium symbiosis, Frankia- Actinorhizal symbioses, Classification of nodulating bacteria, Formation of nodules in leguminous plants, Types of nodules, Genetics of nodulation and nitrogen fixation, sym genes, nod genes, nif genes and fix genes, NOD factors, Hydrogenases. Mycorrhizae: Types of mycorrhizae, Mycorrhizal links with plants and their functioning. Biochemical/ Molecular aspects. Type three secretion systems, Plant growth promoting rhizobacteria (PGPR) and their direct and indirect mechanisms of action, Biocontrol agents and their mechanisms.

Unit 7: Microbiology of food and water

Food and their composition, Food as substrate for micro-organisms, Important bacteria in food microbiology, Microflora of meat, fish, eggs, fruits, vegetables, juices, flour, canned foods. Food spoilages, Fermented foods (Sauerkraut, Pickle, Soy Sauce, Tempeh, Miso), Bacterial toxins in food, Food-borne diseases and intoxications, Action of microbes on different components of food, Methods of food preservation. Mycotoxins, Microbiological quality assurance, Hazard analysis and critical control point (HACCP) concept, Methods for examination of micro-organisms in food. Composition of milk and factors affecting the composition, Microbiology of milk, Fermented milk products, Cheese, Pasteurisation, Spoilage of milk and its products, Microbiological methods for examination of milk and its products, Probiotics -concept, microorganisms and proteins used in probiotics; Bacteriological standards for milk and milk products.

Microbiology of water, Sources and types of water, Procedures for water purification, Water

pollution and its sources, Nuisance bacteria in water, Water-borne diseases and their spread and prevention. Modern tools in food and aquatic microbiology- PCR based techniques, microarrays, sensors.

Unit 8: Industrial Microbiology

Theory and principles of industrial fermentation, Fermenter design, Different types of fermenters used in industrial fermentation, Microbial culture selection, Strain development, The formation and extraction of fermentation product, C&N sources used for industrial fermentation.

New approaches and advances in downstream processing, Primary and secondary metabolites, Ethanol, Second generation biofuels, Beer, Wine and Cider fermentation.

Enzyme production : Rennet, Cellulase, Amylase etc., Microbial enzymes, Immobilization of enzymes, Organic acid, Vinegar production, Amino acid production : Glycine and Glutamic acid, Biomass production, Microbial insecticides. Single cell protein production for use as food and feed, Vitamin and related compounds (Carotenoid, Vitamin B12, Riboflavin), Antibiotic production, Biotransformation, Bioplastics, Bioprocess cost evaluation. High and low volume/value products, Bioprocess cost evaluation, Product finishing, formulation, encapsulation, immobilization, preservation, quality. Current advances in production of antibiotics, vaccines, Biotransformation, Bioplastics, Production of recombinant DNA products; production of vitamins and fine chemicals, source of single cell protein (SCP). Yeast technology, Genetics and strain improvement for brewing, baking and distilleries.

Unit 9: Applications of microorganisms in agriculture

Role of microbes in bioindustries, Value addition, Production of recombinant vaccines and hormones, Biosensors, Bioflavours, Biowarfare, Bioremediation Bioprocess engineering; Process design for various classes of products. Microorganisms in aquatic environment, pollution control, Bioindicators of pollution, Metal detoxification, Controlled photosynthesis and its application, Bioremediation, carbon sequestration, mitigation of global warming and environmental sustainability. Pesticides: Types, Resistance to microbes and metabolism; Residual effects of pesticides. Extremophiles as source of novel bioproducts, Microbial biofilms and their applications, Anaerobes in industry and environment, Serology and Immunodiagnostics in agriculture, Transplantation immunology. Microbial ore leaching (biomining), Microbial enzymes in clinical diagnostics, Metabolic pathway engineering, Principles of crop inoculation with microbial agents, Overview of microbial inoculants and their production, Carriers for inoculants- types and their characteristics, Strain selection for biofertilizer production and quality control, Mass multiplication – methodology and constraints/benefits, Bulk production (small scale and commercial scale), Setting up of pilot scale inoculant production plants. Rhizobium-evaluation as biofertilizer, Azotobacter-evaluation as biofertilizer, Phosphate solubilizing microorganisms: Methods for their identification, AM fungi, Ecology of inoculants/ microorganisms in soil, Biocontrol agents. Biogas production technology, Methanogens, Methanotrophs and their applications. Retting and Silage production, Techniques of composting and vermi-compost and their evaluation. Microbial inoculants: Formulation and application methods; Quality standards of inoculants.

Role of microorganisms in sewage treatment, Phyto and microbial remediation approaches; Biological oxygen demand, Effluent management, Integrated systems for pollution abatement and clean water. Microbial strategies for mitigation of stress. Patents and IPR issues in microbiology.

Unit 10: Microbial omics

Microbial Genomics, metagenomics, metatranscriptomics, Proteomics, Microbial functional genomics; Principles, methods and recent advances in DNA sequencing; RNA and protein sequencing; Microbial Gene Manipulation-Gene fusions and reporter genes; Microbial genes for

improving resistance to biotic stresses and tolerance to abiotic stresses in crop plants; Microbial genes for quality improvement in agricultural products and value addition; Concept of Microbiome: Soil and Plant Microbiome. Isolation of metagenome from environmental sources, Development of environmental libraries, DGEE, 16S rDNA community analysis, Functional and sequence based analysis of clones, Bioremediation of recalcitrant compounds. Bioinformatics, Bioprospecting, Microbial diversity and global environment issue, IPR and biosafety.

Unit 11: Data Analysis

Methods of statistical analysis as applied to agricultural data – standard deviation, standard error, accuracy and precision, analysis of variance (ANOVA), correlation and regression; t-test, chi- square (X2), F test, Probit analysis.

Experimental designs - basic principles, completely randomized, randomized block, Latin square and split plot designs.

VETERINARY SCIENCES

Subject: Ph.D. ANIMAL GENETICS AND BREEDING:

Unit 1: Overview of Genetics

History and development of genetics. Classic researches and pioneer scientists in genetics. Mendalism and its deviations. Chromosomes and heredity. Sex in relation to chromosomes and genes. Linkage and crossing over. Artificial transmutation of genes. Pleiotropy. Penetrance and expressivity. Multiple factor inheritance. Gene modifiers. Nonchromosomal genes and their inheritance, sex-linked, sex limited and sex influenced inheritance. Sex determination, Chromosomal aberrations. Mosaicism and chimerism.

Unit 2 : Advanced Genetics

Fine structure of chromosomes and chromosomal banding. Gene and mechanism of gene action. DNA replication. Central dogma. Protein synthesis. Genetic code and DNA cloning. Recombinant DNA technology. PCR. Gene banks. Split gene. Use of biotechnological tools in improving animal productivity. Application of immunogenetics. Biochemical polymorphism. Genetic polymorphism. Chromosomal studies in livestock improvement programmes. Development of clones in relation to animal productivity and maintaining biodiversity. Production of transgenic animals. Gene mixing for useful functions.

Unit 3 : Overview of Breeding

Brief history of domestication of livestock. Important breeds of livestock & poultry with special reference to economic characters. Evolution of genetic systems. Isolating mechanisms and origin of species / sub-species, their adaptation. Mating systems for different livestock and poultry. Genetic and phenotypic consequences and applications of inbreeding and out-breeding. Genetic basis of heterosis and its use. Diallele and polyallele crossing. Reciprocal and reciprocal-recurrent-selection. Combining ability. Developments in population and production of livestock and poultry in India. Status of Animal Genetic Resources in India.

Unit 4 : Genetic Properties of Population

Population Vs individual. Inheritance and continuity of population. Effective population size. Biodiversity. Description of animal population. Value and means; Average effect of gene and gene substitution. Components of total phenotypic variance of a population. Resemblances between relatives. Concept of heritability, repeatability; & phenotypic, genetic and environmental correlations. Methods of estimation, uses, possible biases and precision of estimates.

Unit 5 : Population Genetics

Gene and genotypic frequencies and factors affecting them. Hardy Weinberg Law and consequences of it. Prediction of selection response by different methods. Selection for threshold characters. Indirect selection and correlated response. Theoretical basis of change of population mean and variance on inbreeding and cross breeding. Genotype - environment interaction. Metric characters under natural selection. Quantitative trait loci and their applications. Marker-assisted selection.

Unit 6 : Genetic Strategies

Purpose-wise breeding strategies for livestock and poultry under different agro-climatic zones of India. Evaluation of past genetic improvement programmes for livestock and poultry in India. Bottlenecks in implementation of livestock breeding programmes in India. Evaluation and characterization of various indigenous breeds of livestock and poultry. Ex-situ and In-situ conservation of animal and poultry genetic resources. Development of new breeds / strains for better productivity in animals. Open nucleus breeding system in livestock improvement in India. Biotechnology and its role in improving animals and poultry production. Role of artificial insemination / frozen semen / embryo transfer / ONBS / MOET technology in animal breeding. Formulation of breeding programmes: Purpose-wise, breed-wise, region-wise for different species of livestock and poultry. Programmes for genetic improvement of non-descript livestock population of different species. Evaluation and current recommendations of cross breeding programmes of cattle, sheep and goat in India.

Unit 7 : Selection & Selection Experiments

Basis and methods of selection. Construction of selection indices. Different methods of sire evaluation. Selection differential and intensity of selection. Prediction of response. Improvement of response. Effect of selection on variance. Realised heritability. Long-term and short-term objectives of selections. Selection experiments in livestock and poultry. Role of control population in selection experiments. Selection for disease resistance and development of general and specific disease resistant strains / breeds. Purpose based selection and breeding of domestic animals and poultry. Genetic-slippage. Estimation of genetic divergence and its implications in livestock improvement programmes. Selection for better feed conversion efficiency in meat animals and poultry.

Unit 8 : Genetic Laboratory Techniques

Culturing Drosophila stock. Study of Drosophila with markers. Gene sequencing. Blood group typing. Karyotyping and chromosomal mapping. Gene mapping. Nucleic acid hybridization. Development of breed descriptors at molecular level for different livestock and poultry breeds. Biochemical polymorphism analyses – blood groups, transferrins, milk proteins. Collection and storage of samples for DNA fingerprinting; isolation and quantification of DNA from blood and semen; Restricted enzyme digestion of genome DNA, Analysis and transfer of DNA from agarose electrophoresis; Nucleic acid hybridization; Analysis of DNA fingerprinting, PCR-RFLP assay. Cryogenic preservation of animal germplasm.

Unit 9 : Research Techniques for Quantitative Animal Genetics

Use of computers in handling animal breeding data. Estimation of variances and covariances. Development of statistical models for analyses of breed data and to quantify environmental variance. Estimation of inbreeding and relationship. Estimation of inbreeding rate in a closed herd / flock. Estimation and interpretation of genetic and phenotypic parameters. Development of efficient selection programmes and procedures. Estimation of genetic gains. Designing and evaluation of breeding strategies like reciprocal recurrent selection, diallele and polyallele crossing. Designing field based progeny testing programmes. Development of efficient methods and traits for genetic evaluation of males under indigenous conditions. Data bank concept.

Unit 10 : Laboratory Animal Breeding

Laboratory animal species viz mice, rat, guinea pig, rabbit, dog and monkey – Their chromosome numbers – genome size – major genes. Physiological, nutritional, reproduction parameters, maintenance protocol – pedigree recording, planned mating. Selection and Mating methods /systems- monogamous, polygamous and others. Genetic control and monitoring- Record keeping-Ethics and legislation for management and use of laboratory animals. Nomenclature for different strains, inbred lines (SPF line, Knockout mice, etc.) – Animal model for human disease. Specific utility of different laboratory species for different requirements.

Subject: Ph.D. ANIMAL NUTRITION:

Unit 1: Energy and Proteins

Nutritional significance of carbohydrates, lipids and proteins. Cell-wall fractionation. Available energy from organic nutrients. Partitioning of dietary energy. Basal metabolic rate. Energy retention. Efficiency of energy utilization. Factors affecting energy utilization. Direct and indirect calorimetry. Dietary lipids - their digestion, absorption and metabolism. Essential fatty acids. Effect of dietary fat on milk and body composition. Proteins - digestion, absorption and utilization. Essential, critical amino and limiting acids. Protein evaluation. Metabolizable protein concept. Protein energy inter-relationship. Energetic of protein utilization for maintenance and different productive functions.

Unit 2: Minerals, Vitamins and Feed Additives

Minerals: Classification of minerals, ultra trace elements, newer elements, occasionally possible elements, Physiological functions, Deficiency symptoms and toxicity - Inter-relationships - Synergism and antagonism - Requirements - Different sources and bio-availability - Role of chelated, nano and hydrated minerals. Vitamins: Physiological functions and co-enzyme role - Deficiency symptoms, hyper-vitaminosis. Requirements, Sources and vitamin analogues - Antivitamins –Relationship between mineral and vitamin functioning. Feed Additives: Feed additive regulations. Nutritional role. Prebiotics, Probiotics, synbiotics and eubiotics, phytochemicals other metabolic modifiers. Role of phyto-chemicals as growth promoters.

Unit 3: Rumen Eco-system and Functions

Rumen and its environment. Development of functional rumen. Digestion kinetics in reticulo-rumen. Role of rumen microbes, Classification of rumen microbes Significance of rumen fungi-Defaunation and transfaunation. Microbial fermentation in rumen. VFA production, inter-conversion and utilization. Dietary protein breakdown. Microbial protein synthesis. NPN compounds and their utilization. Recycling of urea in ruminant, Ammonia toxicity - Role of slow release urea compounds. Manipulation of rumen fermentation. Bio-hydrogenation and utilization of dietary lipids. Methanogenesis their mechanism of production, essentiality and methane inhibitors. Carbon trading.

Unit 4: Non-ruminant Nutrition

Comparative gastrointestinal physiology of monogastrics – digestion and metabolism of organic nutrients in poultry and swine. Significance of minerals and vitamins in mono-gastrics. Inter relationship in nutrient sparing activity. Feeding systems. Role of feed additives - Factors affecting nutritional quality and performance. Special nutritional needs of rabbits, horses and companion animals.

Unit 5: Nutrient Requirements

Energy protein requirements for maintenance and productivity in ruminants and non-ruminants. Colostrum feeding of calf, mineral and vitamin requirements. Nutrient intake in relation to productivity. DM: water intake ratio. Palatability. Nutritional intake and energy density. Feeding standards - NRC, ARC, Kearl and Indian etc. Nutrient requirements under

temperate and tropical environment. Feeding strategies during different stress conditions and natural calamities - Ration formulation - least cost rations, ration formulation application.

Unit 6: Forage Conservation and Evaluation

Natural and cultivated forges-Their composition and nutritive values. Nutritive value Index. Forage quality evaluation in range animals -Role of indicator methods-Advances in silage and haymaking- Factors affecting quality of conserved forages- Quality criteria and grading of silage and hay under tropics-artificial drying of forages.

Unit 7: Global feed industry and production scenario

Feed Processing and Technology Methods of feed processing - physical, chemical and biological effect of processing on nutritional quality and utilization. Pelleted and extruded feeds. Quality control of raw feedstuffs and finished feeds: Significance of BIS (standards). Handling and storage of raw and finished feeds. Methods to improve shelf life of fat rich feeds, Byproducts of newly introduced commercial crops including residues of genetically modified feeds, Newer and alternative feed resources, Alternative feed resources. Current approaches in enriching tropical feed resources - concept of total mixed ration and advances in complete diet formulation.

Unit 8: Anti-metabolites and Toxic Principles

Naturally occurring anti-nutritional factors and common toxins in feeds and forages. Methods of detoxification. Health hazards due to residual pesticides in feeds and forages - Environmental pollutants.

Unit 9: Elements of Research Methodology

Principles of animal experimentation -Experimental designs in nutritional research. Modern methods of feed evaluation – Invitro, gas production and nylon bag techniques, Rumen simulation techniques -Rusitec Tracer techniques in nutrition research - Role of NIR Spectroscopy - Feed microscopy in quality evaluation of feedstuffs.

