भा0कृ0अ0प0–भारतीय पशुचिकित्सा अनुसंधान संस्थान
(सम विश्वविद्यालय)
इज्जतनगर–243 122 (उ0प्र0) भारत

ICAR-INDIAN VETERINARY RESEARCH INSTITUTE
(Deemed University)
IZATNAGAR–243 122 (UP) INDIA

INFORMATION BULLETIN cum-PROSPECTUS

2025-26

for admission to

BACHELOR OF TECHNOLOGY

(B. Tech.)

IN BIOTECHNOLOGY

(with specialization in Animal Biotechnology)

Website: www.ivri.nic.in/academics/UGProgBtech.aspx

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1. INTRODUCTION

Indian Veterinary Research Institute (IVRI) was established on 9th December, 1889 as Imperial Bacteriological Laboratory at Pune (Maharashtra) and was shifted to Mukteswar, Distt. Nainital (Uttarakhand) in 1893. Subsequently, for extending the activities of the Institute; Izatnagar, Bareilly (UP) campus was established in 1913 for large-scale production of serum and vaccines. It gradually expanded to the present size with its headquarters at Izatnagar (UP) and campuses at Mukteswar, Distt. Nainital (Uttarakhand), Bengaluru (Karnataka) and regional stations at Palampur (HP), Kolkata (West Bengal) and Pune (Maharashtra). The administrative control of the Institute is vested with the Indian Council of Agricultural Research (ICAR).

The research contributions of the Institute have facilitated development of new biologicals including diagnostics, vaccines and technologies for diagnosis, prevention, cure and control of many devastating diseases of livestock and poultry, increased production of milk, meat, eggs and other animal products. Improvement of livestock and poultry with increased production potential, overcoming the shortage of animal feeds by better utilization of existing feed resources and substitution of conventional feeds by cheaper agro-industrial byproducts are other significant contributions.

Post-graduate teaching and training programmes started in 1900 at the Institute when training was imparted to field veterinarians, civil and army personnel on various aspects of animal healthcare. Later, Associate-ship and National Diploma courses were added as part of post graduate teaching programme. However, with the establishment of Post-Graduate College of Animal Sciences in 1958, the institute started conferring degree in Veterinary and Animal Sciences. The Institute has been conferred the status of Deemed to be University with effect from 16th November, 1983 under Section 3 of the University Grants Commission Act (1956). The first academic session of the Deemed University started on 15th January, 1985. From the academic session 2015-16, the institute has initiated under-graduate programme in Veterinary Sciences (BVSc & AH degree). Besides, imparting undergraduate education leading to BVSc & AH degree, the institute is also providing quality education at masters' and doctorate levels in 19 and 17 disciplines, respectively.

The Institute has been attracting a large number of foreign students, especially from developing countries. Scholars have also been deputed to this Institute from different countries for various short-term and long-term training programmes, diplomas and degree programmes. Besides the above courses, the institute has also been conducting various short-term National and International Training Programmes, Short Courses and Summer Institutes from time to time to make the professionals familiar with latest developments in Veterinary and Animal Sciences. The Institute has also been recognized as the Centre for Advanced Faculty Training in Animal Nutrition and Animal Physiology by ICAR, New Delhi.

The Institute, spread over an area of 440.54 Acres, has a well-established National Library of Veterinary Sciences, ARIS Cell (computer centre), Communication centre, Student Welfare Section, Medical dispensary, Referral Veterinary Polyclinic-cum-Teaching Veterinary Clinical Complex, Livestock farms, Feed and Fodder Farms, Boys' and Girls' Hostels, Bank and Post Office facilities at its Izatnagar campus. It is located at a distance of 258 km from New Delhi, and about 8 km from Bareilly airport, about 7 km from Bareilly Jn. and 1 km from Izatnagar Railway Station.

2. AUTHORITIES OF IVRI DEEMED UNIVERSITY

Sl. No.	Name	Phone/Fax Nos./Email Id	Extension No.
1.	Dr. Triveni Dutt Director & Vice Chancellor	Phone: +91-581-2300096 Email: directorivri@gmail.com	4005
2.	Dr. S.K. Mendiratta Joint Director (Academic) & Dean	Phone: +91-581-2301462 Email: jdaicarivri@gmail.com	4007
3.	Shri Rajeev Lal Joint Director (Admn.)& Sr. Registrar	Phone: +91-581-2302179 Email: registrar.ivri@gmail.com	2535
4.	Dr. Gyanendra Singh Controller of Examination & Academic Coordinator	Phone: +91-581-2301224 Email: universityivri@gmail.com acadcord@gmail.com	2507/ 2542
5.	Dr. P.K. Gupta, Coordinator B Tech Biotech Programme	Phone: Email: btechivri@gmail.com	2412
6.	Dr. Ajay Kumar, Associate Coordinator, B Tech Programme	Phone: Email: btechivri@gmail.com	2334
7.	Dr. Rupasi Tiwari Chief Hostel Warden (Girls) & Students' Welfare Officer(Girls)	Phone: +91-581-2303528; +91-581- 2302179 Email: rupasitiwari@gmail.com	2425/2420
8.	Dr. Praveen Singh Chief Hostel warden (Boys)	Phone: +91-581- 2301613 Email: psingh67@yahoo.com	–
9.	Dr. S.K. Saha Student Welfare Officer (Boys)	Phone: +91-581-2303528, +91-581- 2302179 Email:subodhksaha@yahoo.com	2584/2092
10.	Dr. Manish Mahawar Nodal Officer Nodal Cell (Education Division)	Phone: +91-581-2302368, +91-581- 2302179 Email: manishbiochemistry@gmail.com nodalcellivri@gmail.com	2518/2340
11.	Dr. Abhishek Incharge Placement Cell	Phone: +91-581-2301375 Email: abhivbm@gmail.com	2541
12.	Dr. Amit Kumar, ELP Coordinator	Phone: +91-581-2301327, +91-581- 2302179 Email: vetamitchandan07@gmail.com	2390
13.	Dr. Madhu C.L. Associate Nodal Officer Nodal Cell (Education Div.)	Phone: +91-581-2301327, +91-581- 2302179 Email: nodalcellivri@gmail.com	2518
15.	Shri Sakar Asstt. Admin. Officer (Acad.)	Phone: +91-581-2302179 Email: acadsec2021@gmail.com	2508
16.	Shri Vishwadeep, Asstt. Administrative Officer (Exam.)	Phone: +91-581-2301224 Email: coeexamsection@gmail.com	2506
17.	Shri Alka Rani Asstt. Admin. Officer (A&F)	Phone: +91-581-2301095 Email: afsection@gmail.com	2544
18.	IVRI Deemed University's EPABX No.	0581-2301654/2301613/2301998 (Change in tone then dial your choice of Extension No.)	

3. B.TECH. BIOTECHNOLOGY DEGREE PROGRAMME (with specialization in Animal Biotechnology)

Highlights

- The B.Tech. (Biotechnology) program is designed over 4 years, covering 167 credit hours of coursework. Additionally, students to register in 4 credit hours of non-gradial courses and 10 credit hours of MOOCs/Online Courses.
- The coursework consists of 112 credit hours, comprising 80 credits in major courses (including 20 credit hours of elective courses) and 32 credits in minor courses, 9 credit hours of Multi-Disciplinary Course (MDC), 6 credit hours of Value Added Course (VAC), 8 credit hours of Ability Enhancement Course (AEC), 12 credit hours of Skill Enhancement Course (SEC), and 20 credit hours of student READY activities. Two credit hours of non-gradial courses and 10 credit hours of (massive open online courses) MOOCs/Online Courses.
- Upon completing the first year and undertaking a 10-credit (10-week) industry/institute training or internship, students qualify for the first-level exit with a UG-Certificate in Biotechnology. However, students advancing to the second year of the program will not participate in this industry or institute training/internship.
- Upon completing the first and second years and undertaking a 10-credit (10-week) industry/ institute training or internship, students are eligible for the second level exit with a UG-Diploma in Biotechnology. However, students progressing to the third year of the program will not participate in this industry or institute training/internship.
- During the fifth and sixth semesters in the third year, the students will be offered with specialized and advanced courses in Biotechnology and related disciplines. In the fifth semester, students participate in an Educational Tour spanning two weeks (10-14 days), designated as a non-gradial course.
- The proposed elective structure for the seventh semester includes a single course in Animal Biotechnology, offering a total of 20 credits.
- In the eighth semester, the student READY including in-plant training (RAWE/industry attachment/experiential learning/hands on training/project work/internship) will be taken up by the students.
- Students will enroll MOOCs/Online Courses totaling 10 credit hours during the four years (preferably during the third and fourth years) through approved portals with prior notification to the Head of the Institution.

Multiple Entry and Exit Options

The entry and exit options for the UG program in Biotechnology are shown in the Figure.

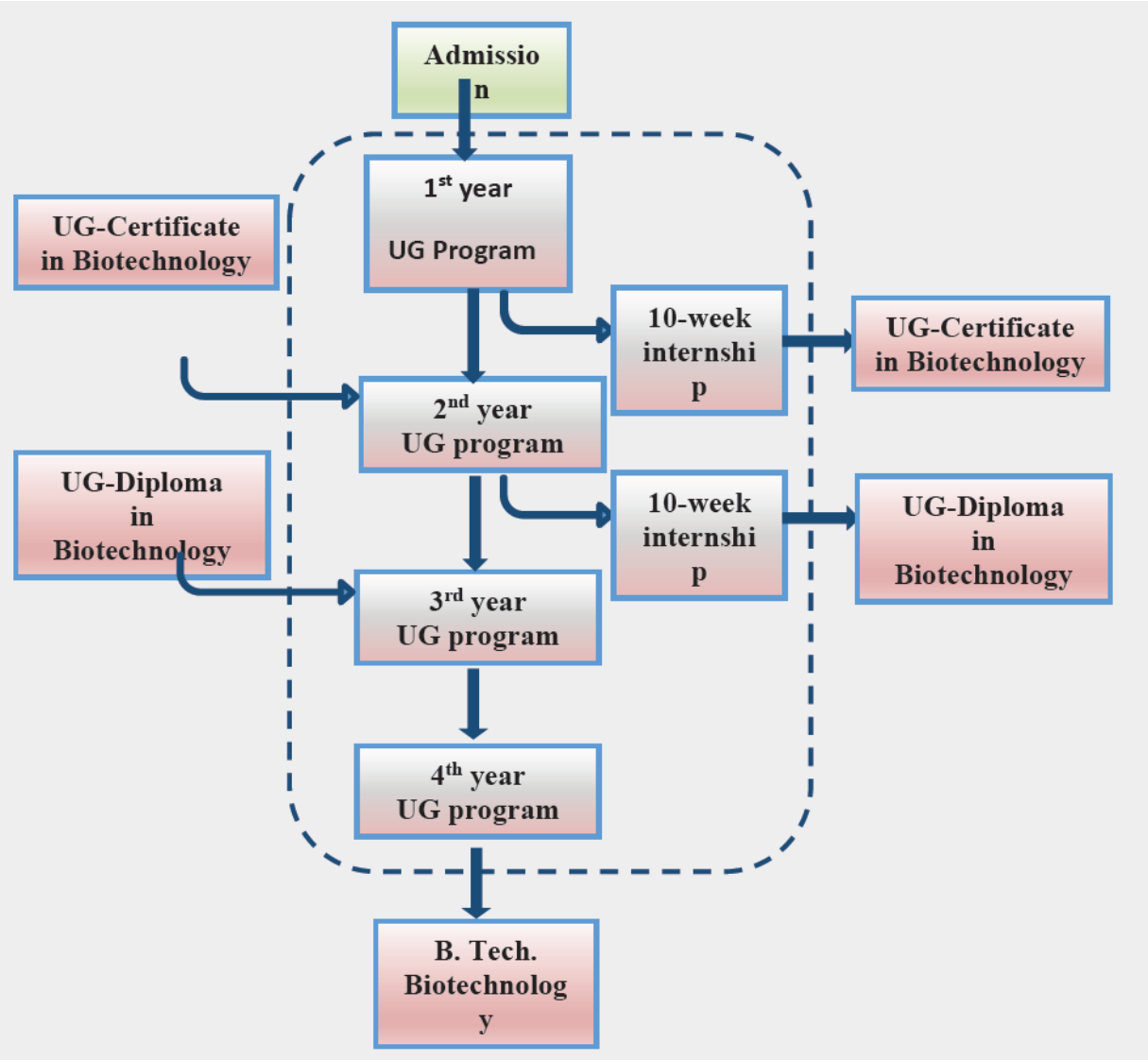

Fig- Entry and exit options for the UG program in Biotechnology

Entry Options

The lateral entry at 3rd semester will be for the candidates having UG-certificate or those who have completed Diploma (3 years course after 10th) in recognised institutions. The lateral entry in 5th semester will be for candidates who have completed UG-Diploma.

Exit options

1. **UG-Certificate in Biotechnology (NEP-NHEQF Level 4.5):** Exit after the first year and completion of a 10-week internship.
2. **UG-Diploma in Biotechnology (NEP-NHEQF Level 5.0)**: Exit after the second year and completion of a 10-week internship.
3. **B. Tech. Biotechnology (NEP-NHEQF Level 6.0):** On successful completion of four-year degree requirements.

4. ELIGIBILITY & INTAKE CAPACITY FOR B.TECH. BIOTECHNOLOGY DEGREE PROGRAMME WITH SPECIALIZATION IN ANIMAL BIOTECHNOLOGY

3.1. ELIGIBILITY:

- Candidates should have a minimum qualification of 10+2 or equivalent with Physics, Chemistry, Biology or Mathematics & English from a recognized Board.
- 50% minimum marks in aggregate (40% marks in aggregate for SC/ST, OBC categories) excluding optional subjects.

3.1. DURATION OF COURSE

The duration of B.Tech degree course is spread over four years including compulsory Student READY Programme of one year duration.

3.2. ADMISSION CAPACITY (for Academic Session 2024-25): **22** (to be filled by ICAR)

3.3. RESERVATION OF SEATS

3.3.1. Regular/ Open Seats

(a) 15% seats are reserved for SC candidates,

(b) 7.5% seats are reserved for ST candidates,

(c) 27% seats are reserved for non-creamy layer OBC candidates as per Hon'ble Supreme Court order dated 10.04.2008 and according to detailed instructions of the Ministry of Human Resource Development issued vide their O.M. No. 1-1/ 2005-UIA/847 dated 20.4.2008. Reservation would be applicable to the castes mentioned in the Central list of OBC. Thus, the candidates falling in this list may mention OBC in the Category Column in application form.

Candidates from creamy layer and those who do not come under Central List of OBC are advised to mention the category as General.

(d) 10% seats are reserved for Economically Weaker Section (EWS) of General Category

(e) 5% seats*** are reserved on Horizontal basis for Divyang Category (Physically handicapped) candidates as per Rights of Persons with Disabilities Act, 2016.

(***Horizontal reservation to be given for Divyang Category (PH) candidates as per their merit against the category i.e. General/ OBC/SC/ST to which they belong).

5. RIGHT TO REFUSE ADMISSION

The Director cum Vice-Chancellor, IVRI reserves the right to refuse admission to any candidate without assigning any reason thereof. The decision of the Director shall be final and legally binding.