Unit 10: Clinical Nutrition

Role of nutrition to control digestive and metabolic disorders (milk fever, ketosis, ruminal acidosis-laminitis, bloat), metabolic profile tests. Role of nutrition in immunity, nutrition and reproduction, nutrients as antioxidants. Role of nutrition in management of GI parasites

Subject: Ph.D. LIVESTOCK PRODUCTION & MANAGEMENT:

Unit 1: General

Present status and future prospects of livestock and poultry development in India. Animal production systems in different agro-climatic zones of the country. Sustainability issue in relation to environment. Livestock farming systems. Effect of mechanization of agriculture on livestock sector. Breeds of cattle, buffalo, sheep, goat, pigs, equine, camels, rabbits and poultry. Various livestock and poultry development programmes & their impact on productivity & health. Livestock behaviour vis-à-vis adaptation and production. Behaviour & welfare. Systems of behaviour. Sexual behaviour in various species of livestock and poultry. Social order in farm animals. Behavioural aberrations – causes and control. Adaptation of livestock and poultry in tropics, deserts cold and high altitudes. Biosecurity and environmental considerations. Emerging challenges for livestock production in relation to the climate change scenario. Biotechnology in animal improvement.

Unit 2: Breeding Management

Basic principles of inheritance. Concept of heritability, repeatability and selection. Important methods of selection and systems of breeding in farm animals and birds. Importance of maintaining breeding records and their scientific interpretation.

Unit 3: Feeding Management

Nutrients and their functions. Nutritional requirements and feeding managements of different categories of livestock and poultry. Feed additives including antibiotic and probiotic feeding in farm animals and birds. Formulation and compounding of rations for various categories of livestock and poultry. Least cost ration formulation. Systems of feeding livestock and birds. Feeding standards for livestock and poultry. Feed conversion efficiency of various categories of livestock and poultry. Processing and storage of conventional and nonconventional feed ingredients. Agro-industrial by-products in animal feeds.

Unit 4: Reproduction Management

Reproductive systems of farm animals and birds. Climate and nutrition affecting reproductive performance in farm animals. Importance of early pregnancy diagnosis. Methods of heat detection. Artificial insemination. Oestrous prediction and synchronization. Causes of disturbed fertility and its prevention in farm animals. Management factors affecting reproductive efficiency. Summer and winter management problems and their solutions.

Unit 5: Shelter Management

Housing systems, Selection of site and lay out of animal and poultry houses. Space requirement for livestock and poultry, Housing designs in different agro-climatic regions. Macro and micro-climatic changes affecting designs of animal and poultry houses. BIS (standards) for livestock and poultry housing. Construction of cheap animal and poultry housing utilizing local resources. Automation in livestock farming. Types & designs of Milking parlours suitable for different scales of production. Disposal of animal wastes under urban and rural conditions. Disposal of carcasses.

Unit 6: Health Management

General approach to livestock health programmes. Prevention of diseases. Hygiene and sanitation on animal farm. Symptoms of ill health, important infectious diseases of livestock and poultry and their control. Vaccination schedules in animals and poultry. Internal and external parasites and their control. Accidental health disorders and their control. Common disinfectants used on animal farms. Concept of first aid at farms. Segregation and quarantine management for large animals and birds. Quarantine Act, Zoonotic diseases, labour health programme.

Unit 7: Production and Management of Cattle and Buffalo

Cattle and buffalo production trends and factors affecting them. Prenatal and postnatal care and management of cattle and buffalo. Care of neonates and young calves. Management strategies for reducing mortality in calves, age at first calving, and calving intervals. Management to improve reproductive efficiency in cattle and buffalo. Management strategies against summer & winter stress. Feed conversion efficiency for growth and milk production. Application of body condition scoring & other scoring techniques to improve productivity & efficiency of dairy animals. Milking management: hand vs machine milking practices. Standard milking protocols for clean milk production. Management practices for high yielding cows & buffaloes. Standard norms for manpower deployment for dairy farms & measures for improving labour efficiency. Dairy farm management efficiency measures. Mechanization & automation of various dairy farm operations (milking, feeding, waste disposal, heat detection, identification & health monitoring).

Unit 8: Production and Management of Other Animals

Draft animals: Population dynamics of various categories of draft and work animalsin India. Characteristics of draft animals. Estimating draft capacity of different species. Harness for various types of draft animals. Training of work animals. Feeding, care and management of draft animals. Management of camel with special reference to rearing, feeding and watering. Behavioural studies of various draft animals. Economics of draft animals vis-à-vis machine power.

Sheep and goat: Selection of breeds and breeding systems for improving wool, mohair, meat and milk. Feeding practices for economic rearing. Scope of intensive milk and meat production from goat. Mutton and wool production from sheep. Low cost shelter management. Sheep and goat reproduction. Health management.

Poultry: Brooding of chicks. Management of growing, laying and breeding flocks. Shelter management. Cage layer management and well-being of birds. Light management. Hatchery business management. Management during stress. Chick sexing. Maintenance of farm records. Health and sanitation problems. Prevention and disease control. Poultry shows. Handling care of table eggs and processing of birds for meat.

Equine: Care and management of horses, feeding and breeding systems, shelter management, shoeing, preparation and management of race horses.

Swine: Importance of pig as a meat animal. Selection of breeds and breeding systems for improving pig production. Feeding strategies for pigs. Care and Management of pregnant sows and unweaned piglets. Reproduction problems in pigs and remedial measures.

Rabbit: Economic importance. Important fur and meat type breeds. Housing, handling, feeding, watering, breeding, management, sanitation and health care of rabbits.

Unit 9: Wildlife Management

Status of wildlife in India and its conservation. Biological and ecological basis of management of wildlife. Breeding and feeding of wildlife in captivity. Principles & practices health management of wild animals.

Unit 10: Forage Production and Conservation

Classification of feeds and forages. Feed and fodder resources used for feeding of livestock and poultry. Nutritive value of feeds and fodders. Conservation and preservation of feeds and fodders. Annual and perennial fodder crops. Strategies for round the year fodder production. Pasture development and management. Enrichment of poor quality roughages.

Unit 11: Economics and Marketing of Livestock and Poultry and their Products

Economic principles as applied to livestock production. Production functions. Farm size, resources and product combinations. Cost concepts. Criteria for use of resources in livestock production. Maintenance of evaluation of different production records. Insurance and financing of livestock enterprises. Project formulation for setting up livestock farms. Different approaches to marketing of livestock and its products. Present status of cattle fairs and methods of selling livestock. Market news and information. Estimation of cost of different livestock products (milk, meat, egg & wool). Determination of prices of livestock products

Subject: Ph.D. LIVESTOCK PRODUCTS TECHNOLOGY:

Unit 1: Basic and General Aspects of Livestock Products

Composition and physico-chemical properties of cow and buffalo milk. Milk proteins, lipids, carbohydrates, minerals, vitamins and other minor constituents of milk. Nutritive value of milk. Reception of milk - platform tests, filtration and clarification, Membrane processing and related techniques, chilling, separation, standardization, pasteurization and homogenization. Cleaning and sanitation of dairy equipments. Present status and future prospects of meat and poultry industry. Structure, composition, physical biochemical and nutritive aspects, and functional properties of different kinds of meat, fish, poultry and eggs. Sensory evaluation and organoleptic properties of livestock products. Post-mortem aspects of muscle as meat. Ageing of meat and chemical changes. Meat in human health. Bacteria, yeasts, molds, parasites important in food

microbiology. General principles of spoilage. Chemical and deteriorative changes caused by micro-organisms. Contamination and spoilage of meat, fish, poultry and eggs. Food poisoning and food-borne infections. Assessment of microbial condition and wholesomeness of different livestock products. National and International microbial standards.

Unit 2: Abattoir and Poultry Processing Plants

Origin and source of animal foods. Lay out, construction, design, organization, operation and maintenance of abattoirs and poultry processing plants. Pre-slaughter care and slaughtering techniques for different food animals and birds. Effect of transport on meat Quality. Ante-mortem and post-mortem inspection. Judging and grading of animals and birds on foot and on rail. Carcass grading and preparation of cut up parts. Condemnation and disposal of unfit material. Disposal of slaughterhouse effluents. Sanitation, plant operation and maintenance. Sanitary standards for meat packing plants. Meat cutting and deboning. Adulteration and misrepresentation of meat. State, municipal and other regulations pertaining to meat trade. Meat food products order. Processing and utilization of various animal and poultry by-products, slaughterhouse and poultry plant offals. Methods of utilization of blood, fat, hides and skin, horns, hooves, wool, hair, feather, glands and other byproducts. Importance and utilization of by- products in industry, Application of computer science in abattoir operation. Robot technology and its application in meat and poultry industry.

Unit 3: PFA and FSSAI standards of different dairy products

Processing and Preservation Principles of processing of dairy products. Special milk: sterilized milk, flavoured milk, homogenized milk, soft curd milk, Vitaminized/irradiated milk, fermented milk, standardized milk, reconstituted/rehydrated milk, recombined milk, toned, double toned milk, skimmed milk, Humanized milk. Processing of dairy products: - butter, butter oil, ice-cream, fresh and ripened cheeses, cream, condensed milk, dried milk, dried milk products etc. Indigenous dairy products: ghee, khoa, dahi, misti dahi, makkhan, chhana, paneer, Khurchan, Lassi, kunda, milk cake, Organic milk. Principles of preservation of livestock products. Equipment and technology of processing and preservation. Industrial food preservation, chilling, freezing, freeze drying, dehydration, bio preservation, canning irradiation, pasteurization, curing, smoking, use of chemical additives and antibiotics. Recent advances in preservation of livestock products. Cooking methods including micro-wave cooking. Tenderisation and use of enzymes for processed foods. Production of value added products, process methods, process optimization and quality control. Development and preservation self-stable (canned and dehydrated) intermediate moisture, textured, cured, fermented fabricated meat and poultry products. Sanitation, regulation and inspection of processed meat foods. Development of emulsified, communited, restructured and other processed meat products. Desugarization, freezing, pasteurization and dehydration of eggs. Principles involved in preparation of egg powder and other egg products. Effect of processing on nutritional, chemical, microbiological and organoleptic qualities of livestock products. Economics of pre-costing and product development. Application of biotechnology in processing and preservation of meat, poultry and fish products. Genetically modified foods. Bioactive products and biogenic amines.

Unit 4: Wool, Mohair and Fur

Basic aspects of wool science. Development and structure of wool fibers. Shearing, physical and chemical characteristics, processing, grading, standardization, storage and marketing of wool, mohair, fur and other speciality fibers (National and International).

Unit 5: Packaging

Principles of packaging. Types of packaging materials. Characterization, methods and systems of packaging. Gas packing, Vacuum packing, modified atmosphere packing, controlled atmospheric packaging, shrink and stretch packing, industrial packaging. Aseptic and retort pouches. Standardization and quality control of packaging material. Product attributes and

packaging requirements for different livestock products. Latest trends in packaging of meat, poultry, eggs, wool and fish products: Active and smart packaging, antimicrobial packaging, edible films and coatings, nanocomposite materials for food packaging. Use of biosensors in livestock products packaging.

Unit 6: Quality Control

Grades and grading of livestock products. Stress factors effecting meat quality – PSE, DFD, Hot boning, Cold shortening, thaw rigor, freezer burn and electrical stimulation. Regulatory and inspection methods – Municipal and State laws. Bureau of Indian Standards and International Standards of fresh meat and poultry including their products and by-products. Detection of antibiotics, chemical residues, heavy metals and toxins in meat. Techniques for detection of adulteration of meat. Different techniques for meat speciation. HACCP concept of quality control of meat, fish, poultry and eggs.

Unit 7: Marketing

Livestock production and supply characteristics. Meat consumption and related demands. Present status, constraints and future aspect of livestock production and marketing. Types of market and trends in marketing livestock products and by-products, wholesale, retail and future trends. Consumer aptitude, education and awareness, and popularization of new products. Corporate bodies in regulation of markets, marketing boards, Co-operative agencies, internal trade and development of international market for livestock products. Organization, operation and sanitation of meat, poultry, fish and egg retailing units. Fast food chains and super markets. Situation and outlook and methods for promotion and marketing of livestock products.

Subject: Ph.D. VETERINARY ANATOMY:

Unit 1: Comparative Osteology and Arthrology

Structure, chemical composition and classification of bones, Bones of appendicular and axial skeleton of ox as a type and their comparison with those of horse, dog, pig and poultry, classification and detailed study of different joints of the body. Study of various indices for estimating race, sex and age of different animals. Basics of biomechanics of the locomotor system, Radiography of normal and developing bones.

Unit 2: Comparative Splanchnology

Descriptive anatomy of various organs of digestive system and associated glands, respiratory system and associated glands and urinary system and associated glands of ox and their comparison with those of horse, dog, pig and poultry. Study of boundaries of thoracic, abdominal and pelvic cavities, pleura and peritoneum and their reflection. Complete study of various organs and associated glands of male and female genital systems, surgical sites for various operations and clinically significant areas for performing auscultation, percussion and for carrying out surgical procedures such as laryngotomy, oesophagotomy, gastrotomy, rumenotomy, cystotomy, urethrotomy, caesarian section, exploratory laparotomy, mammectomy, thoracotomy, thoracocentesis, etc.

Unit 3: Myology, Angiology, Neurology and Aesthesiology of Ox

Classification of muscle fibres, origin, insertion and relations of muscles of different body parts. Topographic anatomy of the vascular system comprising of heart, arteries, veins and lymphatics. Study of various components of central nervous system, peripheral nervous system and autonomic nervous system. Complete study of the gross anatomy of various sense organs. Study of different nerve blocks, injections in different species of domestic animals, sites and enucleation of eyeball.

Unit 4: Histological and Histochemical Techniques

Preparation of tissues for light microscopy using different fixatives, different staining methods for routine light microscopy, frozen sectioning techniques and staining methods for enzymes, carbohydrates, lipids, proteins, pigments etc. Silver staining techniques for nervous tissue.

Unit 5: General and Systemic Histology and Ultrastructure

General: Light and ultra-structural details of animal cell, epithelial tissue, muscular tissue, connective tissue and nervous tissue. Systemic: Light and ultrastructure of different organs of digestive system, respiratory, lymphoid organs, endocrine organs, cardiovascular system, urogenital system, different sense organs, integumentary system and nervous system of ruminants with differential features among domestic animals.

Unit 6: Developmental Anatomy

Gametogenesis, fertilization, cleavage and gastrulation, development of foetal membranes and placenta in domestic animals, histogenesis of nervous system, sense organs, endocrine organs and cardiovascular system, embryonic development of digestive, respiratory, urogenital and musculoskeletal system.

Unit 7: Principles and Applications of Biomechanics

Biomechanics, its definition and scope with reference to anatomy and physiology of domestic animals and musculo-skeletal dynamics. Locomotion and clinical applications, biomechanics of cortical and trabecular bones, biomechanics of fracture fixation, instrumentation and techniques in locomotion and their application in lameness.

Unit 8: Avian Anatomy

Gross and microscopic features of different body systems of domestic fowl.

Unit 9: Neuroanatomy

Gross and microscopic anatomy of the brain and spinal cord, various cranial and spinal nerves along with their associated nuclei and ganglia, motor and sensory pathways, different ascending and descending tracts of brain and spinal cord and autonomic nervous system.

Unit 10: Endocrine Anatomy

Advanced gross and microscopic anatomy of the hypothalamus and pituitary gland, thyroid, parathyroid, thymus, adrenal glands, islets of Langerhans, pineal body and other tissues associated with endocrine secretions.

Unit 11: Theory and Applications of Electron Microscope

Introduction and principles of electron microscopy, methods for transmission electron microscopy and scanning electron microscopy.

Unit 12: Histoenzymology and Immunocytochemistry

Classification of enzymes – principles of enzymes, histochemistry methods; Substrates – combination–coupling azo-dye methods –capture reagents, localization of enzymes and controls in enzyme histochemistry. Fluorescence microscopy in enzyme histochemistry, immunohistochemistry- principles and techniques.

Unit 13: Applied Embryology and Teratology

Principles of experimental embryology and teratology, factors affecting the developmental mechanisms of embryo. Use of organizer implants, chemical and hormonal preparations in the developmental models and available literature on teratogenic experimentation.

Unit 14: Functional Veterinary Anatomy

The relationship of structure to form and function, the relationship of structure for adaptation and behaviour and in relation to clinical conditions/ applications.

Unit 15: Gross Anatomy of Laboratory Animals

Study of different organs of digestive system of different laboratory animals, detailed study of urinary, male and female reproductive systems of different laboratory animals, complete study of respiratory system of different laboratory animals, study of organs of circulation and nervous system of different laboratory animals. Descriptive anatomy of endocrine glands of different laboratory animals.

Subject: Ph.D. VETERINARY EXTENSION EDUCATION:

Concept, philosophy, principles, genesis, growth and scope of extension education, earlier extension efforts. Emerging issues, problems and challenges of animal husbandry extension education. Communication- meaning, concept, purpose and process, Models of communication. Types of communication intrapersonal, interpersonal, verbal and non-verbal. Criteria of effective communication, Determinants of communication. Concept of diffusion. Elements in diffusion process, Decision-making, Stages in diffusion-adoption process. Concepts and stages of adoption. Adopter categories and their characteristics. Factors influencing adoption. Attributes of innovations, rate of adoption and sources of information.

Teaching learning process and its principles. Steps in extension teaching process, cone of experience. Learning situation. Criteria for effective teaching and learning. Extension approaches in livestock development- individual, group and mass approach (electronic and non-electronic). Relative merits and demerits of different teaching methods in animal husbandry extension. Audio-visual aids- classification, use and evaluation. Importance of programme planning in veterinary and animal husbandry extension. Objectives, principles and steps in programme planning process. Role of animal husbandry extension agencies, local leaders, livestock owners and institutions in planning and implementation of need-based veterinary extension programmes. Concept, principles, types and methods of evaluation. Concept of FSR, Participatory Approaches- Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA).

Concept, nature and scope of research in social sciences. Types of research- fundamental, applied and action research, experimental and non-experimental research. Variables, types and their measurement. Selection and formulation of research problem. Hypothesis- importance, selection criteria (quality of workable hypothesis), formulation and testing of hypothesis. Concept of development, social and economic development; Historical overview on Rural Development in India. Transfer of Technology (TOT) programmes of ICAR. Recent trends in extension. Privatisation of extension. Public Private Partnership. Contract farming. Organic animal husbandry. Animal welfare programmes.

Concept, importance and functions of human resource management. Process of management- planning, organizing, staffing, directing, coordination, reporting and budgeting. Principles, levels and types of organization. Training methods, identification of training needs, training evaluation and developing strategies for human resource development in animal husbandry sector. Role of livestock sector in Indian economy and poverty alleviation. Enterprise integration women in agriculture and livestock. Livestock and agrarian scenario. ICT - concept, importance and types of tools; Development and application of ICT tools including information kiosks, E-learning.

Subject: Ph.D. VETERINARY BIOCHEMISTRY:

Unit 1

Scope of Biochemistry and molecular biology in animal sciences. Structural and functional organization of prokaryotic and eukaryotic cells, viruses and bacteriophages. Compartmentalization of metabolic processes within the cell and fractionation of subcellular components. Structure and functions of biomem branes with special reference to active transport of ions and metabolites. Chromatin structure. Molecular aspects of cell division and cell cycle. Cellular regulation, development and differentiation. pH, water, Henderson-Hasselbalch equation, buffers, Extra and intracellular communication.

Unit 2

Structure and properties of biologically important carbohydrates including storage and structural polysaccharides, mucopolysaccharides, blood group substances, peptidoglycans and bacterial polysaccharides. Structure and properties of fatty acids, acyl glycerol, glycerophospholipids, sphingolipids, glycolipids, sulfolipids, aminolipids, sterols, bile acids and prostaglandins. Basic principles of isolation, estimation and analysis of carbohydrates and lipids.

Unit 3

Aminoacids, structure and properties. Primary, secondary, tertiary and quaternary structure of proteins. Glycoproteins, lipoproteins, nucleoproteins, fibrous and globular proteins. Structure and functions of immunoglobulins, myoglobin and hemoglobin. Physical and chemical properties of proteins. Structure of different types of nucleic acids. Acid base properties, sedimentation behaviour, hyperchromic effect, base sequencing and restriction analysis of DNA. General description of cell culture, hybridoma and animal cloning techniques. Computer applications in molecular biology, primer designing, sequence analysis and phylogenetic analysis.

Unit 4

Major classes of enzymes, general properties, kinetics and mechanism of their action. Activation energy and transition state. Coenzymes and cofactors. Regulation of enzyme activity and enzyme inhibition. Isoenzymes and enzymes of clinical significance. Applications and scope of enzymes in bioprocess technology and genetic engineering.

Unit 5

Bioenergetics, biological oxidation, respiratory chain and oxidative phosphorylation. Citric acid cycle and ATP generation. Glycolysis, Kreb's cycle,pentose phosphate pathway and gluconeogenesis, cori cycle, glycogenolysis and glycogenesis. Biosynthesis and oxidation of fatty acids. Volatile fatty acids as source of energy in ruminants. Ketogenesis and cause of ketosis in ruminants. Biosynthesis of sterols and phospholipids. Catabolism of amino acids, transamination and determination, urea cycle. Integration of carbohydrate, lipid and amino acid metabolism. Conversion of amino acids into other bioactive compounds. Biosynthesis of nutritionally non-essential amino acids. Metabolism of purines and pyrimidines. Disorders of lipid, carbohydrate, nucleic acid and amino acid metabolism. Inborn errors of metabolism and scope of gene therapy in combating genetic disorders.

Unit 6

Mechanism of storage, transmissions and expression of genetic information. DNA replication and control of gene expression in prokaryotes and eukaryotes. RNA synthesis and factors regulating transcription. Biosynthesis of proteins. Features of genetic code in prokaryotes and eukaryotes. Wobble hypothesis, post-translational modification, degeneracy and regulation of translation. Basic principles of recombinant DNA technology and its scope in animal health and production. Recombinant proteins and vaccines, safety, ethical issues and IPRs in molecular biology.

Unit 7

Fundamental principles of nutrition, nutritional requirements, balanced diet, nutritive value of foods, importance of dietary fiber, assessment of protein quality, deficiency diseases and metabolic disorders; diabetes, food toxins; Structure and metabolic functions of water soluble and lipid soluble vitamins. Trace elements and their role in biological processes. Deficiencies and nutritional significance of vitamins and trace elements in domestic animals and poultry, nutraceuticals & probiotics. General description of nature of hormones, receptors and mechanisms of their action. Feedback mechanisms. Metabolic function of different hormones and associated disorders due to hypo or hyper secretions of major endocrine glands viz. pituitary, thyroid, adrenal, pancreas and gonads. Growth factors and their role.

Unit 8

Blood composition and biochemical constituents of erythrocytes, leucocytes and platelets. Important plasma proteins and their functions. Haemoglobin in oxygen and carbon dioxide transport. Role of kidneys in acid base balance. Composition and metabolism of muscle, connective, tissue, cartilage, bone, nervous, tissue, adipose tissue and mammary tissue. Clinical significance of iron, iodine calcium and phosphorus metabolism in domestic animals and poultry. Biochemical tests for hepatic and renal functions. Urine composition and analysis.

Unit 9

Basic principles and use of latest photometric, chromatographic, electrophoretic and radioisotopic methods of biochemical analysis. Chromatography: partition, ion-exchanges, adsorption and affinity, TLC, HPTLC, HPLC, Gel Filtration and GLC. Electrophoresis: PAGE, SDG PAGE, agarose gel electrophoresis and isoelectrofocusing; Blotting techniques; Electroblotting, Northern, Southern and Western blotting; Radiotracer techniques: beta and gamma emitters and their detection, solid and liquid counting, autoradiography and phosphor image analysis, isotope dilution technique; Binding assays: RIA and ELISA; Spectroscopy: UV- visible, fluorescence, ORD, CD, NMR, ESR and Mass; PCR & RT-PCR. Methods of isolation,
purification and characterization of proteins, DNA and RNA. Basic principles of RIA, ELISA, PCR, RFLP and DNA fingerprinting NA probes, vectors, microarray, imaging, applications of nanotechnology, proteomics. Determination of enzymes, hormones, vitamins and other biochemical constituents with special reference to disease diagnosis in domestic animals.

Unit 10

Environmental pollution in relation to animal health and production. Biotechnology in pollution control. Biochemical basis of pollutant tolerance, host defence mechanisms including antigenic and non-antigenic interactions. Free radicals, carcinogenesis and role of liver and kidneys in detoxification. Oncogenes and mechanism of immunosuppression in cancer therapy and organ transplantation.

Unit 11

Overview of the immune system, cells and organs of immune system, Innate and adaptive immune system Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecule, .generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and Tcellreceptors, humoral and cell-mediated immune responses, primary and secondary immune modulation,the complement system, Toll-like receptors, cell-mediated effector functions, cytokines, Hypersenstive reaction, autoimmunity and vaccines.

Subject: Ph.D. ANIMAL REPRODUCTION GYNAECOLOGY & OBSTETRICS:

Unit 1: Veterinary Gynaecology

Biology of sex. Development of female genitalia. Functional anatomy of female reproductive system of farm animals. Growth, puberty and sexual maturity. Reproductive cycles (oestrous cycle) in female farm animals. Oogenesis and folliculogenesis. Follicular dynamics and ovulation. Transport and survival of gametes, fertilization, cleavage, implantation and maternal recognition of pregnancy. Sex determination and differentiation, Development of foetus and foetal membranes. Period of embryo and period of fetus, Teratology of fetus, Placenta classification and functions. Gestation and pregnancy diagnosis in farm animals.

Unit 2 : Reproductive Endocrinology

Reproductive hormones, classification, synthesis, chemical composition and mechanism of action. Hypothalamus, pituitary, thyroid, gonadotropic, gonadal, placental and pineal gland hormones. Prostaglandins, pheromones, growth factors and hormone antagonists and their significance in animal reproduction. Hormonal assays. Hormonal regulation of male and female reproduction.Clinical uses of hormones.

Unit 3 : Accidents during Gestation

Pregnancy, Pseudocyesis, Ectopic pregnancy, Abnormalities of fertilization and foetal development, Superfecundation and superfetation. Abortion – bacterial, viral, mycotic, protozoal, physical, toxic and miscellaneous causes, diagnosis and prevention, Dropsy of foetal membrane and foetus, Maceration, mummification, Pyometra, Antepartum vagino-cervical prolapse, Uterine torsion and displacement of uterus. Retained fetal membranes.

Unit 4: Veterinary Obstetrics

Pelvis and pelvimetry. Parturition – Signs approaching parturition, initiation and stages of parturition, induction of parturition and postpartum period. Presentation, position and posture.Causes and forms of dystocia and its treatment.Epidural anaestheia. Obstetrical maneuvers including fetotomy and Caesarean section. Post-partum complications in domestic animals, retention of placenta, uterine proplapse, endometritis, metritis, septic metritis. Post parturient metabolic disorders.

Unit 5 :Andrology

Comparative anatomy of male reproductive system. Thermoregulation of testis and blood testis barrier, Growth, puberty and sexual maturity.Spermatogenesis including cycle of somniferous epithelium and spermatogenic wave.Sperm morphology and ultra-structure of spermatozoa, sperm transport, maturation and storage in male genital tract, Secretions of male reproductive tract including accessory glands and their role in reproduction, Sexual/mating behaviour.Training of young bulls for semen collection, Semen and its composition, biochemistry of semen and

sperm metabolism, sperm abnormalities and its classification, sperm separation and spermatozoa karyotyping. Breeding soundness evaluation of bulls, testicular cytogram, routine semen analysis, advances in semen analysis techniques including fluorescent dyes.

Unit 6 : Male Infertility

Fertility, infertility and sterility in male domestic animals. Causes and forms of male infertility. Testicular hypoplasia, cryptorchid, testicular degeneration, orchitis, affections of epididymis, vas deference, penis, prepuce and accessory glands & their management, tumors of the male reproductive tract, nutritional infertility, Vices in the males. Libido problem and its management, fertility markers. Evaluation of male for breeding soundness, reproductive health status. Effect of parental drugs and vaccines on semen quality.

Unit 7 : Frozen Semen Technology and Artificial Insemination

History and development of artificial insemination. Advantages and disadvantages of AI and frozen semen, selection of bulls for AI purpose. Management of breeding bulls, methods of semen collection in different domestic animals, semen evaluation including latest techniques for evaluation of motility and fertilization. Ideal extenders, extenders for liquid semen. Preservation of semen at various temperatures. Processing and preservation of liquid semen. Extenders for frozen semen, principles and techniques of semen freezing. Cold shock and ultra-low temperature shock. Cryoprotectants. Semen additives. Evaluation of frozen semen. Transport and storage semen. Handling of frozen semen, Liquid nitrogen and its containers. Insemination techniques. Estrus and estrus detection tools, Planning and organization of semen bank.

Unit 8 : Reproductive Technology

Synchronization of oestrous cycle in domestic animals, control of ovulation. Embryo transfer technology – History, advantages and disadvantages, superovulation, collection, evaluation, preservation and transfer of oocytes / embryos. History of in vitro maturation and fertilization. Recovery of oocytes in vitro and in vivo, maturation, fertilization, culture, evaluation, preservation and transfer of oocytes / embryos. Micromanipulation of embryos. Embryo splitting and cloning. Stem cells and production of transgenic animals. Sex determination and gene insertion. Establishment of laboratory for ETT, IVM, IVF and IVC. Use of Ultrasonography, laparoscopy and ovum-pick technology in farm animals.

Unit 9 : Infertility in Cows and Buffaloes

Fertility, infertility and sterility. Fertility indices, Evaluation of herd fertility. Incidence and economic role of infertility, forms of infertility, congenital and hereditary defects, infectious diseases. Pathological conditions of ovary, oviduct, uterus, cervix and vulva. Management causes of infertility. Hormonal causes of infertility, anestrus, repeat breeding, cystic ovarian degeneration, sexual health control and reproductive health programmes. Breeding soundness examination of cows and buffaloes.

Unit 10 : Reproduction and Infertility in Ovine/Caprine

Puberty, sexual maturity, breeding season, oestrous cycle, Breeding and conception, gestation, parturition, periparturient and obstetrical complications. Synchronization of oestrous cycle. Embryo transfer. Causes of infertility and their management.

Unit 11 : Reproduction and Infertility in Swine

Oestrous cycle, synchronization of oestrous cycle, Hormonal control of reproduction. Various forms of infertility in swine and their management. Various obstetrical problems and their management.

Unit 12 : Equine Reproduction

Physiology and pathology of equine reproduction. Research techniques and methodology for the study of equine reproduction. Equine andrology. Reproductive behaviour and management of stallion. Semen collection, examination and artificial insemination. Pregnant mare behaviour. Application of modern reproductive techniques in equine reproduction. Equine infertility.

Unit 13 : Canine and Feline Reproduction

Functional anatomy of dog and cat reproductive system, oestrous cycle and endocrinology of oestrous cycle and detection of optimum breeding time. Exfoliative vaginal cytology. Methods of pregnancy diagnosis, contraception. Medical termination of pregnancy. Infertility in bitches, disorders of oestrous cycle, pseudopregnancy, pyometra, cystic endometrial hyperplasia, tumors of reproductive tract. Difficult whelping – types and methods of handling dystocia. Caesarean section. Ovarian hysterectomy. Peri-parturient complications. Semen collection, evaluation, techniques of artificial insemination, infertility in male including testicular tumors – cryptorchid, affections of prostate.

Subject: Ph.D. VETERINARY MEDICINE:

Unit 1: General Medicine

Epidemiology and its ingredients Definitions of diseases known as – infectious, contagious, sporadic, epizootic, enzootic, panzootic, exotic, zoonotic, etc. Meaning and purpose of segregation, isolation, quarantine, etc., role of occurrence, prevalence, incidence, morbidity rate, mortality rate, case fatality rate, mode of transmission, vectors, spread, economics, etc. in terms of epidemiology of diseases. General systemic states like – bacteremia, septicemia, pyemia, toxemia, hyperthermia, hypoglycemia, allergy, anaphylaxis, shock, dehydration, stress, sudden death, anasarca, anaemia, pica, etc.

Unit 2: Diagnosis of Animal Diseases

History taking. General clinical examination. Special clinical examination – electrocardiography, paracentesis, rumen fluid examination, haematology, blood biochemistry, urinalysis, ophthalmoscopy, otoscopy, endoscopy, ultrasonography, biopsies, etc.

Unit 3: Gastroenterology

Specific conditions of organs of gastrointestinal system with special emphasis to – simple/acid/alkaline indigestion, GI ulcers, choke, tympany, colic, impaction, traumatic reticulitis / peritonitis, abomasal displacement, ascites, jaundice, hepatitis, enteritis, gastritis, etc.

Unit 4: Diseases of Cardiovascular and Pulmonary System

Principles of circulatory failure, Acute heart failure, Congestive heart failure, Perpheral circulatory failure. Myocardial and valvular diseases. Epistaxis. Pulmonary congestion and oedema. Emphysema. Pneumonia. Pleurisy, URI Aspiration pneumonia.