6. ORIENTATION PROGRAMME

In order to make all fresh students fully conversant with the requirement and working of the course credit system of instruction followed at this Institute, an Orientation Programme will be held on December 05, 2025.

7. REGISTRATION OF STUDENTS

Documents required at the time of admission:

All the Selected students in the counseling of CUET shall bring Original and one set of self attested photocopy of the following certificates/documents, which are mandatory and required to submit at the time of admission at IVRI, failing which his/her admission/registration will not be accepted:

a. Matriculation (Class X) Marksheet and certificate for date of birth.
b. Higher Secondary (10+2) or equivalent certificate and Marksheet
c. Character certificate from last attended school.
d. Transfer Certificate
e. Migration Certificate
f. Scheduled Caste/Scheduled Tribe/OBC certificate as per annexure from the authority empowered to issue such certificate of verification, wherever necessary. Until the certificates are verified from the competent authority, the admission under these reserved quotas will be treated as provisional.
g. All the certificates as per annexure enclosed in the Information Bulletin.
h. Certificate from Competent Authority for Physically Challenged (PH) candidates.
i. Following documents will be submitted in original at the time of admission, failing which his/her admission/registration will not be accepted:
    i. Transfer Certificate
    ii. Migration Certificate
    iii. Medical Fitness Certificate
    iv. Anti-ragging certificates (both from candidate & parents)
    v. Declaration/Undertaking for OBC Candidates
    vi. Affidavit by the students
    vii. Affidavit by the Parents
    viii. Five passport size latest photo.
j. All correspondence for admission should be addressed to the Assistant Administrative Officer (Acad.), IVRI, Izatnagar-243 122, Bareilly (UP) India.

Every student enrolled shall be required to register at the beginning of each semester, as per calendar, till the completion of his/her degree requirements. Registration shall consist of the following steps:

a) Filling up the registration forms for course(s) to be offered in that semester.
b) Payment of the fee.
c) Depositing the prescribed registration forms duly filled in by the student in person and signed by the Advisor & Coordinator (UG).

The Registration for the first semester of the year for fresh students is a part of the admission procedure and shall be governed by the admission rules. Registration in respect of continuing students in each semester shall, however, be completed on the first day of each semester and the classes shall commence thereafter. No student can be permitted to register in subsequent semester unless he/she completes all the examinations of the course registered in the previous semester.

The Registration of continuing students shall not be permitted later than the last date of registration with late fee approved by the Joint Director (Acad.). A continuing student who does not register on the notified date shall be required to pay a late fee of Rs. **1500/-** or as may be prescribed by the Institute.

In case, the name of a student is dropped out/struck off for a semester, re-registration of the student may be done only after the approval of Joint Director (Academic). The student will be required to submit the re-registration fee of Rs. **1500/-** in addition to late fee in the next semester.

RAGGING

Ragging is totally prohibited in the campus and all the students shall observe and abide by the rules & UGC regulations on curbing the menace of ragging in higher educational institutions 2009 under Section 26(1)(G) of the University Grant Commission Act 1956 dated 17.06.2009 published in the Gazette of India part-III, Section 4. Any student found guilty of ragging and/or abetting ragging, whether actively or passively or bearing a part of a conspiracy to promote ragging is liable to be punished in accordance with the aforesaid regulations.

If any incident of ragging comes to the notice of authorities of the Deemed University, IVRI, the concerned students shall be given liberty to explain and if his/her explanation is not found satisfactory, the authority would expel him/her from the Institute.

8. CANCELLATION OF REGISTRATION

The Director may cancel the registration of any student or group/batch/class of students who indulge(s) in acts of indiscipline, misconduct, violation of rules and regulations of the University, strikes, absence from classes without permission or without any valid reason or in whose case, the Director has reasons to believe that his/her continuance in the University would not be in the best interest of University.

The students, who have been permanently dropped from this University either on account of poor academic performance or on account of acts of indiscipline or misconduct, shall not be eligible to make an application for re-admission to this Institute.

It is the responsibility of the candidates to furnish full and correct information on the application form. Any admission made on the basis of wrong information supplied by the candidates or through a clerical mistake in the Registrar's Office and detected subsequent to the admission and joining of the candidate, would be cancelled at the cost and risk of the student.

9. HOSTEL ACCOMMODATION

The newly admitted students will be provided Hostel either in double or triple occupancy in the Hostels. For Girl students, there are Girls hostel. All the hostels are provided with internet/ Wi-Fi facilities.

NOTE: There is limited Hostel facility at present in the campus. The Hostel will be allotted on the basis of merit/rank depending on availability of Hostel. The students are advised to make their own arrangements for accommodation during the course of study.

10. FEE STRUCTURE

Sl. No.	Particulars	First Year Semesters Fees (In Rupees)			
		General/OBC candidates		SC/ST candidates	
		I Semester	II Semester	I Semester	II Semester
1.	Caution money (Refundable, paid once on admission)	10000	-	10000	-
2.	Admission Fees	5000	-	5000	-
3.	Registration Fees	2000	-	2000	-
4.	Tuition Fees	7500	7500	-	-
5.	Examination Fees	2000	2000	-	-
6.	Magazine fees	250	250	-	-
7.	Library Fees	500	500	500	500
8.	Sports & Games charges	500	500	-	-
9.	Cultural & literacy activities fee	250	250	250	250
10.	Identity Card	300	-	300	-
11.	Transport charges	500	500	500	500
12.	IVRI Students Council Fee	250	250	-	-
13.	IVRI Students Welfare Fund Fee	350	350	-	-
Sub Total		**29,400**	**12,100**	**18,550**	**1,250**
14.	Hostel Security Deposit (Refundable, paid once on admission)	5000	-	5000	-
15.	Hostel fees	6000	6000	6000	6000
Grand Total		**40,400**	**18,100**	**29,550**	**7,250**

Sl. No.	Particulars	Second Year/Third Year/Fourth Year Semesters Fees (In Rupees)			
		General/OBC candidates		SC/ST candidates	
		I Semester	II Semester	I Semester	II Semester
1.	Registration Fees	2000	-	2000	-
2.	Tuition Fees	7500	7500	-	-
3.	Examination Fees	2000	2000	-	-
4.	Magazine fees	250	250	-	-
5.	Library Fees	500	500	500	500
6.	Sports & Games charges	500	500	-	-
7.	Cultural & literacy activities fee	250	250	250	250
8.	Transport charges	500	500	500	500
9.	Hostel fees (including water and electricity charges)	6000	6000	6000	6000
10.	IVRI Students Council Fee	250	250	-	-
11.	IVRI Students Welfare Fund Fee	350	350	-	-
12.	Late Registration Fee /Fine Rs1500/-				
Grand Total		**20,100**	**18,100**	**9,250**	**7,250**

Other charges (as and when applicable)		
1.	Duplicate Degree Certificate if lost	2000
2.	Certificate verification charges	250.00 (each certificate)
3.	Any other certificate except Bonafide/character certificate etc.	250
4.	Late registration fee to be imposed after due date	1500

5.	PDC/Transcript and Award	1500
6.	Award of degree in absentia	2000
7.	IVRI Alumni Association	1000
8.	Compartment exam. (per paper)	2000

i. Fee and other charges can be revised without any prior notice.

ii. Fees and other charges once paid are not refundable.

11. ACADEMIC SESSION AND TERM CALENDAR

The academic year of the Institute is comprised of two semesters, each of at least 90 instructional days. The date for programme of studies of each semester in a particular academic year is decided by the Institute well in advance. The time schedule of the academic year 2025-26 is given below:

I Semester : December to April
II Semester : April to August

TERM CALENDAR (Subject to change) I Semester:

S. No.	Events	1st Semester
1.	Registration/Fee deposition for admission of Students	Dec 01, 2025
2.	Last date for Admission/Registration and payment with late fee	Dec 04, 2025
3.	*Deeksharambh* Programme of first year B. Tech. students	Dec 01 – 10, 2025
4.	Commencement of Classes	Dec 11, 2025
5.	Quiz Examination	Jan 12 –16, 2026
6.	Last Date for Submission of Quiz Exam Results	Jan 23, 2026
7.	Mid Term examination	Feb 09 –20, 2026
8.	Last date of submission of result of Mid Term examination	Feb 27, 2026
9.	End Term Examination	Mar 23 – April 01, 2026
10.	Internal Practical Examination	April 02 – 10, 2026
11.	Semester Break	April 11 – 19, 2026
12.	Declaration of Result	April 20, 2026

TERM CALENDAR (Subject to change) II Semester:

S. No.	Events	2nd Semester
1.	Registration/Fee deposition	April 20, 2026
2.	Last date for Admission/Registration and payment with late fee	April 23, 2026
3.	Commencement of Classes	April 21, 2026
4.	Quiz Examination	May 25 - 29, 2026
5.	Last Date for Submission of Quiz Exam Results	June 05, 2026
6.	Mid Term examination	June 22 – July 03, 2026
7.	Last date of submission of result of Mid Term examination	July 10, 2026
8.	End Term Examination	Aug 03 – 11, 2026
9.	Internal Practical Examination	Aug 12 – 21, 2026
10.	Semester Break	Aug 22 –30, 2026
11.	Declaration of Result of Semester end examination	Aug 31, 2026

NOTE: In case of holiday falls on any above date, the schedule will be shifted to next working day.

12. B. TECH BIOTECH WITH SPECIALIZATION IN ANIMAL BIOTECHNOLOGY SEMESTER-WISE DISTRIBUTION OF COURSES

Sl. No.	Course Title	Credit Hours	Total Credit hours
FIRST YEAR			
Semester I			
1.	*Deeksharambh* (Foundation Course)	2 (0+2) NG Non-gradial	
2.	Introductory Cell Biology	3 (3+0)	**21 (13+8) +2 Non-gradial**
3.	Fundamentals of Genetics	3 (3+0)	
4.	Basic Mathematics/Basic Botany/Basic Zoology	2 (2+0)	
5.	Environmental Studies and Disaster Management	3 (2+1)	
6.	Farming Based Livelihood Systems	3 (2+1)	
7.	Communication Skills	2 (1+1)	
8.	National Cadet Corps I/ National Service Scheme I	1 (0+1)	
9.	SEC 1: Practices in Animal Cell Culture	2 (0+2)	
10.	SEC 2: Laboratory Management and Instrumentation	2 (0+2)	
Semester II			
1.	Introduction to Biotechnology	3 (3+0)	**21 (12+9)**
2.	Introduction to Plant Breeding	3 (2+1)	
3.	Elementary Microbiology	2 (1+1)	
4.	Entrepreneurship Development and Business Management	3 (2+1)	
5.	Molecular Biology	3 (3+0)	
6.	Personality Development	2 (1+1)	
7.	National Cadet Corps II/ National Service Scheme II	1 (0+1)	
8.	SEC 3: Basic Techniques of Molecular Biology and Biotechnology	2 (0+2)	
9.	SEC 4: Bioinformatics and Biocomputation	2 (0+2)	
SECOND YEAR			
Semester III			
1.	Livestock Production and Management	3 (2+1)	**20 (12+8)**
2.	Recombinant DNA Technology	2 (2+0)	
3.	Molecular Marker Technology	2 (2+0)	
4.	Anatomy and Physiology of Livestock	3 (2+1)	
5.	Livestock Product Technology	3 (2+1)	
6.	Agriculture Informatics and Artificial Intelligence	3 (2+1)	
7.	Physical Education, First Aid and Yoga Practice	2 (0+2)	
8.	SEC 5: Methods in Recombinant DNA Technology	2 (0+2)	
Semester IV			
1.	Introductory Bioinformatics	4 (3+1)	**21 (15+6)**
2.	Classical and Molecular Cytogenetics	3 (2+1)	
3.	Biomathematics	2 (2+0)	
4.	Basic Biochemistry	4 (3+1)	
5.	Human Ethics	1 (1+0)	
6.	Agriculture Marketing and Trade	3 (2+1)	
7.	Biodiversity and Its Conservation	2 (2+0)	
8.	SEC 6: Practices in Molecular Marker Technology	2 (0+2)	

THIRD YEAR			
Semester V			
1.	Microbial Genetics	4 (3+1)	**23 (18+5) +2 (Non-gradial)**
2.	Molecular Genetics	3(3+0)	
3.	Nanobiotechnology	4 (3+1)	
4.	Animal Biotechnology	3 (2+1)	
5.	Genomics and Proteomics	3 (3+0)	
6.	Enzymology and Enzyme Technologies	3 (2+1)	
7.	Immunology	3 (2+1)	
8.	Educational Tour	2 (0+2) NG	
Semester VI			
1.	Molecular Diagnostics	3 (2+1)	**20 (15+5)**
2.	Industrial Biotechnology	3 (3+0)	
3.	Epigenetics and Gene Regulation	2 (2+0)	
4.	IPR, Biosafety and Bioethics	2 (2+0)	
5.	Computational Biology	3 (2+1)	
6.	Introduction to Animal Breeding	3 (2+1)	
7.	Biostatistics	2 (1+1)	
8.	Food Science and Processing	3 (2+1)	
FOURTH YEAR			
Semester VII			
	Animal Biotechnology		
1.	Principles and Procedures of Animal Cell Culture	4 (3+1)	**20 (14+6)**
2.	Animal Genomics	4 (3+1)	
3.	Transgenic Animal Production	3 (3+0)	
4.	Molecular Virology and Vaccine Production	3 (2+1)	
5.	Embryo Transfer Technologies	3 (2+1)	
6.	Animal Reproductive Biotechnology	3 (2+1)	
Semester VIII			
1.	Student READY (RAWE/industry attachment/experiential learning/hands on training/project work/internship) in the area of Animal Biotechnology	20 (0+20)	**20 (0+20)**

13. B. TECH BIOTECH WITH SPECIALIZATION IN ANIMAL BIOTECHNOLOGY DEPARTMENT-WISE COURSE BREAKUP

Sl. No	Department-wise Courses	Credit Hours
Agriculture Courses		
1.	Farming Based Livelihood Systems	3 (2+1)
2.	Introduction to Plant Breeding	3 (2+1)
3.	Agriculture Marketing and Trade	3 (2+1)
Animal Science Courses		
1.	Livestock Production and Management	3 (2+1)
2.	Anatomy and Physiology of Livestock	3 (2+1)
3.	Livestock Product Technology	3 (2+1)
4.	Introduction to Animal Breeding	3 (2+1)
Basic Science Courses		