Unit 5: Diseases of Urinary, Nervous, Musculoskeletal and Integumentary Systems

Nephrosis, Nephritis, Pyelonephritis, Cystitis, Urolithiasis, Uremia, Cerebral anoxia, Encephalitis, Encephalomalacia, Meningitis, Encephalomyelitis, Paralysis, Urticaria, Dermatitis, Photosensitisation, Seborrhoea, Conjunctivitis, Otitis, Kerato-conjunctivitis, Corneal ulcers, Eczema, Impetigo, Alopecia

Unit 6 : Production and Deficiency Diseases

Metabolic profile test, milk fever, Downer's cow syndrome, ketosis, hypomagnesaemia, diabetic ketoacidosis, hypomagnesaemia, post-parturient haemoglobinuria, azoturia. Fat cow syndrome, rickets, osteomalacia, osteodystrophiafibrosa. Trace mineral and vitamin deficiency.

Unit 7 : Common toxicities

Sources, pathogenesis, clinical manifestations, post-mortem findings, diagnosis and treatment of conditions occurring in the following classes of poisonings: Metal Corrosives/irritants. Plant poisonings. Water-borne toxicities. Pesticide poisonings. Insect bites and stings. Snake bite. Environmental pollution hazards. Radiation hazards and injuries.

Unit 8 : Infectious Diseases (Bacterial and Mycoplasmal)

Etiology, epidemiology, pathogenesis, clinical manifestations, post-mortem findings, diagnosis, treatment and control of the following diseases of livestock : Mastitis, Strangles. Caseous lymphadenitis in sheep and goats.Clostridial diseases.Ulcerative lymphangitis in horses & cattle.Listeriosis, Leptospirosis, Erysipelas, Collibacillosis, Salmonellosis, Pasteurellosis, Brucellosis, TB, JD, Actinomycosis, Actinobacillosis, Glanders and Mycoplasmal diseases.

Unit 9 : Infectious Diseases (Viral, Chlamydial, Rickettsial and Fungal)

Etiology, epidemiology, pathogenesis, clinical manifestations, postmortem findings, diagnosis, treatment and control of the following diseases of livestock: Hog cholera. African swine fever. Leucosis FMD, RP. PPR. BMC BSE. Bovine viral diarrhoea. Mucosal diseases. Bluetongue. Influenza. Maedi. Pulmonary adenomatosis. Rabies. Encephalomyelitis. Pseudorabies. Louping ill.Caprine arthritis, encephalitis, Scrapie, Visna, Contagious ecthyma.Pox, Papillomatosis, Distemper.Infectious canine hepatitis.Parvovirus enteritis. Felinepanleucopenia. Anaplasmosis, Heart water diseases, Contagious opthalmia., Aspergillosis, Ring worm, Bursattee, Lymphangitis, Babesiosis, Theileriosis, Coccidiosis, Trypanosomosis, Toxoplasmosis.

Unit 10: Parasitic Diseases

Etiology, epidemiology, pathogenesis, clinical manifestations, post-mortem findings, diagnosis, treatment and control of the following diseases of livestock: Major conditions produced by nematode, cestode and trematode infestations. Major conditions produced by arthropod parasites.

Unit 11: Poultry Disease

Etiology, epidemiology, pathogenesis, clinical manifestations, post-mortem findings, diagnosis, treatment and control of the following diseases of poultry: Newcastle disease, IBD, ILT, mycoplasmosis, coccidiosis, salmonellosis, necrotic enteritis, malabsorption. leucosis. Marek' disease, mycotoxicosis, avian encephalomyelitis.hydropericardium syndrome. avian influenza, psittacosis-ornithosis, TB, histomonosis, spirochaetosis, trichomonosis, etc., parasitic diseases of poultry.

Unit 12: Veterinary Jurisprudence and Ethics

Judicial procedure. Duties of veterinarian particularly as an expert evidence. Vetero-legal aspects of wounds. Vetero-legal aspect of death in general, due to diseases, drowning, near drowning, electrocution, lightening, etc. Post-mortem examination of a vetero-legal, cases. Collection and dispatch of materials for forensic science examination. Common offense against animals. Common frauds in dealing with livestock and livestock products. Animal Insurance. Identification of animal species for vetero-legal purposes. Determination of time since death. Examination of blood and semen stains. Blood grouping in animals and its vetero-legal significance. Veterinary ethics: Code of conduct, professional ethics and etiquette for veterinarian. Laws: Role of veterinarian. Legal enactment in IPC related to animals and veterinarians. Prevention of Cruelty to Animal Act, Indian Veterinary Council Act. Wild life (protection) Act. Glanders and Farcy Act, Livestock Importation Act. Dangerous Drug Act and Prisoning Act. Legal provisions related to animals, animal diseases and drugs.

Unit 13: Special Therapeutic Approaches

Veterinary fluid therapy with fluid, electrolyte, plasma expanders, packed cell transfusions, etc. Clinical assessment of their requirement and doses. Blood transfusion with blood groups in animals-their therapeutic significance. Blood matching methods. Oxygen therapy.

Unit 14: Prevention and Control of Diseases

General principles of control of diseases. Role of OIE in disease control. Internationally recongnised control methods of designated diseases. Prevention and control methods for national, area and herd based control programmes of diseases like TB, JD, rabies, brucellosis, HS, anthrax, BQ, mastitis, FMD, bluetongue, etc.

Unit 15: Common Diseases of Zoo, Laboratory Animals and Wildlife

Clinical signs, diagnosis and treatment of diseases of wildlife and zoo animals: Shock, stress, diseases of cardiovascular system, capture myopathy, metabolic and nutritional diseases,

toxicosis by chemicals and plants, tuberculosis, paratuberculosis, pasteurellosis, anthrax, rabies, FMD, RP, Kyasanur forest diseases (KFD), surra, helminthiasis. Clinical symptoms, diagnosis and treatment of diseases of laboratory animals: Tyzzer's diseases, salmonellosis, pasteurellosis, strepto and staphylococcosis, psedudomoniasis, corynibacteriosis, mycoplasmosis (MRM), herpesvirus infection, pox diseases, coccidiosis, toxoplasmosis, giardiasis, helminthic infection, dermatophytosis, scabies, dermatitis, metabolic and nutritional deficiencies. Management related diseases of mice, rat, guinen pig, hamster and rabbit.

Subject: Ph.D. VETERINARY MICROBIOLOGY:

Unit 1: General Bacteriology

Milestones in the development of microbiology, Classification and nomenclature of bacteria. Structure, function and chemistry of bacterial nuclear apparatus. Cytoplasm, Intracellular granules, Cell wall, Cytoplasmic membrane, Mesosomes, Capsule, Flagella, fimbriae, Endospore, Protoplasts, Spheroplasts, L-forms, Involution forms. Bacterial stains, staining and microscopy. Growth and nutritional requirements of bacteria. Bacterial enzymes. Respiration in bacteria. Carbohydrate protein, fat and nucleic acid metabolism in bacteria. Reproduction and growth phase of bacteria. Effects of chemical and physical agents and antibiotics. Bacterial variations including transduction, transformation and conjugation. Bacterial vaccines and toxins. The role of microbial toxins in the pathogenesis of diseases; Biochemical and biological characteristics of toxins produced by various bacteria. Toxin producing Gram-positive and Gram-negative bacteria. Properties and clinical conditions produced by different bacterial toxins.

Unit 2: Systematic Bacteriology

Systematic study of bacteria belonging to genera Borrelia, Leptospira, Campylobacter, Pseudomonas, Brucella, Bordetella, Escherichia, Citrobacter, Salmonella, Shigella, Klebsiella, Enterobacter, Proteus, Vibrio, Haemophilus, Staphylococus, Streptococcus, Bacillus, Clostridium, Listeria, Erysipelothrix, Corynebacterium, Nocardia, Rickettsia, Chlamydia, Mycoplasma, Acholeplasma, Spiroplasma, Anaeroplasma and Thermoplasma, Rhodococcus, Mycobacterium, Pasteurella and Neisseria.

Unit 3: General Virology

Historical development of virology. Evolution, classification and nomenclature of viruses. Biophysical and biochemical characteristics of viruses. Cultivation of viruses and their growth pattern in cell culture, embryonated eggs and experimental animals. Purification and concentration of viruses. Qualitative and quantitative assay of viruses. Viral replication. Virus-host cell relationships. Replication strategies of animal viruses and molecular pathogenesis for selected viral system. Latent, persistent and chronic viral infections. Study of genetic variability of animal viruses through use of monoclonal antibodies, autoimmunity, immunosuppression and viral mutation in persistence infections. General principles of laboratory diagnosis of viral diseases. Epidemiology and pathology of viral infections. Immune mechanism in viral diseases. Interference and interferon. Viral vaccines, point of action of antiviral molecules during the replication cycle of a virus and search for new antiviral compounds, viruses and gene therapy. Chemotherapy of viral infections.

Unit 4: Systematic Virology

Systematic study of RNA and DNA viruses in livestock and poultry with reference to antigenicity, cultivation, pathogenesis, epidemiology, diagnosis and immunity, RNA viruses: Retroviruses and lymphotropic viruses, Visna and Maedi, Arboviruses, Rotaviruses. Birnaviruses. Picornaviruses. Bunyaviruses. Cornoaviruses. Togaviruses, Paramyxoviruses,

Orthomyxoviruses, Rhabdoviruses. Picornaviruses. Bunyaviruses. Arenaviruses. Arterioviruses. Caliciviruses. Filoviruses, DNA viruses: Poxviruses. Hepadnaviruses. Iridoviruses, Adenoviruses, Papovaviruses. Parvoviruses. Circoviruses. Unclassified viruses. Slow viruses - Scrapie, Flavi virus, Borna virus, Herpes virus, Asfar virus.

Unit 5: Mycology

General characteristics of fungi. Classification and study of pathogenic fungi-Epidermophyton, Microsporum, Trichophyton, Cryptococcus, Aspergillus, Blastomyces, Coccidioides, Histoplasma, Candida, Rhinosporidum, Contaminating fungi, Rhizopus, Mucor and Penicillium. Fungi causing mastitis, abortion and mycotoxicosis, Malseezia furfur.

Unit 6: Immunology

Historical Perspectives. Host-parasite relationships. Antigens. Types of antigens. Properties and specificity of antigens. Factor determining antigenicity. Haptens and carriers. Heterophile antigens. Adjuvants. Mechanisms of action, classification and their uses. Immunoglobulins – their classes and sub-classes, structure and function. Allotypes. Idiotypes. Genes coding for Igs. Generation of diversity. Monoclonal antibodies. Purification of antibodies. Theories of antibody formation. Lymphoid organs: primary, secondary and circulation of lymphocytes, cells involved in the immune response – B lymphocytes, T lymphocytes, subsets and nature of receptors. Macrophages, Dendritic reticular cells, Langerhan's cells. Cellular interactions Cell-mediated immune responses. Mechanism of interaction of antigen and antibody. The complement system. Classical and alternate pathways. Serological reactions: agglutination, precipitation, neutralization, CFT, FAT, ELISA, DIE, RIA, etc, Immunological methods as an aid to diagnosis, blotting techniques like Northern, Western blotting, Major, Histocompatibility complex: organization. Nature of antigens and MHC restriction. Hypersensitivity – immediate and delayed types, and mechanism of hypersensitivity. Mechanism of immunity, autoimmunity and immunological tolerance.

Unit 7: Molecular Cell Biology (Vaccine & Diagnostic Technology)

Role of biotechnology in diagnostics and vaccines, RNA electropherotyping. Probes - preparation of cDNA. Use of DNA probe in animal diseases diagnosis. Monoclonal antibodies. Application on monoclonal antibodies for diagnosis of animal diseases. Preparation of monoclonal antibodies. Nucleic acid hybridization. Modern trends in vaccines. Recombinant DNA vaccines and their probable use in animal diseases. Bioinformatic tools in microbial research, Biosafety, Biosecurity, GMP and GLP.

Subject: Ph.D. VETERINARY PARASITOLOGY:

Unit 1: Veterinary Helminthology

Introduction to veterinary helminthology, general account of morphology, classification, life-cycle patterns, epizootiology, pathogenesis, symptoms, diagnosis; treatment and control of parasites belonging to the various families, Identification of various snail species, laboratory rearing, dissection and general control measures against snail borne helminthosis. Vaccines and recent advances in diagnostic techniques for helminth diseases.

Unit 2: Veterinary Entomology

Introduction to veterinary entomology, classification, distributions, morphology, life-cycle, seasonal patterns and economic significance of insects and acarines belonging to the various families. Treatment, control and integrated arthropod pest management. Current advances in immunological interventions/ Control of arthropods, Vaccines and recent advances in diagnostic techniques for arthropods

Unit 3: Veterinary Protozoology

Introduction to veterinary protozoology, classification, morphology, life-cycle, clinical symptoms, pathogenesis, diagnosis, chemotherapy, prophylaxis and control of parasites belonging to the various families, Vaccines and recent advances in diagnostic techniques for protozoan diseases.

Unit 4: Clinical Parasitology

Clinical and parasitological signs of parasitic infections in domestic animals, Parasitic diseases of skin, eyes, alimentary, respiratory, urinary, genital, nervous, cardio-vascular and haematopoietic systems. Keys to identification and different diagnosis of helminthic eggs, nematode larvae, gravid proglottids of major tape worms, blood protozoans and apicomplexan group of parasites.

Unit 5: Parasitic Zoonoses

Introduction and importance of parasitic zoonoses, classification of parasitic zoonoses, geo-veterinary and epidemiological aspects including factors influencing prevalence, distribution and transmission of diseases. Role of reservoir hosts, natural habitat, wildlife and their public health significance, clinical features, pathology, diagnosis, treatment, control and prophylaxis of zoonotic parasitic infections.

Unit 6: Management of Livestock Parasitism

Factors affecting epidemiology, host environment, development and survival of infective stages, microhabitat, seasonal development (hypobiosis/diapause), dietary and host factors altering susceptibility, concurrent infections. Influence of genetic factors, general approaches to control of parasitic diseases – stock management practises, stock rates, rotational grazing, clean grazing. Parasite worm burden (EPG). Strategic and tactical control strategies involved in chemical control of helminth, protozoan and arthropod infestations. Broad and narrowspectrum anthelmintics, antiprotozoal drugs, insecticides and acaricides. Newer drug delivery systems-slow and pulse release methods. Anthelmintic failure – drug resistance monitoring and management. Prospects of alternative methods of control, breeding for host resistance against parasites. Control of vectors and intermediate hosts and sustainable management. Estimation of economical losses due to parasitic diseases.

Unit 7: Immunoparasitology

General principles of parasitic immunity and immune responses to helminths, protozoa, arthropods – The adaptive immune responses, evasion of immunity, classical antiparasite responses – concomitant immunity, premunition, spring-rise, self-cure, VLM, CLM, parasitic granuloma, nodule formation, Hypersensitivity reactions to parasitic diseases. Parasitic antigens relevant to immunity and diagnosis, their identification and purification-general protocols, immunomodulators and their use in immunopotentiation. Demonstration and characterisation. Development of live, attenuated, killed and new generation vaccines.

Unit 8: Diagnostic Parasitology

Laboratory diagnostic procedures for parasite identification and detection, coprodetection techniques, floatation/concentration, methods, direct microscopy, parasitic staining and special techniques used in parasite identification. Culture and identification of nematode larvae, cercaria, identification of metacestodes and animal infestation, methods for parasite isolation. Diagnostic procedures for manage and bot infestations. General immunodiagnostic assays (ELISA, IFAT, Dot-ELISA, EITB). Principles of validation of diagnostic assays, and OIE recommendations for diagnosis and knowledge of referral laboratory of O.I.E. and molecular techniques used in parasite epidemiology and diagnosis.

Subject: Ph.D. VETERINARY PATHOLOGY:

Unit 1: Introduction, History and Etiology

Introduction, history and scope of pathology. Definitions. Etiology of the disease. Predisposing factors, intrinsic and extrinsic factors responsible for the disease. Physical agents, mechanical injuries. Heat, cold and decreased atmospheric pressure, light (photosensitization) UV light, microwaves, electricity, chemical agents-exogenous chemicals (toxin, poisons, drugs and food

substances), endogenous chemicals (metabolites, cytolytic or inhibitory immune complexes, free radicles, oxidants)

Unit 2: Haemodynamics Derangements, Degeneration and Necrosis

Disturbances of circulation/haemodynamic derangements hyperaemia, ischaemia, haemorrhage, sludged blood, thrombosis, embolism, infarction, oedema and shock. Disturbances of cell metabolism – protein, carbohydrate and lipid metabolism, pigment metabolism, pathological calcification / ossification. Apoptosis, necrosis, gangrene. Ultrastructural changes in cell organelles in haemodynamic derangements and cell metabolic disturbances.