1.	Biomathematics	2 (2+0)
2.	Basic Biochemistry	4 (3+1)
3.	Enzymology and Enzyme Technologies	3 (2+1)
4.	Immunology	3 (2+1)
5.	Biostatistics	2 (1+1)
Biotechnology Core Courses		
1.	Molecular Biology	3 (3+0)
2.	Introductory Cell Biology	3 (3+0)
3.	Fundamentals of Genetics	3 (3+0)
4.	Practices in Animal cell Culture	2 (0+2)
5.	Laboratory Management and Instrumentation	2 (0+2)
6.	Introduction to Biotechnology	3 (3+0)
7.	Elementary Microbiology	2 (1+1)
8.	Basic Techniques of Molecular Biology and Biotechnology	2 (0+2)
9.	Bioinformatics and Biocomputation	2 (0+2)
10.	Recombinant DNA Technology	2 (2+0)
11.	Classical and Molecular Cytogenetics	3 (2+1)
12.	Methods in Recombinant DNA Technology	2 (0+2)
13.	Introductory Bioinformatics	4 (3+1)
14.	Molecular Marker Technology	2 (2+0)
15.	Biodiversity and Its Conservation	2 (2+0)
16.	Practices in Molecular Marker Technology	2 (0+2)
17.	Microbial Genetics	4 (3+1)
18.	Molecular Genetics	3 (3+0)
19.	Nanobiotechnology	4 (3+1)
20.	Animal Biotechnology	3 (2+1)
21.	Genomics and Proteomics	3 (3+0)
22.	Molecular Diagnostics	3 (2+1)
23.	Industrial Biotechnology	3 (3+0)
24.	Epigenetics and Gene Regulation	2 (2+0)
25.	IPR, Biosafety and Bioethics	2 (2+0)
26.	Principles and Procedures of Animal Cell Culture	4 (3+1)
27.	Animal Genomics	4 (3+1)
28.	Transgenic Animal Production	3 (3+0)
29.	Molecular Virology and Vaccine Production	3 (2+1)
30.	Embryo Transfer Technologies	3 (2+1)
31.	Animal Reproductive Biotechnology	3 (2+1)
Deficiency/Remedial Courses		
1.	Basic Mathematics	2 (2+0)
2.	Basic Botany	2 (2+0)
3.	Basic Zoology	2 (2+0)
General Courses		
1.	National Cadet Corps I/ National Service Scheme I	1 (0+1)
2.	Communication Skill	2 (1+1)
3.	Entrepreneurship Development and Business Management	3 (2+1)
4.	Environmental Studies and Disaster Management	3 (2+1)
5.	National Cadet Corps II/ National Service Scheme II	1 (0+1)
6.	Personality Development	2 (1+1)
7.	Physical Education, First Aid and Yoga Practice	2 (0+2)

8.	Human Ethics	1 (1+0)
9.	Agriculture Informatics	3 (2+1)
10.	Computational Biology	3 (2+1)
11.	Food Science and Processing	3 (2+1)
Student READY		**20 (0+20)**
Non-gradial Courses		
1.	*Deeksharambh* (Foundation Course)	2 (0+2)
2.	*Educational Tour*	2 (0+2)
MOOCs/Online Courses		**10 (0+10)**

14. SUMMARY OF CREDIT HOURS FOR DIFFERENT CATEGORIES OF COURSES

Sl. No.	Major Courses	Credit Hours	Total Credit Hours
1.	Molecular Biology	3 (3+0)	**60 (51+9)**
2.	Introductory Cell Biology	3 (3+0)	
3.	Fundamentals of Genetics	3 (3+0)	
4.	Introduction to Biotechnology	3 (3+0)	
5.	Introduction to Plant Breeding	3 (2+1)	
6.	Elementary Microbiology	2 (1+1)	
7.	Livestock Production and Management	3 (2+1)	
8.	Recombinant DNA Technology	2 (2+0)	
9.	Classical and Molecular Cytogenetics	3 (2+1)	
10.	Introductory Bioinformatics	4 (3+1)	
11.	Molecular Marker Technology	2 (2+0)	
12.	Biodiversity and Its Conservation	2 (2+0)	
13.	Microbial Genetics	4 (3+1)	
14.	Molecular Genetics	3 (3+0)	
15.	Nanobiotechnology	4 (3+1)	
16.	Animal Biotechnology	3 (2+1)	
17.	Genomics and Proteomics	3 (3+0)	
18.	Molecular Diagnostics	3 (2+1)	
19.	Industrial Biotechnology	3 (3+0)	
20.	Epigenetics and Gene Regulation	2 (2+0)	
21.	IPR, Biosafety and Bioethics	2 (2+0)	
Minor Courses			
1.	Basic Mathematics/Basic Botany/Basic Zoology	2 (2+0)	**32 (23+9)**
2.	Anatomy and Physiology of Livestock	3 (2+1)	
3.	Livestock Product Technology	3 (2+1)	
4.	Biomathematics	2 (2+0)	
5.	Basic Biochemistry	4 (3+1)	
6.	Human Ethics	1 (1+0)	
7.	Enzymology and Enzyme Technologies	3 (2+1)	
8.	Immunology	3 (2+1)	
9.	Computational Biology	3 (2+1)	
10.	Introduction to Animal Breeding	3 (2+1)	
11.	Biostatistics	2 (1+1)	
12.	Food Science and Processing	3 (2+1)	

Multi-Disciplinary Courses			
1.	Farming Based Livelihood Systems	3 (2+1)	**9 (6+3)**
2.	Entrepreneurship Development and Business Management	3 (2+1)	
3.	Agriculture Marketing and Trade	3 (2+1)	
Value Added Courses			
1.	Environmental Studies and Disaster Management	3 (2+1)	**6 (4+2)**
2.	Agriculture Informatics	3 (2+1)	
Ability Enhancement Courses			
1.	National Cadet Corps I/ National Service Scheme I	1 (0+1)	**8 (2+6)**
2.	Communication Skill	2 (1+1)	
3.	National Cadet Corps II/ National Service Scheme II	1 (0+1)	
4.	Personality Development	2 (1+1)	
5	Physical Education, First Aid and Yoga Practice	2 (0+2)	
Skill Enhancement Courses (SEC)			
1	SEC 1: Practices in Animal Cell Culture	2 (0+2)	**12 (0+12)**
2	SEC 2: Laboratory Management and Instrumentation	2 (0+2)	
3	SEC 3: Basic Techniques of Molecular Biology and Biotechnology	2 (0+2)	
4	SEC 4: Bioinformatics and Biocomputation	2 (0+2)	
5	SEC 5: Practices in Recombinant DNA Technology	2 (0+2)	
6	SEC 6: Practices in Molecular Marker Technology	2 (0+2)	
Elective Courses in Animal Biotechnology			
1	Principles and Procedures of Animal Cell Culture	4 (3+1)	**20 (15+5)**
2	Animal Genomics	4 (3+1)	
3	Transgenic Animal Production	3 (3+0)	
4	Molecular Virology and Vaccine Production	3 (2+1)	
5	Embryo Transfer Technologies	3 (2+1)	
6	Animal Reproductive Biotechnology	3 (2+1)	
Student READY			**20**
Non-gradial Courses			
1	Deeksharambh (Foundation Course)	2 (0+2)	**4 (0+4)**
2	Educational Tour	2 (0+2)	
MOOCs/Online Courses			**10**

Abstract of Credit Hour Allocation over the Semesters (Credit Hours)

Semester	Core Courses (Major+ Minor)	Multi-Disciplinary Courses (MDC)	Value Added Courses (VAC)	Ability Enhancement Courses (AEC)	Skill Enhancement Courses (SEC)	Internship/ Project/ Student READY	Total Credit Hours	Non-gradial	MOOCs/ Online Courses
I	11	3(1)		1(2) + 2(3)	4(4,5)	-	21	2(6)	10
II	8	3(7)	3(8)	1(9) + 2(10)	4(11,12)	-	21	-	
Post-II	-	-	-	-	-	10(13)	-	-	
III	16	-	-	2(14)	2(15)	-	20	-	
IV	13	3(16)	3(17)	-	2(18)	-	21	-	
Post-IV	-	-	-	-	-	10(19)	-	-	
V	23	-	-	-	-	-	23	2(20)	
VI	21	-	-	-	-	-	21	-	
VII	20	-	-	-	-	-	20	-	
VIII	-	-	-	-	-	20	20	-	
Total	**112**	**9**	**6**	**8**	**12**	**20**	**167**	**4**	**10**

Note: The credit hours indicated represent the combined total of theory and practical components.

[(1)] Farming Based Livelihood Systems
[(2)] National Cadet Corps I/ National Service Scheme I
[(3)] Communication Skill
[(4)] Practices in Animal Cell Culture
[(5)] Laboratory Management and Instrumentation
[(6)] *Deeksharambh* (Foundation Course)
[(7)] Entrepreneurship Development and Business Management
[(8)] Environmental Studies and Disaster Management
[(9)] National Cadet Corps II/ National Service Scheme II
[(10)] Personality Development
[(11)] Basic Techniques of Molecular Biology and Biotechnology
[(12)] Bioinformatics and Biocomputation
[(13)] Internship for those exiting with UG-Certificate in Biotechnology
[(14)] Physical Education, First Aid and Yoga Practice
[(15)] Practices in Recombinant DNA Technology
[(16)] Agriculture Marketing and Trade
[(17)] Agriculture Informatics
[(18)] Practices in Molecular Marker Technology
[(19)] Internship for those exiting with UG-Diploma in Biotechnology
[(20)] Educational Tour

Summary of Credit Distributions

Categories of Courses		**Credit Hours**
Core Courses (Major and Minor)	:	92
Common Courses (MDC+VAC+AEC)	:	23
Skill Enhancement Courses (SEC)	:	12
Elective Courses	:	20
Student READY	:	20
MOOCs/Online Courses (Non-gradial)	:	10**
Grand Total	**:**	**167+10****

15. EXAMINATION AND EVALUATION SYSTEM

There will be a uniform system of the evaluation and grading to be followed with Grade point average (GPA) system. The following pattern of examination is recommended.

	External Theory	**Internal Theory (Mid-Term)**	**Quiz/ progressive assessment**	**External Practical**
For courses having both theory and practical components	40%	20%	20%	20%
For courses with theory only	50%	30%	20%	-
Courses with practical only	-	30%	20%	50%

For the external theory examinations, the question paper will be obtained from external experts. The HoDs of the respective departments will ensure due coverage of the syllabus with the provision of moderation, if necessary. Paper evaluation to be done by a external expert.

The external theory examinations should be of 2 to 2.5 hours' duration and the mid-term examinations should be normally of 1-hour duration. The format of assessment and

duration of quizzes/ progressive assessment duration will depend upon the course teacher.

External practical examination to be conducted by the external expert.

The evaluation of the skill enhancement courses will be done as courses with practical only.

Usually for any subject, there will be two quizzes within the semester, one before the mid-term and one after. There will be provision of corrections in between, i.e. the students scoring lower than 50% marks in any one quiz can opt for appearing for a third quiz to improve their grades. The assessment of the students through quizzes should focus on their critical thinking and creativity rather than rote reading.

The quiz and progressive assessment can also be considered in form of group assignments (which should encourage creativity, critical thinking and problem-solving attitude).

The evaluation of internship will be done both by the parent institute and the host industry/ organisation. It should be 50% weightage for each. The student shall submit a report to the parent institute and present the learnings before the other students and faculty after the internship programme. The format of evaluation may be developed by the parent institute.

The online/MOOC courses, successfully completed by the student, will be indicated in the transcript with 'Satisfactory' remark.

When students take deficiency course(s), they will be assessed as 'Satisfactory' or 'Unsatisfactory' without any grade points.

The evaluation will be done on a 10-point scale.

10 point = 100 marks

The per cent of marks in a subject will be divided by 10 to obtain the grade point.

The grade point average for a semester will be calculated as follows.

$$GPA = \frac{\sum (Grade\ \ p\ \ \text{int} \times credit\ \ hours)_{\text{in one semester}}}{Total\ \ credit\ \ hours \text{ in the semester}}$$

The Cumulative grade point earned at any stage of the course will be calculated as cumulative grade point average (CGPA) as follows.

$$\text{CGPA} = \frac{\sum (\text{Grade p int} \times \text{credit hours})_{\text{until last semester}}}{\text{Total credit hours until last semester}}$$

If a student passes in a subject in a second attempt, for calculation of CGPA, the grade point for the subject in the second attempt will only be considered. The final CGPA will be named as overall grade point average (OGPA), which will be mentioned in the final transcript of the students.

Award of Divisions

The award of the divisions will be as follows

OGPA	**Division**
5 to <6	Pass
6 to <7	II division
7 to<8	I Division
>=8	1st division and distinction

Semester VIII

1. Project Formulation, Execution and Presentation of 12 weeks duration to be taken up during VIII semester with a weightage of 0+10 credit hours.
2. Entrepreneurial Development in Biotechnology (On-campus/Off-campus) of 12 weeks duration to be taken up during VIII semester in Molecular Diagnostics; Recombinant Protein Production; Animal Cell Culture and Maintenance, etc. with a weightage of 0+10 credit hours.

Student READY - Project Formulation, Execution and Presentation 0+10

Evaluation Criteria:

Parameter	Marks Distribution (%)
Project Formulation and Implementation	20
Work Performance	30
Regularity, General Conduct and Discipline	10
Initiative and Creativity	10
Final Presentation	15
Final Project Report	15

Student READY - Entrepreneurial Development in Biotechnology 10(0+10)

Molecular Diagnostics; Recombinant protein production; Animal cell culture and maintenance, etc.

Evaluation Criteria:

Parameter	Marks Distribution (%)
Project Planning, Writing and Presentation	20
Regularity	10
Monthly Assessment	10
Output Delivery	15
Technical Skill Development	15
Entrepreneurial and Business Networking Skills	10
Report Writing	10
Final Presentation	10

16. ATTENDANCE OF STUDENTS

i. Every student shall attend a minimum of 75% of the total number of lecture and laboratory courses (practical) separately in each course.

ii. Students falling short of the prescribed minimum attendance in a particular course shall not be permitted by the Coordinator (B.Tech.) to take in the examination for that course.

iii. A student can be granted 15 days medical leaves in an Academic Year. Medical leave can be granted only as per the medical certificate from IVRI Medical Officer or District Hospital or IVRI recognized Hospitals.

iv. Cases of students remaining on un-explained absence for more than 15 days shall be promptly reported to the Joint Director (Acad.) and the name of such students shall be struck off from the university rolls for their unauthorized absence.

17. SYLLABUS

Semester I

***DEEKSHARAMBH* (FOUNDATION COURSE)** **2 (0+2)**

Objective

- Aims at creating a platform for students to help for cultural Integration of students from different backgrounds, know about the operational framework of academic process in university, instill life and social skills, social awareness, ethics and values, team work, leadership, creativity, etc. and identify the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario.

  The details of activities will be decided by the parent universities. The structure shall include, but not restricted to:

i. Discussions on operational framework of academic process in University, as well as interactions with academic and research managers of the University.

ii. Interaction with alumni, business leaders, perspective employers, outstanding achievers in related fields, and people with inspiring life experiences.

iii. Group activities to identify the strength and weakness of students (with expert advice for their improvement) as well as to create a platform for students to learn from each other's life experiences.

iv. Activities to enhance cultural Integration of students from different backgrounds.

v. Field visits to related fields/ establishments.

vi. Sessions on personality development (instilling life and social skills, social awareness, ethics and values, team work, leadership, etc.) and communication skills.

MOLECULAR BIOLOGY **3 (3+0)**

Objectives

1. To study the principles and techniques of molecular biology
2. To study the central dogma of life
3. To study the tools in molecular biology

Theory

History of molecular biology. Central dogma of life. Structure of DNA and RNA. Gene structure and function. DNA replication and transcription. Genetic code and translation. Structure of prokaryotic and eukaryotic nuclear and organelle genomes. Gene regulation in prokaryotes. Lac operon concept and tryp operon concept.

Introduction to microbial genetics; conjugation, transformation and transduction. Tools in molecular biology. Role of enzymes in molecular biology. Principles of Polymerase Chain Reaction and electrophoresis.