Unit 3: Inflammation and Healing

Inflammation – definitions associated with inflammatory phenomenon, etiology of inflammation, cardinal signs, pathogenesis of inflammation, chemical mediators released from injured tissues and inflammatory cells. Cellular reponse in inflammation, structure and functions of cells associated with inflammation. Role of humoral and cell mediated defenses. Various classifications of inflammation. Healing, cellular regeneration capability of different body cells. Role of cells (macrophages, fibroblasts, myofibroblasts, endothelial cells), extracellular matrix components and growth factors in healing.

Unit 4: Immunopathology

Immunopathology – anibody and cells, immuno-competence of foetus and new-born. Immune mediated tissue injury, hypersensitivity reactions- anaphylaxis, Arthus reaction, cyototoxic antibody reaction, immune complex disease, delayed hypersensitivity to chemicals, immunodeficiency diseases, defective immuno-competence, autoimmune diseases.

Unit 5: Genetically Determined Diseases

Genetic abnormalities, aberrations of chromosomes, mosaicisi, chimerism, anomalies in sex chromosomes and it autosomal chromosomes. Pathological states determined by one or more genes, lethal genes.

Unit 6: Disturbances in Cell Growth and Oncology

Disturbance in cell growth – aplasia, hypoplasia, hyperplasia, atrophy, metaplasia, dysplasia. Neoplasms-growth, etiology, classification, morphology, and behaviour of the neoplasms, structure and biology of the tumor cell, tumor immunology, tissue response to tumors, spread of tumors, pathological features of various neoplasms.

Unit 7: Post-mortem Diagnosis and Histopathological Techniques

Post-mortem examination as a diagnostic tool. Post-mortem techniques for different species including poultry, post-mortem changes, lesions in various organs in different diseases, identification and interpretation of lesions, preparation of necropsy reports. Handling of necropsy in vetero-legal cases, collection, preservation and dispatch of materials for diagnosis. Fixation and processing of tissues for histopathology and histochemistry. Different staining techniques. Histochemistry and histoenzymology as diagnostic tools. Principles of electron microscopy, processing of tissue for scanning and transmission electron microscopy.

Unit 8: Clinical Pathology

Clinical laboratory examination of various biomaterials from different livestock species, complete blood counts, serum enzymology, bone marrow examination, erythrocytes, leucocytes and platelet disorders and their interpretations. Electrolyte and acid base analysis, altered electrolyte concentrations and their interpretations, fluid accumulation disorders, examination of effusions (chemistry and exfoliative cytology). Complete examination of urine, skin scrapings stools, CSF and milk for pathological constituents and interpretation of results.

Unit 9: Systemic Pathology

Pathology of cardiovascular, haemopoietic, respiratory, digestive, urinary, genital, nervous and musculoskeletal systems, endocrine glands, organ of special senses i.e, eye, ear, skin, appendages.

Unit 10: Pathology of Infectious Diseases

Pathology of bacterial, mycotic, viral, mycoplasmal, rickettsial, chlamydial and parasitic diseases. Diseases caused by prions.

Unit 11: Avian Pathology

Farm placements and building in relation to disease, management and nutrition in relation to disease. Biosecurity in the control of diseases. Stress and its effects. Omphalitis and yolk sac infection, Newcastle disease, infectious bronchitis, infectious laryngotracheitis, viral arthritis, infectious bursal disease, egg drop syndrome, inclusion body hepatitis and hydropericardium syndrome, infectious stunting syndrome, swollen head syndrome, Marek's disease, avian leucosis/sarcoma complex, salmonellosis, pasteurellosis, mycoplasmosis, chlamydiosis, colibacillosis, spirochaetosis, aspergillosis, thrush, mycotoxicosis, parasitic diseases – nematodes, cestodes and protozoa, nepherosis/nephritis syndrome, multi-etiology syndromes. Immunosuppression and conditions/diseases associated with it. Vaccinations against various diseases, their failures and remedies.

Unit 12: Nutritional and Production Pathology

Pathology of nutritional deficiency disease – protein, carbohydrate, mineral and vitamins. Concept of production diseases – pathology of milk fever, ketosis, magnesium tetany, rumen indigestion, nutritional haemoglobinuria.

Unit 13: Pathology of Toxicosis

Clinico-pathological features of toxicosis due to heavy meals, mycotoxins, insecticides, pesticides, toxic plants, chemicals and drugs.

Unit 14: Pathology of Diseases of Laboratory and Wild Animals

Etiopathology of common diseases of laboratory and wild animals.

Subject: Ph.D. VETERINARY PHARMACOLOGY & TOXICOLOGY:

Unit 1: General Pharmacology

Development and Scope, branches of pharmacology,Terminology, Sources and nature of drugs. Pharmacopoeia and drug compendia.Drug Schedules.Factor modifying drug activity. Concepts of pharmacogenetics, pharmacogenomics Gene based therapy, overview of indigenous medicinal plants its active principles in therapeutic use. Pharmacodynamics: Drug structure activity relationship. Drug receptor interaction.Role of secondary messengers.Drug modulation via different types of channels.Characterisation of agonist, antagonists. Pharamacokinetics: Principles, Drug absorption, distribution, metabolism and excretion. Factors modifying drug kinetics.Kinetic constants. Different models, determination of kinetic parameters and application in rational dosage regimen. Pharmacometrics:Drug discovery and development process. Multidimensional screening methods, bioassays.Determination of median doses – LD50, ED50, therapeutic indices.Types of dose response relationship.

Unit 2: Drugs Acting on Central Nervous System

Role of neurotransmitters in CNS. Sedatives, Hypnotics, General anaesthetics, Hypotheses and clinical stages of anaesthesia. Pre-and post-anesthetics, Molecular mechanism of action of inhalant and parenteral anesthetics. Anticonvulsants. Tranquilizers. Narcotic and non-narcotic analgesics and antipyretics. Drugs affecting behaviour. Drug dependence and addiction and abuses. CNS stimulants. Muscle relaxants. Local anaesthetics.

Unit 3: Drugs Acting on Humoral and Autonomic Nervous Systems

Neurohumoral transmission. Adrenergic and antiadrenergic drugs including adrenergic neuron blockers. Cholinergic and anticholinergic drugs. Purinergic and Adenosine receptors. Dopaminergic and antido paminergic agents. Nitric oxide mediators. Neuromuscular and ganglion stimulants and ganglion blockers.

Unit 4: Drugs Acting on Cardio-vascular and Respiratory Systems

Drugs acting on heart and blood vessles. Antihypotensive and anti-arrhythmic agents.Blood coagulants and anticoagulants. Heamatinics. Haemorrhagic shock and its treatment. Expectorants, antitussives. Cough sedatives. Bronchodilators. Mucolytic agents. Analeptics.

Unit 5: Drugs Acting on Digestive System

Stomachics. Antacids. Carminatives and antizymotics. Emetics and antemetics.Cathartics. Antidiarrhoeal agents. Antispasmodics. Pharmacology of rumen and rumenotoric drugs. Drugs acting on hepatobiliary system.

Unit 6: Drug acting on Urogenital System

General principles of electrolyte therapy. Drugs altering fluid balance. Diuretics and antidiuretics. Drugs acting on uterus (oxytocics and tocolytics).Therapy of infertility and improving conception and synchronization of oestrus.

Unit 7: Endocrine Pharmacology

Mode of action and synthesis of pituitary hormones. Therapeutics of non-pituitary gonadotropin, adrenocorticoids, sex hormones, insulin, thyroid hormones, antithyroid agents, calcitonin, parathormone.

Unit 8: Autacoids

Pharmacological effects and therapeutics of histamine, antihistaminic agents, 5-HT its antagonists, prostaglandins and leukotrienes, peptides and kinins, rennin and angiotensins. Platelet activators. Anti-inflammatory drugs.

Unit 9: Chemotherapy

General principles. Classification of antibiotics based on chemistry, mechanism of action, etc., Drug allergy, hypersensitivity, mechanism of resistance development. Veterinary drug residues and its impacts. Extra label usage of antibiotics. Withdrawal period for antibiotics. Antiseptics and Disinfectants. Antibiotics: beta lactams (Penicillin, cephalosporins, etc.) protein synthesis inhibitors (aminoglycosides, tetracyclines, chloramphenicol and macrolide/lincosamides, Quinolones, nitrofurans, polypeptide and other miscellaneous and emerging antibiotics. Sulphonamides, thrimethoprim and derivatives.Antifungal, antitubercular, antiviral and antineoplastic drugs.Anthelminitic: Antinematodal, anticestodal, antitrematodal drugs. Antiprotozoans, Anticoccidials. Drugs used for ectoparasite control.

Unit 10: Toxicology

Terminology. Classification of poisons. Toxicity rating. Principles of selective toxicity. Toxicodynamics. Toxicokinetics. Diagnosis and treatment of poisoning (anti-dotal and non-antidotal).Mechanism of detoxification. Poisons causingrespiratory insufficiency. Toxicology of common inorganic compounds. Toxicity of metals, nonmetals and metalloids. Poisonous plant-cyanogenic, nitrate and oxalate producers. Mycotoxins : aflatoxin, rubratoxin, ergot. Toxic ferns. Venoms from snakes, scorpions, toads, etc. and treatment.

Unit 11: Ecotoxicology

Toxicity of pesticides, fungicides, weedicides, fertilizers on biosphere. Chemical warfare agents and radiation hazards. Toxicity from food additives, preservatives. Statutory regulation on agrochemical formulation and their uses. Recent advances in evaluation of cytotoxicity, immunotoxicity, teratogenicity, mutagenicity, embroyotoxicity.

Unit 12: Miscellaneous Topics

Drugs promoting growth and production. Agents used for doping and restraining of wild animals. Euthanising agents. Drug control and regulation.

Subject: Ph.D. VETERINARY PHYSIOLOGY:

Unit 1: Cellular Basis of Animal Physiology

Animal cell ultra-structure, composition and functions. Physio-chemical laws and membrane phenomena. Body fluid and its dynamics. Transport through biological membranes.

Unit 2: Blood and Circulation

Composition of blood, structure & functioning of its constituents. Hematopoiesis. Blood coagulation and anticoagulants. Hemoglobin and its polymorphism. Anaemias. Reticulo-endothelial System. Body defense mechanism and immunogenesis. Electrophysiology of heart. Electro-cardiography – Principles and interpretation. Hemodynamics and concerned biophysical principles. Capillary fluid exchange, microcirculation and lymphatic circulation. Neural and humoral control of heart and blood vessels. Cardiac Output and vascular reflexes. Autoregulation mechanism in the heart, Regional circulation – coronary, pulmonary, cerebral, muscle, kidney and skin. Blood brain barrier. Circulatory shock and hypertension and cardiac failure.

Unit 3: Respiration

Mechanics of respiration. Neural and chemical control of respiration. Lung capacity and volumes. Gaseous transport and exchange. Hypoxia. Physiology of hypo-barrism and high altitude. Work and exercise physiology.

Unit 4: Excretion

Modern concepts of urine formation. Control of renal circulation. Secretion and absorption in renal tubules. Regulation of acid-base balance by blood buffers, lungs and kidneys. Hormonal and renal regulation of body fluids dynamics and electrolyte balance. Physiology of micturition. Uremia and other renal disorders.

Unit 5: Digestion

Control of motility and secretion of alimentary canal. Gastric hormones and reflexes in the control of digestive functions. Control of rumen motility. Digestion in ruminant and monogastric animals. GI motility and absorption from rumen and the digestive tract. Manipulation of rumen microflora to enhance fibre digestion and microbial protein synthesis. Nitrogen recycling and rumen bypass mechanisms. Post-ruminal digestion. Physiology of rumen disorders.

Unit 6: Muscle Physiology

Muscle types and their intra-cellular contractile mechanisms. Electrophysiology of muscles. Neuromuscular junction. Excitation contraction coupling, its biochemical and ionic mechanisms. Molecular basis of muscle contraction. Rigor mortis and muscle fatigue.

Unit 7: Nervous System

General organization of nervous system. Neurone structure and function. Excitability and

transmission of impulse in neuron and muscle. Junctional transmission. Neuro-transmitters. Reflex action. Initiation of impulses from sense organ/receptors. Functions of spinal cord, brain stem and cerebellum. Limbic system and cerebral cortex. Hypothalamus and its autonomic functions in endocrine and visceral regulation. Ascending and descending tracts. Cerebral cortex, its role in motor and sensory functions. Physiology of learning and memory. Physiology of pain. Special senses (hearing, vision, taste, smell etc.).

Unit 8: Endocrinology

Hormones. Hormone receptors. Mechanism of hormone action at cellular and subcellular levels. Feedback control of hormone secretion. Hypothalamic – hypophyseal axis. It should include (i) Hypothalamic – hypophyseal axis controlling secretions from thyroid, parathyroid, adrenal and gonads, (ii) Endocrine control of general metabolism. Hypothalamic releasing and inhibiting factors. Pineal gland and its hormones. Hormones of hypophysis and all other endocrine glands. Mechanisms of different hormone actions. GI hormones. Endocrine disorders.

Unit 9: Reproduction and lactation

Gonadal hormones and their functions in male and female. Neuroendocrine-gonadal axis and feedback regulation. Male spermatogenesis. Accessory sex glands. Sexual behaviour erection, ejaculation etc. Semen evaluation. Factors affecting reproduction. Artificial insemination – collection, preservation and transport and semen diluents. Freezing of semen. Oogenesis. Follicular development. Ovulation. Corpus luteum. Reproductive cycles in animals. Factors affecting reproductive cycles. Female reproductive hormones. Oestrous synchronization, super-ovulation. Sperm capacitation and acrosomal reaction. Sperm and ovum transport in female genital tract. Fertilization. Implantation. Maternal recognition of pregnancy, Maintenance of pregnancy and its hormonal control. Physiology of placenta. Physiology of parturition and its hormonal control. Embryo transfer – collection, preservation, transport and transfer of embryos. Oocyte culture. In vitro fertilization. Mammary gland growth before puberty, during pregnancy and after parturition and its hormonal control. Lactation-Hormonal control of mamogenesis, lactogenesis and galactopoiesis. Milk let-down and persistency of milk secretion. Physiology of cessation of lactation and transition period. Physiology of cessation of lactation and transition period. Physiology of cessation of lactation and transition period. Mammary gland involution. Milk precursors, synthesis of milk constituents and factors affecting it. Mastitis Methods of studying mammary uptake of nutrients, Ultrastructure of lactating mammary gland. Milk composition in different animals.

Unit 10: Physiology of Growth

Concept and definition. Growth regulation and factors affecting prenatal and post-natal growth. Role of growth in production. Growth curve and growth measurement, body conformation.

Unit 11: Climate Physiology

Physiology of climatic stress. Adaptation and acclimatization. Effects of stress on production and reproduction. Neuro-hormonal regulation of body temperature in homeotherms. Mechanism of adaptation. Photoperiodicity and biological rhythms. Design of shelters / animal houses for different class of livestock for different climate conditions. Heat stress alleviation tools, physiological and biochemical markers of thermal stress.

Subject: Ph.D. VETERINARY PUBLIC HEALTH & EPIDEMIOLOGY:

Unit 1: Veterinary Public Health

Definitions, concept of Public Health, Intersectoral approach to Human Health, Veterinary Medicine, Veterinary Public Health, Human health goals, veterinarians participation in public health and justifications, Veterinary Public Health Unit – its dimensions and functions, National and International organizations related with Public and Veterinary Public Health, Rural health,

Role of Public Health Veterinarians in Public Health, Health Delivery System.

Unit 2: Milk Hygiene

Definitions, Dairy Industry and milk hygiene in India and other countries, Microbiology, of milk and milk products, microbial spoilage of milk and its products, Bacteriophage, Contamination of milk and its products, Public health aspects of residues: agricultural chemicals, antibiotics and drugs, toxic metals, plant toxins, mycotoxins and adulterants, Milk borne diseases, Milk hygiene, Hygienic aspects of production of milk and processing and manufacture of milk products, Clean milk production, Prevention of contamination by sanitation at dairy farm, collection centers, milk processing and manufacturing plants. Pasteurization, Sterilization, Standards. Quality control tests applied to milk and milk products.

Unit 3: Meat Hygiene

Definitions, Meat industry and meat hygiene in India and other countries. Raising meat food animals and birds, their trade and transport. Hygienic aspects of slaughter, bleeding, dressing and processing and manufacture of carcass meat and meat products. Rigor mortis, Emergency and causality slaughter. Abattoir/ Meat plant Sanitation, Microbiology of meat and their products. Sources of contamination, Disposal and reclamation of slaughterhouse wastes and by-products and associated public health problems. Spoilage of meat and meat products, Preservation of meat. Meat food safety, Ante mortem and post mortem examination, Inspection of poultry meat, eggs, fish and meat from game animals, Judgment, Indices of sanitary quality, National and International standards, Bacteriological, serological and biochemical tests for quality control, substitution and adulteration.

Unit 4: Food-borne Infections and Intoxications

Definitions, Classifications of Food borne diseases, Meat-borne diseases, Milk-borne diseases, Infections and intoxications traced to consumption of fish/eggs, Fast/Street/Convenience foods, Epidemiological characteristics of food-borne infections and intoxications, Sources of pathogens and factors favouring for poisoning, bacterial, viral, protozoan, helminthic, mycotic and chemical food poisoning, Epidemiological investigation of food-borne infections and intoxications, Food specific attack rate. Odd ratio, Detection of foodborne pathogens and their toxins. Management of food poisoning.

Unit 5: Zoonoses

Definitions, Concept and classification of Zoonoses, Ecological aspects of Zoonoses, Wild animals-, cold blooded animals - domestic animals -, and aquatic life, -associated Zoonoses, Vectors-, milk-, meat-, egg-, fish- and waterspread Zoonoses, Occupational zoonoses, Nosocomial zoonoses, xenozoonoses, Nationally and internationally emerging and re-emerging Zoonoses, Epidemiology of bacterial, rickettsial, viral, parasitic and mycotic Zoonoses, Principles of Zoonoses management: methods of prevention, control and eradication of Zoonoses.

Unit 6: Environmental Hygiene

Natural sources of water, water hygiene, Pure and wholesome water; microbial contamination and chemical pollution of water, Impurities in water, plankton, Purification and sanitization of water, Waterborne diseases, Microbiological examination of water, Potable water, Standards for drinking water. The atmosphere. Air Pollutants, Air-borne pathogens and diseases, Ventilation, Methods of air purification. Agricultural chemicals, industrial wastes, domestic and farm effluents polluting environment – and associated hazards and preventive measures. Antibiotic and pesticide residues and their effect on health. Waste-recycling, Methods of disposal of dead animals. Rodents and Vector control measures.

Unit 7: Epidemiology

Definitions, Epidemiology, Epizootiology, Causal association, concept of infection, Theory of natural nidality, Ecological basis of diseases, Disease transmission, Epidemic process, Distribution of diseases in space and time, Epidemiological hypothesis, Types of epidemiological studies, Epidemiological survey, surveillance, monitoring of diseases, experimental epidemiology, epidemiological measurements, Predictive epidemiology, Epidemiological models, Sero-epidemiology. Use of information technology and computer applications in disease monitoring, Epidemiological investigation and evaluation of intervention measures. Scope of Epidemiology: Definitions, uses, components, subdisciplines and types of epidemiology, Concept of causality and epidemiological hypothesis, Measures of describing disease occurrence and frequency in animal populations, epidemiological rates and ratios, Determinants of disease, epidemiological triad, Transmission and maintenance of infection, ecology of disease and landscape epidemiology, Patterns of disease, Survey of animal disease , surveillance and monitoring, Data collection, management ,storage, retrieval and presentation, Epidemiological studies: observational and experimental, Serological epidemiology, Economics of animal disease, Control and eradication of disease, Use of information technology and computer applications in disease monitoring, Epidemiological investigation and evaluation of intervention measures.

Unit 8: Experimental Animal Medicine

Occupational health and safety in the care and use of research animals. Breeding, care and management of experimental animals, Production of gnotobiotic, germfree, specific pathogen free, transgenic, syngenic animals and tailor-made animals in relation to public health, provisions of Animal welfare and Society for Prevention of Cruelty to Animals Act.

Unit 9: Health Education

Health education, communication techniques, Participatory programmes for awareness creation among agricultural workers, butchers, laboratory staff and those engaged in zoological gardens, laboratory animals rearing, processing of animal produce about occupational hazards and hazards to consumers.

Unit 10: Standard Guidelines and Legislation

Definitions, standards/guidelines of products and product ingredients. Hazards Analysis Critical Control Points (HACCP), Good Manufacturing Practices (GMP), Good Laboratory Practices (GLP), Milk and Milk Product Order (MMPO), Meat Food Products Order (MFPO), Total Quality Management (TQM), Quality assurance and food safety management systems, Bureau of Indian Standards, International Organization for Standards, Codex Alimentarius, World Trade Order, Sanitary and Phyto-sanitary (SPS) measures, Technical Barriers to Trade (TBT), National and International Standards related to milk, meat, fish and their products and hygienic standards to ensure safety to domestic and foreign consumers of products of animal origin.

Unit 11: Microbiology in Public Health

Food microbiology, Characters of food bacteria, moulds, yeast and virus, Classifications of food microbes according to their requirements for growth – temperature, acidity, moisture, oxygen and salt concentration, resistance to microenvironment, Food processing and preservation methods. Pathogen- virulence factors, microbial enzymes, toxic metabolites and other molecules associated with pathogenic mechanisms. Resistance mechanism of survival in environment in and outside the host, Antigens eliciting protective and diagnostic antibodies, Microbiological, Serological, Biological and Nucleotide based diagnostic methods. Issues on bioterrorism.

Subject: Ph.D. VETERINARY SURGERY AND RADIOLOGY:

Unit 1: General Surgery

Current concepts of inflammation and its management. Asepsis and antisepsis in surgery.Disinfection and sterilization.Surgical bacteriology.Pre-, Peri and post-operative considerations.Physiopathology of burns, trauma, surgical stress and shock.Haemorrhage, haemostasis and administration of whole blood, blood extracts and plasma substitute. Acid – base and electrolytes imbalance. Rehydration and fluid therapy. Tissue repair including its biochemical aspects. Principles of tissue and organ transplantation.Tissue transplantation immunity.Sutures and suture materials.Operation theatre management. General surgical affections viz..abscess, cyst, haematoma, tumour, gangrene, sinus, fistula and hernia. Neurological examination, paralysis and its treatment.Surgical instrumentations. Care of critically ill patients. Cosmetic surgery.Skin grafting techniques in animals.

Unit 2 :Anaesthesia

History and instrumentation. Pre-anaesthetic considerations of patient.Selection of various anaesthetic and preanaesthetic agents and their effects on different body organs.Inhalant and non-inhalant anaesthetic agents including dissociative, neurolept and balanced anaesthesia and their administration in small and large animals.Monitoring of patient during anaesthesia.Anaesthetic emergencies and their management. Muscle relaxants. Local anaesthetic agents.Local and regional anaesthetic procedures.Anaesthesia for special surgical procedures and special disease conditions.Electronarcosis.Hypothermia. Acupuncture analgesia. Anaethesiaand methods of capture of zoo animals.Therapeutic usage of local anaesthetic agents and techniques.Methods of artificial ventilation.

Unit 3 : Radiology

Production and quality of X-rays; exposure factors and formulation of technique chart. Basics of radiation physics.Interaction of particulate and non-particulate radiations with matter.Radiographic artifacts and their prevention.Radiographic quality and factors affecting it. Radiographic features of diseases of musculo-skeletal, digestive, urogenital, cardiovascular, respiratory and lymphatic system of small and large animals. Radiation hazards.Radiation biology including its mechanism of action and effects on various organ systems.Radiation protection.Radiological contrast agents and common contrast radiographic procedures.Principles of radiotherapy and physiotherapy. Invasive and non-invasive imaging modalities viz. echocardiography, computed tomography, scintigraphy, magnetic resonance imaging, ultrasonography and subtraction angiography.

Unit 4 :Orthopaedics and Lameness

Physiological and biochemical considerations of bone. Osteogenesis and mineralization of bone. Bone research techniques.Circulation of long bones.Biomechanics of fractures. Etiology, classification and healing of fracture; factors affecting fracture healing. Complications of fractures and their management.Methods of internal and external fixations of fracture and factors

governing selection of fixation methods.Effect of various internal fixation methods on physiology and blood circulation of bone. Bone grafts. Metallic and non-metallic materials in bone surgery and their biological behaviour.Surgical affection of vertebral column.Etiology, pathophysiology, diagnosis and treatment of affections of bones and joints.Technique of arthroscopy.Lameness and allied surgical conditions of fore and hind limbs. Various foot diseases. Affections of tendons, ligaments and their management.Relationship between conformation of the limbs, foot and its axis to soundness. Soundness and examination of horse for soundness

Unit 5 : Surgery of Head and Neck Region

Etiology, diagnosis and surgical management of the affections of sinuses, horn, nasal and

buccal cavity, teeth, tongue, salivary glands, larynx, pharynx, trachea and oesophagus. Surgical affections of eye lids, lacrimal apparatus, nictitating membrane, conjunctiva, cornea, sclera, chloroids, iris, retina, lens, optic nerve, aqueous and vitreous humours and other parts of eye and their management.Surgical affections and management of ear and guttural pouch.

Unit 6 : Thoracic Surgery

Various approaches for thoracic surgery in large and small animals. Physiological alterations following thoracotomy.Heart lung machine and its use in thoracic surgery.Different congenital and acquired surgical affections of thoracic wall and thoracic organs viz. lung, mediastinum, oesophagus, heart and diaphragm in large and small animals.Surgical diseases of the vascular and lymphatic systems.

Unit 7 : Abdominal and Pelvic Surgery

Different surgical approaches for abdomen. Hernia: etiology, pathophysiology and treatment. Various acquired and congenital surgical affections of abdominal organs viz. Traumatic reticulitis, abdomasal displacement, impaction of omasum, pyloric stenosis, gastric torsion, caecal dilation, intestinal obstruction, rectal and anal prolapse, and peritonitis. Colic in horse:- etiology, diagnosis and treatment. Affection of liver, spleen, kidney and urinary bladder their complications and surgical management.Urolithiasis, uraemia and their management.Surgery of male and female genital organs.Etiology, diagnosis and surgical management of the affections of udder, teat and tail.

Horticulture and Forestry

Subject: Ph.D. POST-HARVEST MANAGEMENT:

Unit 1: Post-Harvest Technology of Vegetable Crops

Scope and importance of post-harvest management of vegetables;Nature and causes of post-harvest losses; Maturity indices and standards for different vegetables; methods of assessment of maturity, physiological and biochemical changes during maturity and ripening, enzymatic and textural changes, ethylene evolution and ethylene management, respiration, transpiration, regulation methods; Influence of pre-harvest practices and other factors affecting shelf life and post-harvest quality;Harvesting methods, tools, harvesting practices for specific market requirements; pre cooling methods; grading, washing,pack house operations, pre treatments-chemicals, wax coating, edible coating, pre packaging and irradiation; packaging of vegetables, packaging materials; Storage methods - ventilated, refrigerated, MA, CA storage, hypobaric storage, cold storage, zero energy cool chamber; Storage disorders -chilling injury in vegetables, post-harvest diseases and pests - prevention from infestation; principles of transport; food safety standards and export standards.

Unit 2: Post-Harvest Technology of Fruit Crops

Scope and importance of post-harvest management of fruits; Factors leading to post-harvest losses; Maturity indices, methods of assessment of maturity, harvesting practices and grading for specific market requirements; Physiological and biochemical changes during maturity and ripening, ethylene evolution and ethylene management; enzymatic and textural changes, respiration, transpiration; Influence of pre-harvest practices and other factors affecting shelf life and post-harvest quality;Harvesting methods, tools, harvesting practices for specific market requirements; Pre cooling methods; grading, washing, pack house operations, pre treatments treatment prior to shipment, viz., chlorination, waxing, chemicals, bio-control agents and natural plant products, fungicides, hot water, vapour heat treatment, sulphur fumigation and irradiation; Pre packaging and irradiation, packaging of fruits, packaging materials; Storage methods - ventilated, refrigerated, MAS, CA storage ; Physical injuries and disorders; Transportation and marketing standards for international markets, quality evaluation,principles and methods of preservation, food processing, canning, fruit juices,

beverages, pickles, jam, jellies, candies; Dried and dehydrated products, nutritionally enriched products, fermented fruit beverages, packaging technology, processing waste management, food safety standards and export standards.

Unit 3: Value Addition of flowers

Prospects of value addition; National and global scenario, production and export; Women empowerment through value added products making, supply chain management; Types of value added products, value addition in loose flowers, garlands, veni, floats, floral decorations; Value addition in cut flowers, flower arrangement, styles, ikebana, morebana, free style, bouquets, button-holes, flower baskets, corsages, floral wreaths, garlands, floral craftsetc.;Selection of containers and accessories for floral products and decorations; Aromatherapy, pigment and natural dye extraction techniques;Dry flowers – Identification and selection of flowers and plant parts; Raw material procurement, preservation and storage; Techniques in dry flower making – Drying, bleaching, dyeing, embedding, pressing; Accessories; Designing and arrangement – dry flower baskets, bouquets, pot-pourri, wall hangings, button holes, greeting cards, wreaths; Packing and storage; Concrete and essential oils; Selection of species and varieties (including non-conventional species), extraction methods, Packaging and storage, Selection of species and varieties, Types of pigments, carotenoids, anthocyanin, chlorophyll, betalains; Significance of natural pigments, Extraction methods; Applications ; Export standards.

Unit 4: Processing of Plantation Crops, Spices, Medicinal and Aromatic Plants

Prospects of processing and value addition, National and global scenario, production and exports; Commercial uses of spices and plantation crops. Processing of major spices - cardamom, black pepper, ginger, turmeric, chilli and paprika, vanilla, cinnamon, clove, nutmeg, allspice, coriander, fenugreek, curry leaf. Extraction of oleoresin and essential oils; Processing of produce from plantation crops, viz. coconut, arecanut, cashewnut, oil palm, palmyrah, date palm, cocoa, tea, coffee, rubber etc; Processing of medicinal plants– dioscorea, gloriosa, stevia, coleus, ashwagandha, tulsi, isabgol, safedmusli, senna, aloe, catharanthus, etc. Different methods of drying and storage. Microbial contamination of stored product. Influence of temperature and time combination on active principles; Extraction and analysis of active principles using TLC/HPLC/GC. Distillation, solvent extraction from aromatic plants– davana, mint, rosemary, rose, citronella, lavender, jasmine, etc. Extraction of aroma compounds and aromatherapy; Extraction of pharmaceutical and neutracutical compound from medicinal and aromatic crops; Application of nano technology in medicinal and aromatic plants. Applications; Export standards.

Subject: Ph.D. AGRO-FORESTRY:

Unit 1: Forests and Forest Policy

Forests-extent, basis for classification and distribution in India; Geographical distribution and salient features of major world forest types; Phylogeographical regions and vegetation of India; Role of forests in national economy - productive, protective and ameliorative, tribal and rural livelihoods; Forest types of India: distribution and types; Succession, climax and retrogression; Concepts of biomass, productivity, energy flow and nutrient cycling in forest ecosystem; Migration and dispersal mechanism.

National Forest Policy 1894, 1952 and 1988 ; Indian Forest Act, 1927; Forest Conservation Act,1980 and Wildlife Protection Act, 1972; Amendments 1991, 2003 and 2006, Biological Diversity Act, 2002, The Scheduled Tribes and Other traditional forest dwellers (Recognition of Forest Rights) Act, 2006. National Agroforestry Policy, 2014

Unit 2: Silviculture

Definition, object and scope of silviculture; Site factors - climatic, edaphic, physiographic, biotic and their influence on forest vegetation; Forest regeneration: natural and artificial; Silvicultural systems - high forest and coppice systems; Seed collection, processing, storage, viability and pre- treatment; Seed dormancy and methods for breaking dormancy; Seed testing and germination tests; Seed certification and ISTA Rules; Forest nursery - need, selection and preparation of site, layout and design of nursery beds; Types of containers; Root trainers; Growing media and sowing methods; Management of nursery-shading, watering, manuring, fertilizer application, weed control, insect pest and diseases control; Planting techniques: site selection, evaluation and protection; Soil working techniques for various edaphic and climatic conditions; Planting patterns; Plant spacing, manure and fertilizer application, irrigation/moisture conservation techniques; Choice of species. Afforestation on difficult sites: saline-alkaline soils, coastal sands, lateritic soils, wetlands, ravines and sand dunes, dry and rocky areas, cold desert; Tending operations - weeding, cleaning, climber cutting, thinning - mechanical, ordinary, crown and selection thinning, improvement felling, pruning and girdling;Silviculture of important tree species- Populus, Eucalyptus, Dalbergia, Acacia, Tectona, Shorea, Prosopis, Casuarina, Pinus, Gmelina, Azadirachta, Diospyros, Pterocarpus, Anogeissus, Santalum, Quercus and Albizia, bamboos, Melia dubia, Ailanthus excelsa , Simarouba and Karanja. Plantation forestry – industrialand energy plantations

Unit 3: Forest Biology and Tree improvement

Tree improvement: nature and extent of variations in natural population; Natural selection; Concept of seed source/ provenance; Selection of superior trees; Seed production areas, exotic trees, land races; Collection, evaluation and maintenance of germplasm; Provenance testing. Genetic gains; Tree breeding: general principles, mode of pollination and floral structure; Basics of forest genetics - inheritance, Hardy weinberg Law, genetic drift; Aims and methods of tree breeding. Seed orchard: types, establishment, planning and management, progeny test and designs; Clonal forestry - merits and demerits; Techniques of vegetative propagation, tissue culture; Role of growth substances in vegetative propagation.