Suggested Reading

1. Cooper GM and Hausman RE, 2018, The Cell: A Molecular Approach. Sinauer Associates Inc, 8th edn.
2. Lewin B, 2017, Gene XII, Oxford University Press.
3. Nelson DL and Cox MM, 2017, Lehninger Principles of Biochemistry. 7th edn. W. H. Freeman.

4. Satyanarayana U and Chakrapani U, 2021, Essentials of Biochemistry, Elsevier.

INTRODUCTORY CELL BIOLOGY **3 (3+0)**

Objectives

Students will understand-

1. the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
2. how these cellular components are used to generate and utilize energy in cells
3. the cellular components underlying mitotic cell division
4. apply their knowledge of cell biology to selected examples of changes or losses in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.

Theory

Origin and evolution of cell. Introduction to microscopy. Sub-cellular structure of prokaryotic and eukaryotic cells. Membrane structure and function: plasma membrane, cell wall and extracellular matrix. Structural organization and function of intracellular organelles and organelle biogenesis. Nucleus, mitochondria, endoplasmic reticulum, golgi apparatus, lysosomes, peroxisomes, plastids and vacuoles.

Structure and function of the cytoskeleton and its role in motility. Cell membrane transport. Introduction to cell signalling. Cell growth, cell cycle and its control. Cell death and cell renewal.

Suggested Reading

1. Verma PS and Agarwal VK, 2016, Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S Chand and Sons.
2. Cooper GM and Hausman RE, 2018, The Cell: A Molecular Approach. Sinauer Associates Inc.

FUNDAMENTALS OF GENETICS **3 (3+0)**

Objectives

1. To study the history of genetics
2. To study inheritance and variation
3. To study chromosomes and cell division
4. To study the genetic basis of traits

Theory

History of Genetics. Mendel's principles and rediscovery. Cell division. Chromosome structure and function. Chromosome theory of inheritance. Sex-linked, sex-limited and sex-influenced inheritance. Sex determination and sex differentiation.

Multiple allelism. Linkage and crossing-over. Gene-gene interaction. Genetic analysis in prokaryotes and eukaryotes. Extra chromosomal inheritance. Mutations. Hardy-Weinberg law. Quantitative inheritance. Introduction to human genetics. Genetic basis of evolution.

Suggested Reading

1. Brah GS, 2014, Animal Genetics: Concepts and Implications, 2nd edn, Kalyani

Publishers.
2. Gardener EJ, Simmons MJ and Snustad DP, 1991, Principles of Genetics. John Wiley and Sons, Inc, New York, USA.

BASIC MATHEMATICS **2 (2+0)**

Objectives

1. To study the basic principles and functions in mathematics like limits and continuity
2. To study differentiation and integration
3. To study matrices and determinants

Theory

Functions; Limit: Introduction, left-handed and right-handed limits, general rules for the calculation of limits Standard limits. Continuity: Definition of continuity, continuity of algebraic functions. Continuity of trigonometric and exponential functions.

Differentiation: Differentiation by the first principle, sum, difference, product and quotient formulae, differentiation using the chain rule, differentiation of functions in parametric and implicit form, logarithmic differentiation, geometrical interpretation of derivative. Successive ifferentiation, geometrical interpretation of derivative, maxima and minima, tangent and normal.

Integration: Integration by substitution, integration by partial fractions, integration by parts, integration by trigonometric substitution.

Matrices and Determinants: Definition of matrix, addition, subtraction and multiplication, inverse of matrix. Solution of linear equations; by Crammer's rule and inverse of matrix.

Suggested Reading

1. NCERT, 2012, Mathematics of Class XII, NCERT, India.
2. Sharma RD, 2014, Mathematics of Class XII, Dhanpat Rai Publisher.

BASIC BOTANY **2 (2+0)**

Objectives

1. To study the basic taxonomy and classification of plants
2. To study the features of plant kingdom and morphology
3. To study the internal structure of plants

Theory

Plant kingdom and features of each group. Morphology, modifications and functions of root, stem, leaf, flower and inflorescence. Pollination and fertilization. Fruit types. Structure of dicot and monocot seed, and seed germination.

Cell structure. DNA, chromosome and genes. Cell and tissue types. Internal structure of root, stem and leaf. Plant taxonomy, systems of classification. Characteristics and economic importance of Poaceae, Brassicaceae, Fabaceae, Malvaceae, Rutaceae, Rosaceae, Asteraceae and Solanaceae families.

Suggested Reading

1. Bendre AM and Kumar A, 1999, Textbook of Practical Botany. Vol. 2, 7th edn, Rastogi Publications.
2. Bendre AM and Pande PC, 2009, Introduction to Botany, Rastogi publications.
3. Bhatia K.N. and Tyagi M.P. 2020 Elementary Biology. A truemen publication
4. David M Hillis; H Craig Heller; Sally D Hacker; David W Hall; David E Sadava. 2020. Life: the

1. science of biology 12th edn, Sunderland publication. eBook
5. Dutta AC, 1995, A Class Book of Botany, 16th edn, Oxford University Press.
6. NCERT 2021. Biology of Class XI. NCERT, India.
7. Pande PC and Jain DK, 2022, A textbook of Botany Angiosperm. S. Chand publications.

BASIC ZOOLOGY **2 (2+0)**

Objectives

1. To study cells and biomolecules
2. To study animal kingdom and nomenclature
3. To study the organization of mammalian systems

Theory

Introduction to Zoology. Structure and functions of cell and cell organelles. Difference between prokaryotic and eukaryotic cell. Structure and function of biomolecules. Types of simple and compound tissues.

Binomial nomenclature. Classification and general survey of the animal kingdom. Functional organization of various systems of a mammal; digestive, circulatory, respiratory, excretory, nervous and reproductive. Laws of inheritance. Multipleallelism - blood groups. Genetic disorders in human and their inheritance.

Suggested Reading

1. Bhatia KN and Tyagi MP, 2020, Elementary Biology, A Truemen Publication.
2. Chopra G and Dhami PS, 2021, A Text Book of Biology, Pradeep Publications.
3. David MH, Craig HH, Sally DH, David WH and David ES, 2020, Life: the science of biology,12th Ed, Sunderland Publication.
4. NCERT, 2022, Biology of Class XI, 2022-23. NCERT, India.

FARMING BASED LIVELIHOOD SYSTEMS **3 (2+1)**

Objectives

1. To make the students aware about farming based livelihood systems in agriculture
2. To disseminate the knowledge and skill how farming based systems can be a source of livelihood

Theory

Status of agriculture in India and different states. Income of farmers and rural people in India. Livelihood-definition, concept and livelihood pattern in urban and rural areas. Different indicators to study livelihood systems. Agricultural livelihood systems (ALS); meaning, approach, approaches and framework. Definition of farming systems and farming based livelihood systems prevalent farming systems in India contributing to livelihood. Types of traditional and modern farming systems. Components of farming system/ farming-based livelihood systems- crops and cropping systems, livestock, (dairy, piggery, goatry, poultry, duckry etc.). Horticultural crops, agroforestry systems, aquaculture, duck/poultry cum fish, dairy cum fish, piggery cum fish etc. Small, medium and large enterprises including value chains and secondary enterprises as livelihood components for farmers. Factors affecting integration of various enterprises of farming for livelihood. Feasibility of different farming systems for different agro-climatic zones. Commercial farming-based livelihood models by NABARD, ICAR and other organizations across the country. Case studies on different livelihood enterprises associated with the farming. Risk and success factors in farming-based livelihood systems. Schemes and program by central and state government, public and private organizations involved in promotion of farming-based livelihood opportunities. Role of farming based livelihood

enterprises in 21st century in view of circular economy, green economy, climate change, digitalization and changing life style.

Practical

Survey of farming systems and agriculture-based livelihood enterprises. Study of components of important farming-based livelihood models/ systems in different agro-climatic zones. Study of production and profitability of crop based, livestock based, processing based and integrated farming based livelihood models. Field visit of innovative farming system models. Visit of agri-based enterprises and their functional aspects for integration of production, processing and distribution sectors and study of agri-enterprises involved in industry and service sectors (value chain models). Learning about concept of project formulation on farming-based livelihood systems along with cost and profit analysis. Case study of start-ups in agri-sectors.

Suggested Reading

1. Agarwal A and Narain S, 1989, Towards Green Villages: A strategy for Environmentally, Sound and Participatory Rural Development, Center for Science and Environment, New Delhi.
2. Ashley C and Carney D, 1999, Sustainable Livelihoods: Lessons from Early Experience; Department for International Development: London, UK, Volume 7.
3. Bhatt BP, Abhay Kumar, Thakur PK, RS, Amitava Dey UK, Sanjeev Kumar BK, Jha, LK, Pathak KN, Hassan A, Singh SK, Singh KK and Singh KM, 2014, Livelihood Improvement of Underprivileged Farming Community: Some Experiences from Vaishali, Samastipur, Darbhanga and Munger Districts of Bihar by ICAR Research Complex for Eastern Region ICAR Parisar, P.O. Bihar Veterinary College, Patna - 800 014, Bihar.
4. Carloni A, 2001, Global Farming Systems Study: Challenges and Priorities to 2030 – Regional Analysis: Sub-Saharan Africa, Consultation Document, FAO, Rome, Italy.
5. Dixon J, Gulliver A and Gibbon D, 2001, Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World, FAO & World Bank, Rome, Italy & Washington, DC, USA.
6. Evenson RE, 2000, Agricultural Productivity and Production in Developing Countries', In FAO, The State of Food and Agriculture, FAO, Rome, Italy.
7. Panwar AS, Ravisankar N, Prusty AK, Shamim M, Singh R, Bhaskar S, Malik SK, Tomar RK, Arunachalam A and Alagusundaram K, 2019, Integrated Farming System models for Agricultural Diversification, Enhanced Income and employment, Indian Council of Agricultural Research, New Delhi.
8. Reddy SR, 2016, Farming System and Sustainable Agriculture, Kalyani Publishers, New Delhi.
9. Singh JP, Ravisankar N, Prusty AK, Sikka AK and Gangwar B, 2016, Region Specific Synthesized Integrated Farming System Models for Improved Production, Profitability and Nutrition (Series 1). IIFSR Bulletin No. 2016-1, AICRP on Integrated Farming Systems, ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut, pp. 1-88.
10. Walia SS and Walia US, 2020, Farming System and Sustainable Agriculture, Scientific Publishers, Jodhpur, Rajasthan.

NATIONAL SERVICE SCHEME-I **1 (0+1)**

Objective

Evoking social consciousness among students through various activities viz., working together, constructive, and creative social work, to be skillful in executing democratic leadership, developing skill in program, to be able to seek self-employment,

reducing gap between educated and uneducated, increasing awareness and desire to help sections of society

Practical

Orientation: history, objectives, principles, symbol, badge; regular programs under National Service Scheme (NSS). Organizational structure of NSS, Code of conduct for NSS volunteers, points to be considered by NSS volunteers' awareness about health. NSS program activities. Concept of regular activities, special camping, day camps, basis of adoption of village/slums, conducting survey, analyzing guiding financial patterns of scheme, youth program/ schemes of GoI, coordination with different agencies and maintenance of diary. Understanding youth. Definition, profile, categories, issues and challenges of youth; and opportunities for youth who is agent of the social change. Community mobilization. Mapping of community stakeholders, designing the message as per problems and their culture; identifying methods of mobilization involving youth-adult partnership. Social harmony and national integration. Indian history and culture, role of youth in nation building, conflict resolution and peace- building. Volunteerism and *shramdaan.* Indian tradition of volunteerism, its need, importance, motivation, and constraints; shaman as part of volunteerism. Citizenship, constitution, and human rights. Basic features of constitution of India, fundamental rights and duties, human rights, consumer awareness and rights and rights to information. Family and society. Concept of family, community (PRIs and other community-based organizations) and society.

COMMUNICATION SKILLS **2 (1+1)**

Objective

To acquire competence in oral, written and non-verbal communication, develop strong personal and professional communication and demonstrate positive group communication.

Theory

Communication process: the magic of effective communication. Building self-esteem and
overcoming fears. Concept, nature and significance of communication process. Meaning, types and
models of communication. Verbal and non-verbal communication. Linguistic and non-linguistic
barriers to communication and reasons behind communication gap/ miscommunication.

Basic communication skills. Listening, speaking, reading and writing skills. Precise writing/abstracting/summarizing. Style of technical communication. Curriculum vitae/resume writing. Innovative methods to enhance vocabulary, analogy questions.

Structural and functional grammar. Sentence structure, modifiers, connecting words and verbal. Phrases and clauses. Case: subjective case, possessive case, objective case. Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles. Agreement of verb with the subject: tense, mood, voice. Writing effective sentences. Basic sentence faults.

Practical

Listening and note taking. Writing skills; precise writing, summarizing and abstracting. Reading and comprehension (written and oral) of general and technical articles. Micro-presentations and impromptu presentations. Feedback on presentations. Stage manners; grooming, body language, voice modulation, speed. Group discussions. Public speaking exercises; vocabulary building exercises. Interview techniques. Organization of events.

Suggested Reading

1. Allport, GW, 1937, Personality: A Psychological Interpretation. Holt, New York.
2. Brown M and Gyles B, 1994, How to Interview and be Interviewed, Sheldon Press, London.
3. Carnegie D, 1997, The Quick and Easy Way to Effective Speaking, Pocket Books, New York.
4. Francis Peter SJ, 2012, Soft Skills and Professional Communication, Tata McGraw Hill, New Delhi.
5. Kumar S and Pushpa Lata, 2011, Communication Skills, Oxford University Press.
6. Neuliep JW, 2003, Intercultural Communication A Contextual Approach. Houghton Mifflin Co Boston.
7. Pease, A, 1998, Body Language, Sudha Publications, Delhi.
8. Raman M and Singh P, 2000, Business Communication, Oxford University Press.
9. Seely J, 2013, Oxford Guide to Effective Writing and Speaking, Oxford University Press.
10. Thomson AJ and Martinet AV, 1977, A Practical English Grammar, Oxford University.

PRACTICES IN ANIMAL CELL CULTURE **2 (0+2)**

Objectives

To learn-

1. Washing of glasswares, packing and sterilization of glass and plasticware for cell culture
2. Preparation of media and reagents for cell culture.
3. Primary culture technique. Culture and sub-culturing of continuous cell lines. Viability assay by trypan blue dye exclusion method. Cryopreservation of primary cultures and cell lines.
4. Tissue culture laboratory management.

Practical

Laboratory safety and aseptic techniques. Cell culture media and supplements. Composition of cell culture media: DMEM, RPMI, MEM, etc. Serum and serum-free media formulations. Preparation and sterilization of media supplements. Cell culture initiation and maintenance. Cell line authentication and characterization, Thawing and subculturing of cells. Monitoring cell growth and viability. Cell passaging and cryopreservation. Cell line development and authentication. Methods for establishing new cell lines. Authentication techniques: STR profiling, isoenzyme analysis, quality control measures in cell culture. Cell-based assays. Principles of cell-based assays: viability, proliferation, apoptosis, techniques for measuring cell responses: MTT assay, flow cytometry, ELISA. Application of cell-based assays in drug screening and toxicity testing. Transfection (lipofection, electroporation) and gene expression, 3D-cell culture and tissue engineering, cell culture project. Students design and conduct a small-scale cell culture project. They will choose a specific cell line or assay, culture cells accordingly, perform experiments, analyze data, and present their findings.