Unit 4: Forest Mensuration

Forest mensuration - definition, object and scope; Measurement of diameter, girth, height, stem form, bark thickness, crown width and crown length; Measurement methods and their principles. Measurement and computation of volume of logs and felled/standing trees; Construction and application of volume tables; Biomass measurement; Growth and increment; Measurement of crops; Forest inventory: kinds of enumeration, sampling methods, sample plots and aerial photo interpretation; Geographic information systems and remote sensing - concept and scope.

Unit 5: Social forestry and Agroforestry

Social forestry, community forestry and farm forestry; Concept and definition of agroforestry, Benefits and constraints of agroforestry; Historical development of agroforestry and overview of global agroforestry systems. Classification of agroforestry systems: structural, functional, socio-economic and ecological; Diagnosis and design of agroforestry system; Land capability classification and land use; Criteria of an ideal agroforestry design, productivity, sustainability and adoptability; Multipurpose tree species and their characteristics suitable for agroforestry.

Unit 6: Agroforestry management

Plant management practices in agroforestry; Tree-crop interactions: ecological and economic; Concept of complementarity, supplementarity and competition; Productivity, nutrient cycling and light, water and nutrient competition in agroforestry; Concept of allelopathy and its impact on agroforestry; Agroforestry practices and systems in different agro - ecological zones of India..

Unit 7: Wood Science and Forest Products

Logging and ergonomics- wood anatomy, wood seasoning and preservation techniques; Forest Products and utilization- Manufacturing and utilization of wood products (timber and composite wood)and non-wood forest products such as fibres, flosses, dyes, gums, resins & tannins, medicinal plants, essential oils, edible fruits, spices, bamboo and canes.

Unit 8: Forest Degradation and Protection

Extent and causes of land denudation; Effects of deforestation on soil erosion,land degradation. Wastelands: their extent, characteristics and reclamation; Watershed management and its role in social, economic and ecological development; Forest fires: causes, types, impacts and control measures; Major forest pests, diseasesand weeds and its management.

Unit 9: Forest Management and Forest Economics

Forest management: definition and scope; Concept of sustained yield and normal forest; Rotation; Estimation of growing stock, density and site quality; Management of even aged and uneven aged forest; Regulation of yield in regular and irregular forests by area, volume, increment and number of trees; land equivalent ratio; Working plan; Joint forest management; Conservation and management of natural resources including wildlife; Forest evaluation; Internal rate of return, present net worth and cost benefit analysis.Ecosystem services. Economic evaluation of agroforestry systems: cost benefit analysis and land equivalent ratio

Unit 10 : Wildlife

Wildlife biology, ornithology, herpetology, wild life management - Population estimation in wildlife – census methods, Man-animal conflicts and management strategies.

Unit 11 : Forest Genetic Resources and Ecotourism

Role of green revolution in forest conservation in India. In situ and ex situ conservation of forest genetic resources – Sacred groves; Urban forestry – Choice of species, design, development and management, Eco-tourism.

Unit 12 Climate change and mitigation

Climate change: greenhouse effect, sources and sinks of greenhouse gases, major greenhouses gases; Global climate change – its history and future predictions; Impact of climate change on agriculture, forestry, wildlife, water resources, sea level; Livestock, fishery and coastal ecosystems; International conventions on climate change; Global warming: effect of enhanced CO2 on productivity; Ozone layer depletion; Disaster management, floods, droughts, earthquakes; Tsunami, cyclones and landslides; Agroforestry - environmental conservation-carbon sequestration.

Unit 13 : Statistics

Statistics: definition, object and scope; frequency distribution; mean, median, mode and standard deviation, introduction to correlation and regression; Experimental designs: basic principles, completely randomized, randomized block, latin square and split plot designs.

Subject: Ph.D. FRUIT SCIENCE:

Unit 1: Tropical and Dry Land Fruit Production

Commercial varieties of regional, national and international importance, eco-physiological requirements, recent trends in propagation, scion-stock relationship, planting systems, cropping systems, canopy management, nutrient management, water management, fertigation, role of bio-regulators, abiotic factors limiting fruit production, physiology of flowering, pollination, fruit set and development, honeybees in cross pollination, physiological disorders–causes and remedies, quality improvement by management practices; maturity indices,

harvesting, grading, packing, storage and ripening techniques; industrial and export potential, Agri. Export Zones (AEZ) and industrial supports. Crops: Mango, Banana, Citrus, Papaya, Guava, Sapota, Annonas, Aonla, Bael, Wood apple, Jamun, Pomegranate, Ber and minor fruits of tropics.

Unit 2: Subtropical and Temperate Fruit Production

Commercial varieties of regional, national and international importance, eco-physiological requirements, recent trends in propagation, scion-stock relationship, planting systems, cropping systems, root zone and canopy management, nutrient management, water management, fertigation, role of bio - regulators, abiotic factors limiting fruit production, physiology of flowering, pollination, fruit set and development, honeybees in cross pollination, physiological disorders-causes and remedies, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; industrial and export potential, Agri. Export Zones (AEZ) and industrial supports. Crops: Avocado, Pineapple, Jackfruit, Mangosteen, Carambola, Fig and Rambutan, Litchi, Loquat, Apple, Pear, Quince, Grapes, Plums, Peach, Apricot, Cherries, Persimmon, Kiwifruit, Strawberry, Walnut, Almond, Pistachio, Hazelnut.

Unit 3: Biodiversity and Conservation

Biodiversity and conservation; issues and goals, centres of origin of cultivated fruits; primary and secondary centres of genetic diversity; present status of gene centres; exploration and collection of germplasm; Role of NAGS ; Conservation of genetic resources–conservation insitu and exsitu. Germplasm conservation – problem of recal citrancy-cold storage of scions, tissue culture, cryopreservation, pollen and seed storage; inventory of germplasm, introduction of germplasm, plant quarantine; intellectual property rights, regulatory horticulture. Detection of genetic constitution of germplasm and maintenance of core group; GIS and documentation of local biodiversity, geographical indication. Crops: Mango, Sapota, Citrus, Guava, Banana, Papaya, Grapes, Jackfruit, Custard apple, Ber, Aonla, Malus &Prunus sp., Litchi andNuts.

Unit 4: Canopy Management in Fruit Crops

Canopy management - importance and advantages; factors affecting canopy development; Canopy types and structures with special emphasis on geometry of planting, canopy manipulation for optimum utilization of light. Light interception and distribution in different types of tree canopies; Spacing and utilization of land area - canopy classification; Canopy management through rootstock and scion; Canopy management through plant growth retardants, training and pruning and management practices; Canopy development and management in relation to growth, flowering, fruiting and fruit quality in temperate fruits, Grapes, Mango,Sapota,Guava,Citrus and Ber.

Unit 5: Breeding of Fruit Crops

Origin and distribution, taxonomical status - species and cultivars, cytogenetics, genetic resources, blossom biology, breeding systems, breeding objectives, breeding constraints ideo types, 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. Crops: Mango, Banana, Pineapple, Citrus, Grapes, Guava, Sapota, Jackfruit, Papaya, Custard apple, Aonla, Avocado, Ber, Litchi, Jamun, Phalsa, Mulberry, Raspberry, Apple, Pear, Plums, Peach, Apricot, Cherries and Strawberry.

Unit 6: Post-Harvest Technology

Maturity indices, harvesting practices and grading for specific market requirements, influence of pre-harvest practices, enzymatic and textural changes, respiration, transpiration; Physiology and biochemistry of fruit ripening, ethylene evolution and ethylene management, factors leading

to post-harvest loss, pre-cooling; Treatment prior to shipment, viz., chlorination, waxing, chemicals, bio-control agents and natural plant products, fungicides, hot water, vapour heat treatment, sulphur fumigation and irradiation. Methods of storage-ventilated, refrigerated, MAS, CA storage, physical injuries and disorders; Packing methods and transport, quality evaluation, principles and methods of preservation, food processing, canning, fruit juices, beverages, pickles, jam, jelly, candy; Dried and dehydrated products, nutritionally enriched products, fermented fruit beverages, packaging technology, processing waste management and food safety standards; Role of HACCP.

Unit 7: Growth and Development

Definition, parameters of growth and development, growth dynamics, morphogenesis; Annual, semi- perennial and perennial horticultural crops, environmental impact on growth and development, effect of light, photosynthesis and photoperiodism, vernalisation, effect of temperature, heat units, thermoperiodism; Assimilate partitioning during growth and development, influence of water and mineral nutrition during growth and development, biosynthesis of auxins, gibberellins, cytokinins, abscisic acid, ethylene, brassinosteroids, growth inhibitors, morphactins, role of plant growth promoters and inhibitors, developmental physiology and biochemistry during dormancy, bud break, juvenility, vegetative to reproductive interphase,

flowering, pollination, fertilization and fruit set, fruit drop, fruit growth, ripening and seed development; Growth and developmental process during stress - manipulation of growth and development, impact of pruning and training, chemical manipulations in horticultural crops, molecular and genetic approaches in plant growth development.

Unit 8: Biotechnology of Fruit Crops

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

Unit 9: Protected Fruit Culture

Greenhouse – world scenario, Indian situation; present and future, different agro-climatic zones in India, environmental factors and their effects on plant growth; Basics of green house design, different types of structures-glasshouse, shade net, poly tunnels-Design and development of low cost green house structures; Interaction of light, temperature, humidity, CO2, water on crop regulation - Greenhouse heating, cooling, ventilation and shading; Types of ventilation-Forced cooling techniques-Glazing materials-Micro irrigation and Fertigation; Automated green houses, microcontrollers, waste water recycling, management of pest and diseases-IPDM.

Unit 10: Principles and Practices of Plant Propagation

Introduction, life cycle in plants, cellular basis for propagation. Sexual propagation – apomixis, polyembryony, chimeras. Factors influencing seed germination, hormonal regulation of germination and seedling growth. Seed quality, treatment, packing, storage, certification and testing. Rooting of cuttings under mist and hot beds. Physiological, anatomical and biochemical

aspects of root induction in cuttings. Selection of elite mother plants. Establishment of bud wood bank. Stock, scion and inter stock relationship and incompatibility. Physiology of dwarfing rootstocks. Rejuvenation of senile and seedling orchards progeny orchard and scion bank. Micropropagation In vitro clonal propagation, director ganogenesis, embryogenesis, micro grafting and meristem culture. Hardening, packing and transport of micro-propagules.

Subject: Ph.D. VEGETABLE SCIENCES:

Unit 1: Production Technology of Cool Season Vegetable Crops

Introduction, climatic and soil requirement, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting of potato, chow chow, cole crops: cabbage, cauliflower, knolkhol, sprouting broccoli, Brussels sprout, root crops: carrot, radish, turnip, and beetroot, bulb crops: onion and garlic, Peas and beans, leafy vegetables:palak

Unit 2: Production Technology of Warm Season Vegetable Crops

Introduction, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting of: Tomato, eggplant, hot and sweet pepper, Okra, vegetable cowpea, Dolichos lablab and cluster bean, Cucurbitaceous crops, and sweet potato, cassava,yams, coclocasia, moringa and amaranths.

Unit 3: Breeding of Vegetable Crops

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

Unit 4: Growth and Development

Cellular structures and their functions; definition of growth and development, growth analysis and its importance in vegetable production; Physiology of dormancy and germination of vegetable seeds, tubers and bulbs; Role of auxins, gibberellilns, cyktokinins and abscisic acid; Application of synthetic hormones, plant growth retardants and inhibitors for various purposes in vegetable crops; sex expression in cucurbits and checking flower and fruit drops and improving fruit set in Solanaceous vegetables Role and mode of action of antitranspirants, anti-auxin, ripening retardant and plant stimulants in vegetable crop production; Role of light, temperature and photoperiod on growth, development of underground parts, 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 morphogenesis and tissue culture techniques in vegetable crops.

Unit 5: Seed Production

Introduction, importance and present status of vegetable industry.; modes of propagation in vegetables; Seed morphology and development in vegetable seeds; Floral biology of these plant species; classification of vegetable crops based on seed dormancypollination and reproduction behavior; steps in quality seed production; identification of suitable areas/locations for seed production of these crops; methods of seed production; comparison between different methods e.g. pollination mechanisms; sex types, ratios and expression and modification of flowering

pattern in cucurbits; nursery raising and transplanting stage; Seed production technology of vegetables viz. solanaceous, cucurbitaceous, leguminous, malvaceae, cole crops, leafy vegetables, root, tuber and bulb crops; harvesting/picking stage and seed extraction in fruit vegetables, grading, storage,seed quality testing and seed certification standards; clonal propagation and multiplication in tuber crops e.g. Potato and sweet potato, seed-plot technique in potato, TPS (True Potato Seed); hybrid seed production technology of vegetable crops;maintenance of parental lines; use of male sterility and self-incompatibility in hybrid seed production.

Unit 6: Systematics of Vegetable Crops

Principles of classification; different methods of classification; salient features of international code of nomenclature of vegetable crops; Origin, history, evolution and distribution of vegetable crops, taxonomy, botanical description of families, genera and species covering various tropical, subtropical and temperate vegetables; Floral biology, Cytological level of various vegetable crops; descriptive keys for important vegetables; Importance of molecular markers in evolution of vegetable crops; molecular markers as an aid in characterization and taxonomy of vegetable crops :Potato and tomato, Eggplant, hot pepper, sweet pepper and okra, Peas and beans, lettuce, gourds, melons, pumpkins and squashes, cabbage, cauliflower, carrot ,beetroot, radish, moringa, amaranthus, cassava, sweetpotato, lab lab, onion and garlic

Unit 7: Production Technology of Underexploited Vegetable Crops

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, planting time and method, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting of: Asparagus and leek; Chinese cabbage, Chinese potato, and kale; Amaranth, , parsnip, rhubarb, basella and bathu (chenopods); lima bean, winged bean, vegetable pigeon pea and sword bean; Sweet gourd, spine gourd, pointed gourd, Ivy gourd

Unit 8: Post-Harvest Technology of Vegetable Crops

Importance and scope of post-harvest management of vegetables; Maturity indices and standards for different vegetables; methods of maturity determinations; biochemistry of maturity and ripening, enzymatic and textural changes, ethylene evolution and ethylene management,

respiration, transpiration, regulation methods; Harvesting tools, harvesting practices for specific market requirements; grading,post-harvest physiological and biochemical changes, disorders- chilling injury in vegetables, influence of pre-harvest practices and other factors affecting post- harvest losses, packaging house operations, commodity pre-treatments-chemicals, wax coating, pre-packaging and irradiation; packaging of vegetables, post-harvest, diseases and prevention from infestation, principles of transport; Methods and practices of storage-ventilated, refrigerated, MA, CA storage, hypobaric storage, precooling and cold storage, zero energy cool chamber; HACCP, Codex ,FSSAI.

Unit 9: Organic Vegetable Production Technology

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

Unit 10: Hi-tech Production Technology of Vegetable Crops

Importance and scope of protected cultivation of vegetable crops, principles used in protected cultivation and greenhouse technology, effect of temperature, carbon dioxide, humidity; energy

management, low cost structures, training methods, engineering aspects,classification of protected structures including low cost poly-house/green houses and other structures in vegetable production, types of cladding material,types of media, Mulching, solarisation,fumigation, Drip and sprinkler irrigation, fertigation, ,special horticultural practices, hydroponics, vertical farming andsoilless culture for enhancing productivity and off-season of high value vegetable crops like tomato, capsicum and cucumber.