Suggested Reading

1. Al-Rubeai M (Ed), 2015, Animal cell culture. Springer International Publishing, ISBN: 978-3-319-10319-8, 978-3-319-10320-4.
2. Bhatia S, Naved T and Sardana S, 2019, Introduction to animal tissue culture science, IOP Publishing Ltd.
3. Butler M, 2004, Animal cell culture and technology, Taylor and Francis, ISBN: 9781859960493,1859960499.

4. Davis JM (Ed), 2011, Animal cell culture: essential methods. John Wiley and Sons, ISBN: 0470666587, 9780470666586.
5. Michael B, 2003, Animal Cell Culture and Technology, THE BASICS (Garland Science).

LABORATORY MANAGEMENT AND INSTRUMENTATION 2 (0+2)

Objectives

1. To study the establishment and management of different molecular biology laboratories
2. To impart hands-on training on good laboratory practices, calculation of per cent solutions, molarity, molality, normality; and preparation of buffers
3. To study basic equipments used in animal molecular biology and cell culture laboratories, record keeping, teamwork, and SOP of different instruments of the labs
4. Safe disposal of laboratory chemiclas and reagents as per the biosafety guidelines.

Practical

Importance of laboratory safety and regulatory compliance. Quality management systems: ISO 9001, GLP, GMP, laboratory safety and regulatory compliance. Risk assessment and hazard identification. Inventory management and equipment maintenance. Principles of laboratory inventory management. Equipment calibration and preventive maintenance. Documentation and record-keeping for regulatory compliance. Quality assurance and control. Introduction to quality assurance (QA) and quality control (QC). Quality control checks for laboratory reagents and instruments, Troubleshooting common laboratory errors and deviations. Spectroscopy and spectrophotometry, applications in quantitative analysis and molecular biology. Chromatography techniques, microscopy and imaging. Molecular biology techniques. Instrumentation project: students design and conduct a small-scale project using one of the laboratory instruments covered in the course. They will collect data, analyze results, and present their findings.

Suggested Readings

1. Fulekar MH and Pandey B, 2013, Bioinstrumentation, ISBN: 9789382332398.
2. Gakhar SK, Miglani M and Ashwani K, 2013, Molecular Biology: A Laboratory Manual, ISBN: 9789382332305.
3. Green MR and Sambrook J, 2012, Molecular cloning: A Laboratory Manual 4th edn, Cold Spring Harbor.
4. Kreuzer H and Massey A, 2008, Molecular biology and biotechnology: a guide for students 3rd edn, ASM Press.
5. Rapley R and Whitehouse D, (Eds), 2015, Molecular biology and biotechnology, Royal Society of Chemistry.

Semester II

INTRODUCTION TO BIOTECHNOLOGY 3 (3+0)

Objectives

1. To understand the basic concepts of molecular biology and methods used in the manipulation of nucleic acids to isolate and characterize genes
2. To understand how molecular tools are used to modify an organism. To study the history, concepts and scope of biotechnology
3. To study the applications of biotechnology

Theory

Introduction to genetic material, history of genetic material, physical and chemical basis of genetic material. Structure of DNA and RNA, scope and importance of Biotechnology. Plant, microbial, animal, medical, environmental, industrial. Marine, agricultural and food biotechnology. Nanobiotechnology.

Introduction to recombinant DNA technology. Vectors, DNA manipulating and modifying enzymes, gene cloning. Introduction to genomics and proteomics. Molecular markers, DNA sequencing. Genetic transformation and transgenic organisms. Bioinformatics. Biosafety guidelines.

Suggested Readings

1. Chawla HS, 2024, Introduction to Plant Biotechnology, 4th edn, CBS Publishers and Distributors Pvt. Ltd.
2. Singh B, Gautam SK, Chauhan MS and Singla SK, 2015, Textbook of Animal Biotechnology, The Energy and Resources Institute, TERI.
3. Singh BD, 2020, Biotechnology Expanding Horizons, Kalyani publishers.
4. Thieman W and Palladino M, 2018, Introduction to Biotechnology (What's New in Biology), 4th edn, Pearson ISBN 0134650190, 9780134650197

INTRODUCTION TO PLANT BREEDING 3 (2+1)

Objectives

To study the-

1. development and goals of plant breeding
2. modes of reproduction
3. methods of plant breeding

Theory

History, aims and objectives of plant breeding. Role of related sciences in plant breeding. Modes of reproduction - sexual, asexual, apomixes and significance in plant breeding. Modes of pollination, genetic consequences, differences between self- and cross-pollinated crops. Germplasm resources and their utilization.

Methods of breeding: introduction and acclimatization. Selection: mass selection, Johannesen's pureline theory, genetic basis, pure-line selection. Hybridization: aims and 31 objectives, types of hybridization. Methods of handling segregating generations. Pedigree method, bulk method, back cross method. Heterosis, inbreeding depression, various theories of heterosis, exploitation of hybrid vigour. Hardy Weinberg law, selection in cross-pollinated crops. Population improvement program. Synthetics and composites. Methods of breeding vegetatively propagated crops.

Incompatibility and male sterility and their utilization in crop improvement. Mutation breeding. Ploidy breeding. Wide hybridization and its significance in crop improvement. Procedure for release of new varieties.

Practical

Classification of plants. Botanical description and floral biology of field crops: rice, sorghum, maize, wheat, bajra, sugarcane, brassicas, groundnut, sunflower, sesamum, red gram, bengal gram, green gram, soybean, black gram, cotton. Study of megasporogenesis and microsporogenesis. Fertilization and life cycle of an angiosperm plant. Hybridization techniques and precautions to be taken. Selfing, emasculation and crossing techniques. Study of male sterility and incompatibility.

Suggested Reading

1. Allard RW. 1960. Principles of Plant Breeding, John Wiley and Sons.

2. Chahal GS and Gosal SS, 2002, Principles and Procedures of Plant Breeding: Biotechnological and Conventional Approaches, Narosa Publishers.
3. Singh P, 2014, Essentials of Plant Breeding, Kalyani Publishers.
4. Singh BD, 2009, Plant Breeding: Principles and Methods, Kalyani Publishers.

ELEMENTARY MICROBIOLOGY 2 (1+1)

Objectives

To study the-

1. History of microbiology and major groups of eukaryotes and prokaryotes
2. Preservation methods and repositories
3. Bacterial growth and metabolism
4. Applications of microbes

Theory

History of microbiology and its applied areas. Microorganisms and their role in health and environment. Control and prevention measures against microorganisms/diseases. Introduction to eukaryotic and prokaryotic cells. Major groups of eukaryotes; fungi, algae and protozoa. Major groups of prokaryotes; bacteria, archaebacteria, rickettsia and chlamydia. Preservation of microorganisms, microbial repositories at national and international level.

Bacterial growth. Metabolism in bacteria, ATP generation, chemoautotrophy, photoautotrophy, respiration, fermentation. Viruses and Bacteriophages, structure and properties, lytic and lysogenic cycles, viroids, prions.

Beneficial microorganisms in agriculture, biofertilizers, microbial pesticides. Microbes in composting and biodegradation. Microbiology of water and food.

Practical

Microscope and other instruments in a microbiological laboratory. Media preparation, sterilization and aseptic methods for isolation, identification, preservation and storage. Identification of bacteria by staining methods. Enumeration of bacteria by pour plate and spread plate methods. Micrometery.

Suggested Reading

1. Woolverton CJ, Sherwood LM, and Willey JM, 2016, Presscotts Microbiology, McGraw-Hill Education.

ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS MANAGEMENT 3 (2+1)

Objectives

1. To provide student an insight into the concept and scope of entrepreneurship
2. To expose the student to various aspects of establishment and management of a small business unit
3. To enable the student to develop financially viable agribusiness proposal

Theory

Development of entrepreneurship, motivational factors, social factors, environmental factors, characteristics of entrepreneurs, entrepreneurial attributes/competencies. Concept, need for and importance of entrepreneurial development. Evolution of entrepreneurship, objectives of entrepreneurial activities, types of entrepreneurs, functions of entrepreneurs, importance of entrepreneurial development, and process of entrepreneurship development. Environment scanning and opportunity identification need for scanning–spotting of opportunity-scanning of environment– identification of product / service – starting a project; factors influencing

sensing the opportunities. Infrastructure and support systems- good policies, schemes for entrepreneurship development; role of financial institutions, and other agencies in entrepreneurship development. Steps involved in functioning of an enterprise. Selection of the product / services, selection of form of ownership; registration, selection of site, capital sources, acquisition of manufacturing know how, packaging and distribution. Planning of an enterprise, project identification, selection, and formulation of project; project report preparation, Enterprise Management. Production management– product, levels of products, product mix, quality control, cost of production, production controls, Material management. Production management – raw material costing, inventory control. Personal management – manpower planning, labour turn over, wages / salaries. Financial management / accounting – funds, fixed capital and working capital, costing and pricing, long term planning and short-term planning, book keeping, journal, ledger, subsidiary books, annual financial statement, taxation. Marketing management- market, types, marketing assistance, market strategies. Crisis management- raw material, production, leadership, market, finance, natural etc.

Practical

Visit to small scale industries/agro-industries, Interaction with successful entrepreneurs/ agricentrepreneurs. Visit to financial institutions and support agencies. Preparation of project proposal for funding by different agencies.

Suggested Reading

1. Charantimath PM, 2009, Entrepreneurship Development and Small Business Enterprises. Pearson Publications, New Delhi.
2. Desai V, 2015, Entrepreneurship: Development and Management, Himalaya Publishing House.
3. Gupta CB, 2001, Management Theory and Practice. Sultan Chand & Sons.
4. Grover I, 2008, Handbook on Empowerment and Entrepreneurship. Agrotech Public Academy.
5. Khanka SS, 1999, Entrepreneurial Development. S. Chand & Co.
6. Mehra P, 2016, Business Communication for Managers. Pearson India, New Delhi.
7. Pandey M and Tewari D, 2010, The Agribusiness Book. IBDC Publishers, Lucknow.
8. Singh D, 1995, Effective Managerial Leadership. Deep & Deep Publications.
9. Singhal RK, 2013, Entrepreneurship Development & Management, Katson Books.
10. Tripathi PC and Reddy PN, 1991, Principles of Management. Tata McGraw Hill.
11. Desai V, 1997, Small Scale Industries and Entrepreneurship. Himalaya Publication House.

ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT 3 (2+1)

Objective

- To expose and acquire knowledge on the environment and to gain the state-of-the-art – skill and expertise on management of disasters

Theory

Introduction to environment; environmental studies. Definition, scope and importance, multidisciplinary nature of environmental studies. Segments of environment, spheres of earth; lithosphere, hydrosphere, atmosphere. Different layers of atmosphere. Natural resources; classification. Forest resources. Water resources. Mineral resources. Food resources. Energy resources. Land resources. Soil resources. Ecosystems. Concept of an ecosystem; structure and function of an ecosystem. Energy flow in the ecosystem. Types of ecosystems. Biodiversity and its conservation: Introduction, definition, types.

Biogeographical classification of India. Importance and value of biodiversity. Biodiversity hot spots. Threats and conservation of biodiversity.

Environmental pollution. Definition, cause, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, light pollution. Solid waste management; classification of solid wastes and management methods, composting, incineration, pyrolysis, biogas production, causes, effects and control measures of urban and industrial wastes. Social issues and the environment. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Environmental ethics; issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Environment protection act. Air (prevention and control of pollution) act. Water (prevention and control of pollution) act. Wildlife Protection Act. Forest Conservation act. Human population and the environment; environment and human health. Human rights, value education. Women and child welfare. Role of information technology in environment and human health.

Disaster management; disaster definition, types, natural disasters, floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves. Man-made disasters, nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, road accidents, rail accidents, air accidents, sea accidents. International and national strategy for disaster reduction. Concept of disaster management, national disaster management framework, financial arrangements, role of NGOs, community-based organizations and media in disaster management. Central, state, district and local administration in disaster control. Armed forces in disaster response. Police and other organizations in disaster management.

Practical

Visit to a local area to document environmental assets river/forest/grassland/hill/mountain. Energy; biogas production from organic wastes. Visit to wind mill / hydro power / solar power generation units. Biodiversity assessment in farming system. Floral and faunal diversity assessment in polluted and un polluted system. Visit to local polluted site urban/rural/industrial/agricultural to study of common plants, insects and birds. Environmental sampling and preservation. Water quality analysis; pH, EC and TDS. Estimation of Acidity, alkalinity. Estimation of water hardness. Estimation of DO and BOD in water samples. Estimation of COD in water samples. Enumeration of *E. coli* in water sample. Assessment of suspended particulate matter (SPM). Study of simple ecosystem, visit to pond/river/hills. Visit to areas affected by natural disaster.

Suggested Reading

1. Barucha E, 2004, Text book for Environmental studies, University Grants Commission, New Delhi.
2. De AK, 2010, Environmental chemistry, New Age International Publishers, New Delhi. ISBN:13–978 81 224 2617 5. 384 pp
3. Dhar Chakrabarti PG, 2011, Disaster management - India's risk management policy frameworks and key challenges. Centre for Social Markets (India), Bangalore. 36 pp.
4. Parthiban KT, Vennila S, Prasanthrajan M, Umesh Kanna S, 2023, Forest, Environment, Biodiversity and Sustainable development. Narendra Publishing House, New Delhi.
5. Prasanthrajan M, and Mahendran PP, 2008. A text book on Ecology and Environmental Science, ISBN 81-8321-104-6. Agrotech Publishing Academy, Udaipur.

6. Prasanthrajan M, 2018, Objective environmental studies and disaster management, ISBN 9789387893825, Scientific publishers, Jodhpur.
7. Sharma PD, 2009, Ecology and Environment, Rastogi Publications, Meerut. ----- Tyler M and Scot S, 2009, Living in the Environment (Concepts, Connections, and Solutions), Cengage Learning Publication, Belmont, USA.

NATIONAL SERVICE SCHEME (NSS-II) 1 (0+1)

Objectives

- To evoke social consciousness among students through various activities, viz., working together, constructive, and creative social work, to be skillful in executing democratic leadership, developing skill in program, to be able to seek self-employment, reducing gap between educated and uneducated, increasing awareness and desire to help sections of society.

Practical

Importance and role of youth leadership. Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership, Life competencies. Definition and importance of life competencies, problem-solving and decision-making, interpersonal communication. Youth development programs. Development of youth programs and policy at the national level, state level and voluntary sector; youth-focused and youth-led organizations. Health, hygiene and sanitation. Definition needs and scope of health education; role of food, nutrition, safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programs and reproductive health. Youth health, lifestyle, HIV AIDS and first aid. Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid. Youth and yoga. History, philosophy, concept, myths, and misconceptions about yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method.

PERSONALITY DEVELOPMENT 2 (1+1)

Objectives

- To make students realize their potential strengths, cultivate their inter-personal skills and improve employability

Theory

Personality Definition, nature of personality, theories of personality and its types. The humanistic approach, Maslow's self-actualization theory, shaping of personality, determinants of personality, Myers-Briggs typology indicator. Locus of control and performance. Type A and Type B behaviours, personality and organizational behaviour.
Foundations of individual behaviour and factors influencing individual behaviour. Models of individual behaviour. Perception and attributes and factors affecting perception. Attribution theory and case studies on perception and attribution. Learning; meaning and definition, theories and principles of learning. Learning and organizational behaviour. Learning and training, learning feedback. Attitude and values. Intelligence; types of intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence, intelligence and organizational behaviour, emotional intelligence. Motivation; theories and principles. Teamwork and group dynamics.

Practical

MBTI personality analysis. Learning styles and strategies. Motivational needs. Firo-B, Interpersonal Communication. Teamwork and team building. Group Dynamics. Win-win game. Conflict Management. Leadership styles. Case studies on Personality and Organizational Behaviour.

Suggested Reading

1. Andrews S, 1988, How to Succeed at Interviews, 21st (reprint), Tata McGraw-Hill, New Delhi.
2. Heller R, 2002, Effective Leadership, Essential Manager series, DK Publishing.
3. Hindle T, 2003, Reducing Stress, Essential Manager series, DK Publishing.
4. Lucas S, 2001, Art of Public Speaking, Tata McGraw-Hill, New Delhi.
5. Mile DJ, 2004, Power of Positive Thinking, Rohan Book Company, New Delhi.
6. Pravesh Kumar, 2005, All about Self- Motivation, Goodwill Publishing House, New Delhi.
7. Smith B, 2004, Body Language, Rohan Book Company, New Delhi.
8. Shaffer DR, 2009, Social and Personality Development, 6th edn, Wadswor, Belmont, CA.

BASIC TECHNIQUES OF MOLECULAR BIOLOGY AND BIOTECHNOLOGY 2 (0+2)

Objectives

1. To provide hands-on training on isolation and purification of DNA. Measurement of nucleic acid concentration using spectrophotometer and gel electrophoresis. Designing of PCR primers, DNA amplification using PCR, elution of PCR products, SDS PAGE, staining and destaining of proteins, Western blot.
2. To study bacteriological media, preparation of media for bacterial culture, preparation of competent cells and transformation, isolation of plasmids from bacteria, and preservation of bacterial clones.
3. To study basic computing. Introduction to UNIX, LINUX. Nucleotide information resource: EMBL, GenBank, DDBJ, unigene, protein information resource: SwissProt, TrEMBL, Uniprot; structure databases: PDB, MMDB. Search engines: Entrez, ARSA, SRS. Similarity searching: BLAST and interpreting results. Multiple sequence alignment: ClustalW; structure visualization of DNA and proteins using Rasmol.

Practical

Overview of molecular biology: DNA, RNA, proteins. Laboratory safety and basic techniques. Nucleic acid extraction. Principles of DNA and RNA extraction from various sources. Extraction methods: Phenol-chloroform, silica-based columns, quality assessment and quantification of nucleic acids. Polymerase Chain Reaction (PCR), Optimization of PCR conditions and troubleshooting, gel electrophoresis, analysis of PCR products, restriction digests, and DNA/RNA samples. Molecular cloning, DNA sequencing. Principles of DNA sequencing: Sanger sequencing, DNA sequencing reaction setup and analysis, interpretation of sequencing data and sequence alignment. Protein analysis techniques. Gene expression analysis. Practical project: students design and conduct a small-scale molecular biology project. They will choose a specific technique or experiment, perform the necessary procedures, analyze data, and present their findings.

Suggested Reading

1. Green MR and Sambrook J, 2012, Molecular cloning: A Laboratory Manual, 4th edn, Cold Spring Harbor.
2. Kreuzer H and Massey A, 2008, Molecular biology and biotechnology: a guide for students, 3rd edn, ASM Press.
3. Rapley R and Whitehouse D, (Eds), 2015, Molecular biology and biotechnology, Royal Society of Chemistry.

BIOINFORMATICS AND BIOCOMPUTATION **2 (0+2)**

Objectives

1. To expose the students to the construction and use of computers, special algorithms, new complexity theories, computing science and related mathematics
2. To understand the scientific and economic impact of bioinformatics
3. To have a better understanding of organisms, their metabolism and their evolution
4. To study their applications in health care and drug design, new (bio)materials and their engineering, food (engineering) and food production

Practical

Information search and data retrieval, genome analysis and gene mapping, alignment of pairs of sequences, alignment of multiple sequences and phylogenetic analysis, tools for similarity search and sequence alignment, profiles and hidden Markov models, gene identification and prediction, gene expression analyses, protein classification and structure analysis and visualization, protein structure prediction, computational methods for pathway and systems biology, technologies and strategies for drug discovery, biomarkers in drug development, computer-aided drug design.

Suggested Reading

1. Altman RB, Dunker AK, Hunter L, Ritchie MD, Murray TA and Klein TE, 2017, Biocomputing, https://doi.org/10.1142/10388.
2. Laplante PA (Ed), 2004, Biocomputing, ova Biomedical.

Semester III

LIVESTOCK PRODUCTION AND MANAGEMENT **3 (2+1)**

Objectives

To study the-

1. history of livestock in India, animal husbandry and breeds of livestock
2. management of livestock in terms of the housing system, health, and diseases
3. economic importance of livestock

Theory

Livestock history in India: Vedic, medieval and modern era. Demographic distribution of livestock and role in economy. Introductory animal husbandry. Breeds of livestock, cattle, buffalo, sheep, goat and pig. Important traits of livestock. General management and feeding practices of animals. Handling and restraining of animals. Housing systems. Importance of grasslands and fodders in livestock production. Common farm management practices including disinfection, isolation, quarantine and disposal of carcass. Common vices of animals and their prevention. Diseases and parasite control and hygiene care.

History and economic importance of poultry. Poultry breeds. Reproductive system of male and female birds. Formation and structure of eggs. Important economic traits of poultry. Egg production, egg weight, egg quality. Fertility and hatchability, plumage characteristics and comb types. Care and management of chicks, grower and layers/broiler. Brooding management. Hatchery practices. Poultry Diseases, control and hygiene care.

Practical

Visit to livestock farms/demonstration centres. Breeds of cattle, buffalo, sheep, goat and pigs. Familiarization with body parts of animals. Handling and restraining of cattle, buffalo, sheep, goat and swine. Male and female reproductive system and artificial

Insemination. Feeding of livestock. Methods of identification: marking, tattooing, branding, tagging. Milking methods. Record Keeping. Visit to the poultry farm, poultry breeds, body parts of chicken, duck, quail and turkey. Housing, equipment, nesting and brooding requirements. Male and female reproductive system. Methods of identification and sexing. Hatchery layout and equipment. Identification of diseases and control of parasites. Vaccination and maintenance of farm records.

Suggested Reading

1. Banerjee GC, 2020, A Textbook of Animal Husbandry, Oxford and IBH Publication.
2. Sastry NSR and Thomas CK, 2020, Dairy Bovine Production, Kalyani Publishers.
3. Thomas CK and Sastry NSR, 2020, Livestock Production Management, Kalyani Publishers.

RECOMBINANT DNA TECHNOLOGY 2 (2+0)

Objectives

1. The students will be trained on the principles of genetic engineering
2. To study the components like vectors, enzymes, and host cells
3. To study methods used for confirming cloning and expression

Theory

Recombinant DNA technology. Restriction endonucleases: types and uses. DNA manipulating enzymes, DNA ligases. Vectors: properties of an ideal vector, structure of vector, cloning vectors and expression vectors; plasmids, cosmids, phagemids, BACs, PACs, YACs, transposon vectors, shuttle vectors, co-integrating vectors. Competent cells. Gene isolation and cloning; Genetic transformation of *E. coli*, gel electrophoresis, preparation of probes, Southern blotting; Northern blotting; Western blotting, PCR and PCR based methods in recombinant DNA technology.

Suggested Reading

1. Singh BD, 2021, Biotechnology Expanding Horizons, Kalyani Publishers.

CLASSICAL AND MOLECULAR CYTOGENETICS 3 (2+1)

Objectives

This course aims at studying the-

1. basics of chromatin
2. chromosome, banding and chromosome variations
3. genome analysis through chromosome variations

Theory

Introduction and history. Structure of chromatin. Chromosome structure and chromosome landmarks. Specialized chromosomes. Differential staining of the chromosomes - Q-banding, G banding, C banding, R banding. In situ hybridization-FISH, GISH.

Changes in chromosome number: aneuploidy - monosomy, trisomy and tetrasomy, haploidy and polyploidy- autopolyploidy and allopolyploidy. Methods of doubled haploid production. Structural aberrations of chromosomes: deletions, duplications, inversions and translocations. Locating genes on chromosomes. Genome analysis.

Practical

Lymphocyte culture from blood for karyotyping. Fibroblast cultures from eggs for karyotyping. Preparation of metaphase chromosome spread. Staining techniques of chromosome spreads. Karyotyping and ideogram preparation, chromosome banding techniques: Q-banding, G banding, C banding, R banding.

Suggested Reading

1. Becker K and Hardin, 2004, The World of Cell. 5th edn, Pearson Edu.
2. Carroll M, 1989, Organelles, The Guilford Press.
3. Charles B, 1993, Discussions in Ccytogenetics, Prentice Hall.
4. Fan YS, 2002, Molecular Cytogenetics: Protocols and Aapplications. Humana Press.
5. Gupta PK, 2007, Cytogenetics, Rastogi publications.
6. Mahabal R, 2010, Fundamentals of Cytogenetics and Genetics, PHI Learning Pvt. Ltd.
7. Popescu P, Hayes H and Dutrillaux B, 2000, Techniques in Aanimal Ccytogenetics, Springer Science and Business Media.

ANATOMY AND PHYSIOLOGY OF LIVESTOCK 3 (2+1)

Objectives

1. This course introduces the basic concepts in the anatomy and physiology of livestock
2. To study the structure and function of various tissues and organs
3. To study the physiological aspects of tissues and organs

Theory

Definition of terms used in veterinary anatomy, topography, contour, landmarks and functional anatomy of various organs in cow, buffalo, sheep and goat structural and functional classification of muscles.

Structure of animal cells and tissues: study of microscopic structure of organs from digestive, urinary, respiratory, reproductive, nervous, cardiovascular and endocrine systems. Gametogenesis, fertilization, cleavage, gastrulation and the development of fetal membranes in livestock, structure and types of mammalian placenta. Development of the organs of digestive, urogenital, cardiovascular, nervous and endocrine glands.

Introduction to blood physiology. Genetic and endocrine control of the reproductive system; maternal recognition of pregnancy. Introduction to physiology of mammary glands: structure and development, hormonal control of mammary growth, lactogenesis and lactation cycle.

Practical

Hands-on training on the structure and function of the major body systems in livestock, including mammals such as cattle, sheep, goats, and pigs. Practical applications in livestock management and health.

Suggested Reading

1. Dyce KM, Sack MO and Wensing CJS, 2016, Textbook of Veterinary Anatomy, 5th edn, W. B. Saunders Co.
2. Ghosh RK, 2013, Essentials of Veterinary Histology and Embryology, 3rd edn, Current Book International.
3. Ghosh RK, 2020, Primary Veterinary Anatomy (Systemic and Regional), 8th edn, Current Book International.
4. Hafez B and Hafez ESE (Eds), 2013, Reproduction in Farm Animals, 7th edn.
5. McGeady TA, 2017, Veterinary Embryology, 2nd edn, Wiley Blackwell, Singapore.
6. Reece WO, (Ed), Dukes' Physiology of Domestic Animals Ninth Edition.

LIVESTOCK PRODUCT TECHNOLOGY 3 (2+1)

Objectives

1. To study the composition and value of milk
2. To study milk processing and milk standards

3. To study properties and values of the meet

Theory

Composition and nutritive value of milk and factors affecting composition of milk; current status of dairy industry in India. Physiochemical properties of milk. Milk Processing: milk collection, chilling, transportation, standardization, homogenization, pasteurization and packaging. Toxins and pesticide residues in milk and milk products. Organic milk food products. Bureau of Indian standards for milk and milk products; FSSAI standards for milk and milk products. Sanitation in milk plant.

Retrospect and prospects of the meat industry in India. Structure and composition of muscle (including poultry). Conversion of muscle into meat; nutritive value of meat. Meat adulteration, preservation of meat, physicochemical and microbiological quality of meat and meat products. Laws governing national, and international trade in meat and meat products, organic meat food products, and food products of genetically modified animals.

Practical

Sampling of milk, estimation of fat, solids-not-fat (SNF) and total solids. Determination of\ specific gravity of milk. Platform tests, cream separation. Microbiological quality of milk, meat and meat products. Visit modern milk and meat processing units.

Suggested Reading

1. Sharma BD, 1999, Meat and Meat Products Technology: Including Poultry Products Technology, Jaypee Bros Medical Publishers.
2. Sukumar D, 2001, Outlines of Dairy Technology, Oxford University Press.

BIOMATHEMATICS **2 (2+0)**

Objectives

1. This study the basic theories of mathematics
2. To study factor reduction and eigenvalues
3. To study the applications of biomathematics

Theory

Rolle's theorem, Lagrange's theorem, Taylor's and Maclaurin's series. Partial differentiation, Euler's theorem on homogeneous function, change of variable. Jacobian, maxima and minima of two or more than two variables eigen values and eigen vectors of a matrix. Reduction formulae, definite integrals and its applications.

Solution of ordinary differential equation of first degree and first order and their application for determination of the volume of blood and drug distribution. Epidemic models, simultaneous differential equation of first order and their applications to predator models. Linear differential equations of higher order and their applications to the simple biological problem. Numerical methods for solving algebraic and transcendental equations.

Suggested Reading

1. Grewal BS, 2013, Higher Engineering Mathematics, Khanna Publishers.
2. Rastogi SK, 2008, Biomathematics, Krishna Prakashan Media Pvt. Ltd.
3. Srivastava AC and Srivastava PK, 2011, Engineering Mathematics, Vol. I, PHI Learning Pvt. Ltd.
4. Srivastava AC and Srivastava PK, 2011, Engineering Mathematics, Vol.III, PHI Learning Pvt. Ltd.

PHYSICAL EDUCATION, FIRST AID AND YOGA PRACTICES 2 (0+2)

Objectives

1. To make the students aware about Physical Education, First Aid and Yoga Practices
2. To disseminate the knowledge and skill how to perform physical training, perform first aid and increase stamina and general wellbeing through yoga.

Practical

Physical education. Training and Coaching, meaning and concept. Methods of training; aerobic and aerobic exercises. Calisthenics, weight training, circuit training, interval training, Fartlek training. Effects of exercise on muscular, respiratory, circulatory and digestive systems. Balanced diet and nutrition; effects of diet on performance. Physiological changes due to ageing and role of regular exercise on ageing process. Personality, its dimensions and types. Role of sports in personality development. Motivation and achievements in sports. Learning and theories of learning. Adolescent problems and its management. Posture, postural deformities. Exercises for good posture.

Yoga; history of yoga, types of yoga, introduction to yoga. Asanas, definition and importance, Padmasan, Gaumukhasan, Bhadrasan, Vajrajasan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhastasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan – left leg-right leg, Pavanmuktasan, Halasan, Sarpasan, Ardhdhanurasan, Sawasan. Suryanamaskar, Pranayama (Definition and Importance), Omkar, Suryabhedan, Chandrabhedan, AnulomVilom, Shitali, Shitkari, Bhastrika, Bhramari. Meditation, definition and importance, Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh. Mudras, definition and importance, Gyanmudra, Dhyanmudra, Vayumudra, Akashmudra, Pruthvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra, Uddanmudra. Role of yoga in sports. Teaching of asanas, demonstration, practice, correction and practice.