Subject: Ph.D. FLORICULTURE AND LANDSCAPING:

Unit 1: Breeding

Principles – Evolution of varieties, origin, distribution, genetic resources, genetic divergence. Patents and Plant Variety Protection in India; Genetic inheritance of flower colour, doubleness, flower size, fragrance, post-harvest life; Breeding methods suitable for sexually and asexually propagated flower crops and ornamental plants – introduction, selection, domestication, polyploidy and mutation breeding for varietal development, Role of heterosis, Production of hybrids, Male sterility, incompatibility problems, seed production of flower crops; Breeding constrains and achievements made in commercial flowers – rose, jasmine, chrysanthemum, marigold, tuberose, crossandra, carnation, dahlia, gerbera, gladioli, orchids, anthurium, aster, heliconia, liliums, Breeding constrains and achievements made in ornamental plants – petunia, hibiscus, bougainvillea, Flowering annuals (zinnia, cosmos, dianthus, snap dragon, pansy) and ornamental foliages – Introduction and selection of plants for waterscaping and xeriscaping.

Unit 2: Production Technology of Cut Flowers

Scope of cut flowers in global trade, Global Scenario of cut flower production, Varietal wealth and diversity, area under cut flowers and production problems in India – Patent rights, nursery management, media for nursery, special nursery practices; Growing environment, open cultivation, protected cultivation, soil requirements, artificial growing media, soil decontamination techniques, planting methods, influence of environmental parameters, light, temperature, moisture, humidity and CO2 on growth and flowering; Flower production – water and nutrient management, rationing, fertigation, weed management, training and pruning, disbudding, special horticultural practices, use of growth regulators, physiological disorders and remedies, IPM and IDM, production for exhibition purposes; Flower forcing and year round flowering through physiological interventions, chemical regulation, environmental manipulation; Cut flower standards and grades, harvest indices, harvesting techniques, post-harvest handling, Pre-cooling, pulsing, packing, Storage and transportation, marketing, export potential, institutional support, Agrl. Export Zones; Crops: Cut rose, cut chrysanthemum, carnation, gerbera, gladioli, tuberose, orchids, anthurium, aster, lilies, bird of paradise, heliconia, alstroemeria, alpinia, ornamental ginger, bromeliads, dahlia, gypsophilla, limonium, statice, stock, cut foliage.

Unit 3: Production Technology for Loose Flowers

Scope of loose flower trade, Significance in the domestic /export markets, Varietal wealth and diversity, propagation, sexual and asexual propagation methods, propagation in mist chambers, nursery management, pro-tray nursery under shadenets, transplanting techniques; Soil and climate requirements, field preparation, systems of planting, precision farming techniques; Water and nutrient management, weed management, training and pruning, pinching and disbudding, special horticultural practices, use of growth regulators, physiological disorders and remedies, IPM and IDM; Flower forcing and year round flowering production for special occasions through physiological interventions, chemical regulation; Harvest indices, harvesting techniques, post-harvest handling and grading, packing and storage, value addition, concrete and essential oil extraction, transportation and marketing, export potential, institutional support, Agrl. Export Zones; Crops – Jasmine, scented rose, chrysanthemum, marigold,

tuberose, crossandra, nerium, hibiscus, celosia, gomphrena, non-traditional flowers (barleria, Nyctanthes, Tabernaemontana, ixora, lotus, pandanus, etc.).

Unit 4: Landscaping

Landscape designs, Styles of garden, formal, informal and free style gardens, types of gardens, English, Mughal, Japanese, Persian, Spanish, Italian, Vanas, Buddha garden; Urban landscaping, Landscaping for specific situations, institutions, industries, residents, hospitals, roadsides, traffic islands, damsites, IT parks, corporates; Garden plant components, arboretum, shrubbery, fernery, palmatum, arches and pergolas, edges and hedges, climbers and creepers, cacti and succulents, herbs, annuals, flower borders and beds, ground covers, carpet beds, bamboo groves; Production technology for selected ornamental plants; Lawns, Establishment and maintenance, special types of gardens, vertical garden, roof garden, bog garden, sunken garden, rock garden, clock garden, colour wheels, temple garden, sacred groves; Bio-aesthetic planning, eco-tourism, theme parks, indoor gardening, therapeutic gardening, non-plant components, water scaping, xeriscaping, hardscaping.

Unit 5: Protected Floriculture

Prospects of protected floriculture in India; Types of protected structures – Greenhouses, polyhouses, shade houses, rain shelters etc., Designing and erection of protected structures; Low cost/Medium cost/High cost structures – economics of cultivation; Location specific designs; Structural components; Suitable flower crops for protected cultivation; Environment control – management and manipulation of temperature, light, humidity, air and CO2; Heating and cooling systems, ventilation, naturally ventilated greenhouses, fan and pad cooled greenhouses, light regulation; Containers and substrates, soil decontamination, layout of drip and fertigation system, water and nutrient management, weed management, physiological disorders, IPM and IDM; Crop regulation by chemical methods and special horticultural practices (pinching, disbudding, deshooting, deblossoming, etc.), Staking and netting, Photoperiod regulation; Harvest indices, harvesting techniques, post-harvest handling techniques, Pre-cooling, sorting, grading, packing, storage, quality standards.

Unit 6: Value Addition

Prospects of value addition, National and global scenario, production and exports, Women empowerment through value added products making, supply chain management; Types of value added products, value addition in loose flowers, garlands, veni, floats, floral decorations, value addition in cut flowers, flower arrangement styles, ikebana, moribana, free style, bouquets, button-holes, flower baskets, corsages, floral wreaths, garlands, etc.; Selection of containers and accessories for floral products and decorations; Dry flowers – Identification and selection of flowers and plant parts; Raw material procurement, preservation and storage; Techniques in dry flower making – Drying, bleaching, dyeing, embedding, pressing; Accessories; Designing and arrangement – dry flower baskets, bouquets, pot-pourri, wall hangings, button holes, greeting cards, wreaths; Packing and storage; Concrete and essential oils; Selection of species and varieties (including non-conventional species), extraction methods, Plant pigments: Significance of natural pigments, Applications; Selection of species and varieties, Types of pigments - carotenoids, anthocyanin, chlorophyll, betalains; Extraction methods; Packing and storage, .

Unit 7: Turfing and Turf Management

Prospects of landscape industry, History of landscape gardening, site selection, basic requirements, site evaluation, concepts of physical, chemical and biological properties of soil pertaining to turf grass establishment; Turf grasses – Types, species, varieties, hybrids; Selection of grasses for different locations; Grouping according to climatic requirement – Adaptation; Turfing for roof gardens; Preparatory operations; Growing media used for turf grasses – Turf establishment methods, seeding, sprigging/dibbling, plugging, sodding/turfing,

turf plastering, hydro-seeding, astro-turfing; Turf management – Irrigation, nutrition, special practices, aerating, rolling, soil top dressing, use of turf growth regulators (TGRs) and micronutrients, Turf mowing – mowing equipment's, techniques to minimize wear and compaction, weed control, biotic and abiotic stress management in turfs; Establishment and maintenance of turfs for playgrounds, viz. golf, football, hockey, cricket, tennis, rugby, etc.

Unit 8: Computer Aided Designing (CAD) for Outdoor and Indoorscaping

Exposure to CAD (Computer Aided Designing) – Applications of CAD in landscape garden designing, 2D drawing by AUTOCAD, 3D drawing by ARCHICAD, Creating legends for plant and non-plant components, Basics of Photoshop software in garden designing; 2D drawing methods, AUTOCAD Basics, Coordinate systems in AUTOCAD LOT 2007, Point picking methods, Toolbars and Icons, File handling functions, Modifying tools, Modifying comments,Isometric drawings, Drafting objects; Using patterns in AUTOCAD drawing, Dimension concepts, Hyperlinking, Script making, Using productivity tools,e-transmit file, making sample drawing for outdoor and indoor garden by AUTOCAD 2D Drawing techniques, Drawing web format design, Making layout; 3D drawing methods, ARCHICAD file system, Tools and Infobox, modification tools, structural elements, GDL objects (Grid Dimensional Linking), Creation of garden components through ARCHICAD; ARCHICAD organization tools, Dimensioning and detailing of designs, Attribute settings of components, Visualization tools for landscape preview, data management, plotting and accessories for designing, inserting picture using Photoshop, Making sample drawing for outdoor and indoor gardens.

Agriculture Engineering

Subject: Ph.D. FARM MACHINERY AND POWER ENGINEERING

Unit 1: Design of Tillage and Planting Machinery

Modern trends, principles, procedures, fundamentals and economic considerations for design and development of farm machinery. Design considerations, procedure and their applications in tillage and planting machinery. Design of coulters, shares, mould boards, landside, frog, jointer. Forces acting on plough bottom and their effect. Draft on ploughs. Design of disk ploughs, concave disk working tools and forces acting on discploughs. Machines and implements for surface and inter row tillage, peg toothed harrow, disk harrows, graders, rollers, cultivators, design of V shaped sweeps -rigidity of working tools. Rotary machines, trajectory of motion of rotary tillertynes, forces acting and power requirement. Machines with working tools executingan oscillatory motion. Methods of sowing and planting. Grain hoppers, seed metering mechanism, furrow openers an \d seed tubes. Planting and transplanting, paddy transplanters and potato planters.

Unit 2: Design of Plant Protection and Harvesting Equipment's

Modern trends, principles, procedures, fundamentals and economic considerations for design and development of plant protection and harvesting machinery. Machines for fertilizer application and discs type broadcasters. Organic fertilizer application, Properties of organic manure and spreading machines. Liquid fertilizer distributors. Function of sprayer, atomization principles, hydraulic sprayers. Air blast spinning disc and electrostalic sprayers. Design of sprayer components, pumps, pressure vessel, nozzle, materials of construction. Spraydroplets and distribution pattern. Spray application to orchards. Physico-mechanical properties of grass and cereal stalks, resistance to cutting, speed of cutting of stalks, cutting angle of the knife segment. Kinematics of the drive mechanisms of cutting equipment's. Mowers, Design and construction, mowers with rotary cutting units, mower pick up chopper and loader. Grain harvesting, combines and its features. Threshing unit, types and separation process. Straw walker, separation of straw in oscillating straw walker. Grain cleaning and grading and principal parameters. Root crop harvesting, potato other root crop.

Unit 3: Testing and Evaluation of Agricultural Machinery

Types of tests; test procedure, need for testing & evaluation of farm equipment's and standardization of testing machinery, available national and international codes. Need of test codes and advantages of certification. Measurement & calculation of operating speed, wheel slip, draft of manual, trailed & mounted implements, fuel consumption, field capacity, Soil moisture, bulk density, soil inversion, soil pulverization, size & shape of furrow, field efficiency, calibration of test equipment and its usage limitations. Prototype feasibility testing and field evaluation. Laboratory and field testing of primary & secondary tillage equipment. Test code for performance testing for tractors & power tillers - evaluation and interpretation of results. Dynamometers. Review and interpretation of test reports for selected farm machinery.

Unit 4: Tractor Design Principles

Functional Requirement and Limitations, Systems and power outlets, Technical specifications of tractors available in India and modern trends in tractordesign and development. Special design features of tractors in relation to Indianagriculture.Parameters affecting design of tractor engine and their selection. Design of fuelefficient engine components and tractor systems like transmission, steering, front suspension, hydraulic system. Studying tractor performance. Tractor mechanics, Ideal Analysis with and without losses, Engine Performance, Tractor Drawbar performance. Tractor Performance on a Firm Surface and soft soil. Rolling resistance. Tire selection. Hitching and mechanics of the tractor chassis, Weight transfer. Computer aided design and its application in agricultural tractors. Tractorimplements matching and operation.

Unit 5: Ergonomics and Safety in Farm operations

Ergonomics, scope, concepts and areas of application. System concept to humanfactors. Human factor in system development, basic processes in systemdevelopment. Human Skeletal system, muscle, structure and function. Muscle metabolism. Direct and indirect calorimetry Physiological stress and measurement of human energy expenditure during rest and physical activities. Work physiology invarious agricultural tasks. Mechanical efficiency of work, fatigue and shift work. Anthropometric data and measurement techniques, joint movement and method of measurement, analysis and application of anthropometric data in design of foot and hand controls andoperator' seat for tractors and agricultural equipment. Measurement of physical and mental capacities. Effect of illumination, noise, vibration and dust on work performance and health of workers. Thermal and cold stress and its effect on human performance. Field of vision and colour discrimination. Work psychology, basic concepts, Subjective rating scales and quantification techniques. Safety standards at work place. Accidents and prevention. Occupational health hazards of agricultural workers.

Unit 6: Soil Dynamics in Tillage and Traction

Dynamic properties of soil, stress strain relations and distribution, soil strength. Yield in soil, shear, compression, tension and plastic flow. Rigid body soil movement, momentum, friction, adhesion and absorption. Dynamic versus static properties. Dynamic parameters, measuring in dependent parameters and composite parameters. Measuring gross dynamic behavior and rupture. Mechanics of tillage tools: The reaction of soil to tillage tools, mechanics of simple reactions, soil behavior in simplified systems, geometry of soil toolsystems, mechanics of complex reactions. Dimensional analysis of different variables related to soil-tyre system; soil vehicle models; mechanics of steering of farm tractor; special problems of wet land traction and floatation. Introduction of traction devices, tyres-types, function & size, their selection; mechanics of traction devices. Deflection between traction devices and soil, slippage and sinkage of wheels, evaluation and prediction of traction performance. Design of traction and transport devices - Soil compaction by agricultural vehiclesand machines.

Unit 7: Manufacturing Technology

Specification of materials, surface roughness, production drawing, computer aided drawing heat treatment, workshop practices applied in prototype production, common tools and press operations, metal cutting and machining, jigs, fixtures and gauges, casting and die-casting processes; basic joining processes, welding processes, testing of joints and metallurgy.

Unit 8: Instrumentation and Measurement Techniques

Mechanical measurements, sensors and transducers, application of electrical strain gauges, signal transmission and processing, dynamic measurements; measurement of temperature, pressure, strain, force, torque, power vibrations etc.; determination of calorific value, fluid flow rates etc., signal conditioning and monitoring, data acquisition and storage.

Unit 9: Energy in Agriculture

Conventional and renewable energy sources in agriculture; solar radiation and its measurement; characteristics of solar spectrum; solar energy collection, storage and applications; solar photovoltaic conversion and SPV powered systems. Types of wind mills and their applications; thermo-chemical conversion of biomass, direct combustion, Pyrolysis and gasification, chemical conversion processes, carbonization, briquetting, pelletization and densification of biomass; bioconversion into alcohols, methyl and ethyl esters, organic acids, solvents of amino acids; types of biogas plants, biogas properties, uses and distribution, alternate fuels for IC engines. Energy requirement in agricultural production systems, energy ratio and specific energy value, inflow and outflow of energy in unit agricultural operation, energy audit, accounting and analysis.

Common Paper (for all streams PhD.)

RESEARCH METHODOLOGY

Basic concepts of research: Rationale of research, research problem, research objectives, research design, types of research: fundamental, applied, action, quantitative/qualitative

Literature survey/review: Primary sources, secondary sources, searching e- resources: using search engines, searching databases, authenticity of e-resources, writing literature review

Research problem: Identification of research problem, defining research problem, components of research problem, and various steps in scientific research, selection and formulation of research problem

Research Methodology: Types of research methods, survey method (quantitative/qualitative), experimental method (variables, designs), historical methods, content analysis, Hypotheses: meaning, types of hypotheses, formulation of hypothesis

Sampling: Concepts of population, sample, sampling techniques, non-probability sampling techniques

Data collection methods, tools and techniques: Primary data collection, secondary data collection (questionnaire, interview schedule, focus group, library records and reports etc.)

Data analysis techniques: Use of databases, Statistical analysis techniques, qualitative analysis techniques. Common statistical tests, computer processing, interpretation and presentation of results

Report writing/documentation: Title, subtitle, formatting etc. citation, references, bibliography

Research ethics: Ethics in conducting research, copyright, plagiarism, originality of research work.

SAMPLE OF OPTIONS FORM FOR M.V.Sc. COUNSELLING

Counselling Date: _____2023 S.No._____

Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu

DISCIPLINE ALLOTMENT PREFERENCE FORMAT FOR SKUAST-J CET M.V.Sc. COUNSELLING-2023

Roll No. | Name

Category | Marks | Rank

Telephone/cell No. | Email ID

OPTIONS/PREFERENCE FORMAT FOR ALLOTMENT OF DISCIPLINE

S.No	Name of the Discipline where you desire admission (in order of preference)
1.	
2.	
3.	
4.	
5.	
6.	

I have deposited non-refundable counselling fee of Rs. 1000/-

Signature of the Candidate

Recommended provisionally for admission in Discipline of _____

Signature of Counselling Committee Members.

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