History of sports and ancient games. Governance of sports in India. Important national sporting events. Awards in sports. History, latest rules, measurements of playfield, specifications of equipment, skill, technique, style and coaching of major games (Cricket, Football, Table Tennis, Badminton, Volleyball, Basketball, Kabaddi and Kho-Kho) and Athletics.

Need and requirement of first aid. First aid equipment and upkeep. First aid techniques. First aid related with respiratory system. First aid related with heart, blood and circulation. First aid related with wounds and injuries. First aid related with bones, joints, muscle related injuries. First aid related with nervous system and unconsciousness. First aid related with gastrointestinal tract. First aid related with skin, burns. First aid related with poisoning. First aid related with bites and stings. First aid related with sense organs. Handling and transport of injured traumatized persons. Sports injuries and their treatments.

METHODS IN RECOMBINANT DNA TECHNOLOGY 2 (0+2)

Objectives

1. Hands on training on good laboratory practices, media and stock preparation
2. To enable skill development by providing hands-on training on methods in recombinant DNA technology

Practical

Preparation of growth, madia, stock solutions and buffers. Plasmid DNA isolation. Quality and quantity assessmentof DNA. Restriction digestion of DNA. Agarose gel

electrophoresis. Preparation of competent cells and genetic transformation of *E. coli*. Screening of recombinant DNA clones in *E. coli*. Confirmation of recombinant clones.

Suggested Reading

1. Carson S and Robertson D, 2005, Manipulation and Expression of Recombinant DNA, Elsevier.
2. Glick BR and Patten CL, 2022, Molecular biotechnology: principles and applications of recombinant DNA, John Wiley and Sons.
3. Green MR and Sambrook J, 2012, Molecular cloning: A Laboratory Manual, 4th edn, Cold Spring Harbor.

Semester IV

INTRODUCTORY BIOINFORMATICS 4 (3+1)

Objectives

1. To train the students on applications of computers on analyzing the biomolecules (DNA, RNA and protein)
2. To study various types of databases
3. To study various operations and algorithms in bioinformatics

Theory

Introduction to bioinformatics. Development and scope of bioinformatics. Applications of computers in bioinformatics. Operating systems, hardware, software, internet, www resources, FTP, application of bioinformatics in agriculture.

Primary databases: Nucleotide sequence databases (GenBank, EMBL), protein sequence databases; Secondary databases: SwissProt/TrEMBL, conserved domain database, Pfam; Structure databases: Protein Data Bank (PDB), MMDB, SCOP, CATH; File formats: GenBank, EMBL, FASTA, PDB, Flat file, ASN.1, XML.

Introduction to sequence alignment and its applications. Pairwise and multiple sequence alignment, the concept of local and global alignment; Algorithms. Dot Matrix method, dynamic programming methods (Needleman–Wunsch and Smith–Waterman). Tools of MSA: ClustalW, TCoffee. Phylogeny. Introduction to BLAST and FASTA; MSA and phylogeny. Assembly and annotation.

Practical

Hands-on training on databases, database construction and management, algorithms and analysis of DNA, RNA and proteins.

Suggested Reading

1. Baxevanis AD, Ouellette BFF, 2011, Bioinformatics: A practical guide to the analysis of genes and proteins, John Wiley and Sons.
2. Mount DW, 2001, Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor.
3. Xiong J, 2012, Essential Bioinformatics, Cambridge University Press.

MOLECULAR MARKER TECHNOLOGY 2 (2+0)

Objectives

1. To study the importance and types of molecular markers
2. To study the mapping populations; development and analysis
3. To study the applications of molecular markers in mapping and breeding

Theory

Types of molecular markers - RFLP; PCR-based markers like RAPD, SCAR, SSR, STS, CAPS, AFLP, SNP and their variants. Uses of molecular markers. Application as a genetic tool for genotyping and gene mapping. Mapping populations: F2, DH, RILs, NILs. Bulked segregant analysis, linkage maps, physical maps.

Application of molecular markers. Assessing genetic diversity, variety protection. Introduction to genomic selection, marker-assisted breeding for accelerated introgression of trait/transgene and quantitative traits. Human and animal health. Association with genetic-based diseases. Paternity determinations. Parentage using SNP data. Forensic studies. DNA Fingerprinting.

Suggested Reading

1. Gupta PK, 2015, Molecular Biology and Genetic Engineering, Rastogi Publication.
2. Manikanda Boopathi N, 2013, Genetic mapping and marker-assisted selection, Springer.
3. Manikanda Boopathi N, 2020, Genetic Mapping and Marker Assisted Selection: Basics, Practice and Benefits, Springer.
4. Schook LB (ed), 2020, Gene-mapping techniques and applications, CRC Press.
5. Verma PS, 2018, Cell Biology Genetics Molecular Biology Evolution and Ecology, Chaukhamba Auriyantaliya Publishers.
6. Watson JD, Levine M, Baker TA, Gann A, Bell SP and Losick, R, 2014, Molecular Biology of the Gene, Pearson.

BIODIVERSITY AND ITS CONSERVATION **2 (2+0)**

Objectives

1. To study the concepts of biodiversity
2. To study the methods of protecting biodiversity
3. To study regulations on biodiversity conservation

Theory

Concepts of biodiversity, bioresource and wildlife management, conservation strategies: in situ and ex-situ conservation. Wildlife conservation projects in India. Protection of biodiversity for its suitable utilization. Threats to biodiversity. WCU Red data book; Biodiversity hotspots in India. National bureaus of genetic resources. Biodiversity Mapping. Biogeographical regions.

Sustainable development. Diversification of cropping system. Diversity of indigenous livestock. Threats to biodiversity; WCU Red data book. Vulnerability and extinction of flora and fauna. Endangered species in various ecosystems. Germplasm banks. Environmental impact assessment. Bioremediation and biosafety. Introduction to regulatory agencies and legislation.

Suggested Reading

1. Das MK and Choudhury BP, 2008, A Textbook on Plant Nomenclature and Biodiversity Conservation, Kalyani Publishers.
2. Gaston KJ and Spicer JI, 2004, Biodiversity An Introduction, Blackwell Publishers.
3. Hopsetti BB. and Venketashwarlaru M, 2001, Trends in Wild Life Conservation and Management, Vol. 2, Daya Publishing House.
4. Singh MP and Singh BS, 2002, Plant Biodiversity and Taxonomy, Daya Publishing House.

BASIC BIOCHEMISTRY **4 (3+1)**

Objectives

1. To study the structure and functions of biomolecules of living organisms
2. To study metabolism and bioenergetics
3. To study secondary metabolites and their applications

Theory

Introduction and importance. Biomolecules: carbohydrates, lipids, proteins and nucleic acids – structure, functions and properties. Acids, bases and buffers of living systems. The pK of biomolecules. Vitamins and hormones.

Bioenergetics. Metabolism – basic concept: glycolysis, citric acid cycle, glycogenesis, glycogenolysis, oxidative phosphorylation, fatty acid oxidation; Ketone bodies' metabolism.

Secondary metabolites: alkaloids, phenolics and their applications in food and pharmaceutical industries.

Practical

Qualitative tests for carbohydrates, amino acids, proteins and lipids. Extraction and characterization of lipids by TLC. Determination of acid, iodine and saponification values of oil. Extraction, quantitative estimation and separation of sugars by paper chromatography.

Suggested Reading

1. Nelson DL and Cox MM, 2017, Lehninger principles of biochemistry, 7th edn, W. H. Freeman.
2. Satyanarayana U and Chakrapani U, 2021, Essentials of Biochemistry, Elsevier.

HUMAN ETHICS **1 (1+0)**

Objectives

1. To study the meaning and concepts of human behaviour
2. To study human ethical values
3. To study spirituality and attitude
4. To study the methods of stress management

Theory

Universal human aspirations. Happiness and prosperity. Human values and ethics. Concept, definition, significance and sources. Fundamental values. Right conduct, peace, truth, love and nonviolence. Ethics: professional, environmental, ICT. Sensitization towards others particularly senior citizens, developmentally challenged and gender.

Spirituality, positive attitude and scientific temper. Teamwork and volunteering. Rights and responsibilities. Road safety. Human relations and family harmony. Modern challenges and value conflict. Sensitization against drug abuse and other social evils. Developing personal code of conduct (SWOT Analysis). Management of anger and stress.

Suggested Reading

1. Gaur RR, Sangal R and Bagaria GP, 2011, A Foundation Course in Human Values and Professional Ethics, Excel Books.
2. Mathur SS, 2010, Education for Values, Environment and Human Rights, RSA International.
3. Sharma RA, 2011, Human Values and Education -Axiology, Inculcation and Research, R. Lall Book Depot.

4. Sharma RP and Sharma M, 2011, Value Education and Professional Ethics, Kanishka Publishers.
5. Srivastava S, 2011, Human Values and Professional Ethics, S K Kataria and Sons.
6. Srivastava S, 2011, Environmental Science, S K Kataria and Sons.
7. Tripathi AN, 2009, Human Values, New Age International (P) Ltd Publishers.

AGRICULTURAL MARKETING AND TRADE 3 (2+1)

Objectives

1. To understand the fundamentals of agricultural marketing and trade
2. To analyze the factors influencing supply and demand in agricultural markets
3. To explore different marketing channels and strategies in agriculture
4. To examine the role of government policies and regulations in agricultural markets

Theory

Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets; demand, supply and producer's surplus of agri commodities: nature and determinants of demand and supply of farm products, producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities; pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – meaning, merits and demerits; marketing process and functions: Marketing process concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labelling (Agmark); Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products; Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs. Role of Government in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP and DMI – their objectives and functions; cooperative marketing in India. Risk in marketing: Types of risk in marketing; speculation and hedging; an overview of futures trading. Agricultural prices and policy. Meaning and functions of price; administered prices; need for innovations in agricultural price policy. Trade: concept of international trade and its need, theories of absolute and comparative advantage. Present status and prospects of international trade in agri-commodities; WTO; Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR. Role of government in agricultural marketing. Role of APMC and its relevance in the present-day context.

Practical

Plotting and study of demand and supply curves and calculation of elasticities. Study of relationship between market arrivals and prices of some selected commodities. Computation of marketable and marketed surplus of important commodities; Study of price behaviour over time for some selected commodities. Construction of index numbers; Visit to a local market to study various marketing functions performed by different agencies, identification of marketing channels for selected commodity, collection of data regarding marketing costs, margins and price spread and presentation of report in the class. Visit to market institutions – NAFED, SWC, CWC, cooperative marketing society,

etc. to study their organization and functioning. Application of principles of comparative advantage of international trade.

Suggested Reading

1. Acharya, SS, and Agarwal NL, 2006, Agricultural Marketing in India, Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
2. Chinna SS, 2005, Agricultural Economics and Indian Agriculture. Kalyani Pub, N Delhi.
3. Kohls RL, and Uhl JN, 2002, Marketing of Agricultural Products, Prentice-Hall of India Private Ltd., New Delhi.
4. Kotler and Armstrong, 2005, Principles of Marketing, Pearson Prentice-Hall.
5. Lekhi RK and Singh J, 2006, Agricultural Economics. Kalyani Publishers, Delhi.
6. Memoria CB, Joshi RL and Mulla NI, 2003, Principles and Practice of Marketing in India, Kitab Mahal, New Delhi.
7. Pandey M and Tewari, D, 2004, Rural and Agricultural Marketing, International Book Distributing Co. Ltd, New Delhi. Sharma, R., 2005, Export Management, Laxmi Narain Agarwal, Agra.
8. Salvator D, 2008, Microeconomics: Theory and Applications, New York: Oxford University Press.

AGRICULTURAL INFORMATICS AND ARTIFICIAL INTELLIGENCE 3 (2+1)

Objectives

1. To acquaint students with the basics of computer applications in agriculture, multimedia, database management, application of mobile app and decision-making processes, etc.
2. To provide basic knowledge of computer with applications in agriculture
3. To make the students familiar with Agricultural-Informatics, its components and applications in agriculture

Theory

Introduction to computers, anatomy of computers, memory concepts, units of memory, operating system. Definition and types, applications of MS-Office for creating, e diting and formatting a document, data presentation, tabulation and graph creation, statistical analysis, mathematical expressions, database, concepts and types, creating database. Uses of DBMS in agriculture, internet and World Wide Web (WWW); concepts and components.

Computer programming. General concepts, introduction to visual basic, Java, Fortran, C/ C++, etc. concepts and standard input/output operations.

e-Agriculture, Concepts, design and development, application of innovative ways to use information and communication technologies (IT) in agriculture, computer models in agriculture. Statistical, weather analysis and crop simulation models, concepts, structure, inputs-outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation, IT applications for computation of water and nutrient requirement of crops. Computer-controlled devices (automated systems) for agri-input management, smartphone mobile apps in agriculture for farm advice. Market price, postharvest management etc. Geospatial technology; concepts, techniques, components and uses for generating valuable agriinformation. Decision support systems; concepts, components and applications in agriculture. Agriculture expert system, soil information systems etc. for supporting farm decisions. Preparation of contingent crop-planning and crop calendars using IT tools, Digital India and schemes to promote digitalization of agriculture in India.

Introduction to artificial intelligence, background and applications, Turing test. Control strategies, Breadth-first search, Depth-first search, Heuristics search techniques: Best-first search, A* algorithm, IoT and Big Data; Use of AI in agriculture for autonomous crop management, and health, monitoring livestock health, intelligent pesticide application, yield mapping and predictive analysis, automatic weeding and harvesting, sorting of produce, and other food processing applications; Concepts of smart agriculture, use of AI in food and nutrition science etc.

Practical

Study of computer components, accessories, practice of important DoS Commands, Introduction of different operating systems such as Windows, Unix/ Linux, creating files and folders, File management. Use of MS-WoRD and MS Power-point for creating, editing and presenting a scientific document, MS- EXCEL - Creating a spreadsheet. Use of statistical tools. Writing expressions, Creating graphs, Analysis of scientific data, Handling macros. MS-ACCESS, creating database, preparing queries and reports, demonstration of agri- information system, Introduction to World Wide Web (WWW) and its components, Introduction of programming languages such as Visual Basic, Java, Fortran, C, C++, Hands on practice on Crop Simulation Models (CSM), DSSAT/Crop-Info/Crop Syst/ Wofost, Preparation of inputs file for CSM and study of model outputs, computation of water and nutrient requirements of crop using CSM and IT tools, Use of smart phones and other devices in agro-advisory and dissemination of market information, Introduction of Geospatial Technology, Hands on practice on preparation of Decision Support System, Preparation of contingent crop planning, India Digital Ecosystem of Agriculture (IDEA).

Suggested Reading

1. Date CJ, 2007, An introduction to Database Systems, Addison-Wesley.
2. Dhabal PS and Manoranjan P, 2017, Concepts and Techniques of Programming in C, I.K. International Publishing House Pvt. Limited.
3. ITL Education Solutions Ltd, 2006, Introduction to Information Technology, PEARSON Education.
4. Mahapatra SK, Mishra P and Pradhan J, 2022, Introductory Agri Informatics, Jain Brothers.
5. Rajaroman V and Adabala N, 2015, Fundamentals of Computer, PHI Learning Private Ltd, New Delhi.

PRACTICES IN MOLECULAR MARKER TECHNOLOGY 2 (0+2)

Objectives

1. This course aims at imparting skills through hands-on training in the area of molecular markers and their applications
2. To study the development of markers and marker systems, genotyping with various types of markers, mapping, diversity analysis, marker-assisted selection, DNA fingerprinting, diversity and cluster analysis, phylogenetic analysis

Practical

Overview of molecular markers: types, applications, significance. Principles of genetic variation and inheritance, DNA Extraction and quantification, PCR-Based molecular markers, RFLP (Restriction Fragment Length Polymorphism) analysis, AFLP (Amplified Fragment Length Polymorphism) analysis, SSR (Simple Sequence Repeat) analysis, SNP (Single Nucleotide Polymorphism) analysis. Principles of SNP detection, PCR-based SNP genotyping assays, SNP array and sequencing-based approaches. DNA sequencing and sequence analysis, interpretation of sequencing data and sequence alignment, Marker-Assisted Selection (MAS), genomic selection and marker discovery.

Practical Project: students design and conduct a small-scale molecular marker project. They will choose a specific technique or experiment, perform the necessary procedures, analyze data, and present their findings.

Suggested Reading

1. Gupta PK, 2015, Molecular Biology and Genetic Engineering, Rastogi Publication.
2. Manikanda Boopathi N, 2013, Genetic mapping and marker-assisted selection, Springer.
3. Manikanda Boopathi N, 2020, Genetic Mapping and Marker Assisted Selection: Basics, Practice and Benefits, Springer.
4. Schook LB (ed), 2020, Gene-mapping techniques and applications, CRC Press.
5. Verma PS, 2018, Cell Biology Genetics Molecular Biology Evolution and Ecology, Chaukhamba Auriyantaliya Publishers.
6. Watson JD, Levine M, Baker TA, Gann A, Bell SP and Losick, R, 2014, Molecular Biology of the Gene, Pearson.

Semester V

MICROBIAL GENETICS **4 (3+1)**

Objectives

1. To provide an understanding of using microorganisms for genetic analyses
2. To study genetic variability and recombination among microbes
3. To study plasmids, their types and use in recombinant DNA technology

Theory

Microorganisms as tools for genetic studies. Genetic variability in microorganisms. Genetic analysis of representative groups of bacteria, fungi and viruses. Random and tetrad spore analysis. Recombination and chromosomal mapping. Complementation - intergenic and intragenic.

Bacterial plasmids. Structure, life cycle, mode of infection and their role in genetic engineering. Transfer of genetic material in bacteria. Conjugation, transformation and transduction. Genetics of bacteriophage: T4, lambda and M13, life cycle, mode of infection. Mutation: types, mutagens, DNA damage and repair. Transposable elements; Lac operon, yeast genetics.

Concept and application of recombinant DNA technology. Use of genetic tools to improve the microbial strains for industry, agriculture and health.

Practical

Conjugation and transformation in bacteria. Spontaneous and auxotrophic mutation. Chemical and UV mutagenesis in fungi and bacteria.Complementation in fungi. Identification of mutants using replica plating technique. Isolation of genomic DNA from *E*. *coli*. Isolation and curing of plasmid. Identification of plasmid by electrophoresis / antibiotic plates.

Suggested Reading

1. Michael RG and Joseph S, 2012, Molecular Cloning: A Laboratory Manual, Cold Spring Harbor Laboratory Press.
2. Reece RJ, 2013, Analysis of Genes and Genomes, Wiley.

MOLECULAR GENETICS **3 (3+0)**

Objectives

1. This course introduces DNA structure and function

2. To study DNA functions like replication and gene expression
3. To provide an understanding of gene regulation in prokaryotes and eukaryotes

Theory

Structures, properties and modification of DNA. Molecular mechanisms of DNA replication, repair. Types of mutation. Linkage and recombination. Molecular mechanisms of crossing over. Centromere and telomere sequences, and DNA packaging. Repetitive DNA sequences and transposable elements. Markers and QTL.Synthesis and processing of RNA and proteins. Regulation of gene expression.

Genetic code, properties of genetic code, structure of a gene, promoters and their isolation. Synthesis and processing of RNA.

Regulation of gene expression. Transcription factors – their classification and role in gene expression. Epigenetic control of gene expression. Analysis of gene expression. Small RNAs, RNA interference and its applications.

Suggested Reading

1. Allison LA, 2011, Fundamental Molecular Biology, Wiley Global Education.
2. Brown TA, 1998, Genetics: A Molecular Approach, 3rd edn, Stanley Thornes.
3. Gardener EJ, Simmons MJ and Snustad DP, 1991, Principles of Genetics, John Wiley and Sons, Inc, New York, USA.
4. Hartl DL, 2021, Essential genetics and genomics, 7th edn, Jones and Bartlett Learning.
5. Lewin B, 2009, Genes, Jones and Bartlett Learning.
6. Lewin B, 2017, Gene XII, Oxford University Press.
7. Tropp BE, 2014, Principles of Molecular Biology, Jones and Bartlett Learning.
8. Tropp BE. 2012. Molecular Biology: Genes to Proteins, 4th edn, Jones and Bartlett Learning.

NANOBIOTECHNOLOGY **4 (3+1)**

Objectives

1. To provide an understanding of the concepts and terminologies related to nanobiotechnology
2. To study nanosystems, their synthesis and application

Theory

Introduction to nanotechnology. Concepts and Terminology. Nano-Bio Interface. Biological based nanosystems, molecular motors, biosensors and other devices.

Self-assembly of molecules for nanotechnology applications. Biomimetics, biotemplating and de novo designed nanostructures and materials. DNA-nanotechnology. Nanomanipulations, material design, synthesis and their applications.

Practical

Introduction to nanomaterials and their properties. Nanoscale characterization techniques. Scanning electron microscopy (SEM) and transmission electron microscopy (TEM). Atomic force microscopy (AFM) for nanoscale imaging and manipulation. Spectroscopic techniques (UV-Vis, fluorescence, Raman) for nanoparticle analysis. Nanoparticle synthesis and functionalization, chemical synthesis methods for nanoparticles (top-down and bottom-up approaches), surface functionalization techniques for controlling nanoparticle properties. Biomolecular interactions at the nanoscale, nanotoxicology and safety assessment. Project and presentations.

Suggested Reading

1. Gabor L, Hornyak J, Moore J, Tibbals, HF and Joydeep D, 2009, Fundamentals of Nanotechnology, CRC Press.
2. Kumar U, 2008, Nanotechnology: A Fundamental Approach, Agrobios.

ANIMAL BIOTECHNOLOGY **3 (2+1)**

Objectives

1. To study historical developments in animal biotechnology
2. To study the biotechnological tools for improving animal health and products
3. To study the use of molecular markers for animal genome analysis

Theory

History and development of animal biotechnology. Basic techniques in animal cell culture. Introduction to embryo biotechnology, oocyte collection and maturation. Sperm preparation. In vitro fertilization. Cryopreservation of oocyte, sperm and embryos. Embryo transfer technology.

Breeds of livestock and their characteristics. Marker-assisted breeding of livestock. Introduction to animal genomics: RFLP, RAPD, SSRs, QTL, SNP, STR, mitochondrial DNA polymorphism. Rumen and its environment. Rumen microbes - manipulation of rumen microbes for better utilization of feed. Introduction to nutrigenomics. Milk biome. Manipulation of lactation by biotechnological tools. Application of biotechnology in meat and meat products.

Genome and protein-based diagnostics of important animal diseases: FMD, brucellosis, PPR, mastitis, bluetongue, newcastle disease. Introduction to vaccinology, live attenuated vaccines, killed vaccines, cell culture-based vaccines, recombinant vaccines.

Practical

Basic cell culture techniques, oocyte aspiration from ovaries, sperm preparation, in vitro fertilization. PCR-based detection of animal pathogens. PCR-RFLP. Immunohistochemical localization of protein marker in tissues/cells – meat species identification by PCR.

Suggested Reading

1. Singh B, Gautam SK, Chauhan MS and Singla SK, 2015, Textbook of Animal Biotechnology, The Energy and Resources Institute, TERI.
2. Srivastava AK and Singh RK, 2018, Animal Biotechnology, CBS Publishers and Distributors, ISBN 9788120416482, 8120416481.

GENOMICS AND PROTEOMICS **3 (3+0)**

Objectives

1. To provide an understanding of genomics; structural and functional
2. To study comparative genomics and its applications
3. To study proteomics and related tools

Theory

Introduction to genomics. Functional genomics and proteomics. Structural genomics: classical ways of genome analysis. BAC and YAC libraries. Next generation sequencing. Genome analysis and gene annotation. Genome projects: *E. coli*, Arabidopsis, Bovine, Human. Comparative Genomics: orthologous and paralogous sequences. Synteny, gene order, phylogenetic footprinting.

Functional genomics: Differential gene expression techniques: ESTs, cDNA-AFLP, microarray, Differential display, SAGE, RNAseq, Real-time PCR.

Introduction to proteomics. Analysis of proteome. Native PAGE, SDS PAGE, 2D PAGE. Edmann Degradation. Chromatographic techniques: HPLC, GC, Mass Spectrometry: MALDI-TOF, LC-MS, SWATH-MS. Post Translational modifications.

Suggested Reading

1. Andreas H and Samuel C, 2018, Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press.
2. Saraswathy N, Ramalingam P, 2011, Concepts and Techniques in Genomics and Proteomics, Elsevier Science.

ENZYMOLOGY AND ENZYME TECHNOLOGIES 3 (2+1)

Objectives

1. To study the basic structure, function and types of enzymes.
2. To study enzyme kinetics, regulation of enzyme activity and applications of enzymes.

Theory

Classification and nomenclature of enzymes. General characteristics of enzymes, active site, cofactors, prosthetic groups. Metalloenzymes; Isolation, purification, characterization and assays of enzyme and international units. Criteria for purity.

Enzyme kinetics, effect of pH, temperature, determination of Km and Vmax. Regulation of enzyme activity. Enzyme inhibition. competitive, non-competitive and uncompetitive. Isoenzymes, schizomers and isoschizomers. Ribozymes. Immobilization of enzymes. Applications of enzymes; biotechnology, industry, environment, agriculture, food and medicine.

Practical

Isolation, purification and assay of enzymes. Determination of optimum pH and optimum temperature of enzymes. Thermostability of enzymes. Activators and inhibitors of enzyme catalysis. Immobilization of enzymes. Isoenzymes analysis.

Suggested Reading

1. Nelson DL and Cox MM, 2017, Lehninger principles of biochemistry, 7th edn, W. H. Freeman.
2. Satyanarayana U and Chakrapani U, 2021, Essentials of Biochemistry, Elsevier.

IMMUNOLOGY 3 (2+1)

Objectives

1. To study the meaning and importance of immunology
2. To study the classes of antigens and antibodies
3. To study the immunological techniques and DNA vaccines

Theory

History and scope of immunology. Components of the immune system: organs, tissues and cells. Immunoglobulin structure and functions. Molecular organization of immunoglobulins and classes of antibodies. Antibody diversity; antigens, haptens, antigens antibody interactions. Immuno-regulation and tolerance.

Allergies and hypersensitive response. Immunodeficiency. Concept of Vaccines and Vaccinology. Conventional Vaccines. Recombinant subunit vaccines. DNA vaccines and vectored vaccines. Immunological techniques. Immunological application in animal science, monoclonal antibodies and their uses.

Practical

Preparation of buffers and reagents. Precipitation and agglutination test; HA, HI test; immunoblotting, immune electrophoresis and fluorescent antibody test; enzyme immunoassays including ELISA variants, Western blotting. Raising of antisera in laboratory animals. Collection and preservation of antisera – separation, filtration and aliquoting.

Suggested Reading

1. Judy O, Jenni P, Sharon S and Patricia J, 2018, Kuby Immunology.

Semester VI

MOLECULAR DIAGNOSTICS **3 (2+1)**

Objectives

1. To understand the importance of molecular diagnostics
2. To acquaint with various methods of diagnostic methods
3. To compare the advantages of molecular diagnostic methods with those of conventional methods

Theory

Principle and applications of molecular diagnostic tests. Nucleic acid-based diagnostics for detection of pathogenic organisms. Application of restriction endonuclease analysis for identification of pathogens. Polymerase chain reaction (PCR) and its variants. Reverse transcriptase polymerase chain reaction (RT-PCR); isothermal amplification (LAMP); LCR, nucleic acid sequence-based amplification (NASBA); Real-Time PCR; DNA Probes; Southern blotting; Northern blotting. Protein-based assays: SDS-PAGE, Western Blot, Dot-blot, ELISA and lateral flow device.

Advantages of molecular diagnostics over conventional diagnostics, serodiagnostic, DNA array technology, Protein array, tissue array. Biosensors and nanotechnology. Development and validation of diagnostic tests.

Practical

Preparations of buffers and reagents. Collection of clinical and environmental samples for molecular detection of pathogens (bacteria/virus). Extraction of nucleic acids (DNA and RNA) from the clinical specimens. Restriction endonuclease digestion and analysis using agarose gel electrophoresis. Polymerase chain reaction for detection of pathogens in blood and animal tissues. RT-PCR for detection of RNA viruses. PCR based detection of meat adulteration in processed and unprocessed meats. PCR based detection of pathogens in milk, eggs and meat. Lateral flow assay, ELISA.

Suggested Reading

1. Lela B, 2019, Molecular Diagnostics: Fundamentals, Methods and Clinical Applications, FA Davis Company.
2. Singh BD, 2021, Biotechnology Expanding Horizons, Kalyani Publishers.

INDUSTRIAL BIOTECHNOLOGY **3 (3+0)**

Objectives

1. To understand various industrial bioprocesses
2. To acquaint with the production of primary metabolites and secondary metabolites
3. To study the industrial production of bioproducts

Theory

Introduction to industrial bioprocess. Fermentation- bacterial, fungal and yeast. Traditional and modern biotechnology- a brief survey of organisms, processes, and products. Basic concepts of upstream and downstream processing in bioprocess.

Production of primary metabolites. Primary metabolites- production of commercially important primary metabolites like organic acids, and alcohols.

Production of secondary metabolites. Secondary metabolites- production processes for various classes of secondary metabolites: antibiotics, vitamins and steroids.

Production of bioproducts. Production of biopesticides, biofertilizers, biopreservatives, biopolymers biodiesel. bheese, beer, and bushroom culture, bioremediation.

Suggested Reading

1. Balasubramanian D, Bryce CFA, Dharmalingam K, Green J and Kunthala J, 2004, Concepts in Biotechnology, Universities Press Pvt.Ltd.
2. Dubey RC, 2006, A Textbook of Biotechnology, S. Chand and Sons.
3. Kumar HD, 1998, A Textbook on Biotechnology, 2nd edn, Affiliated East West Press Pvt.
4. Ratledge C, and Bjorn K, 2001, Basic Biotechnology, 2nd edn, Cambridge University Press.

EPIGENETICS AND GENE REGULATION 2 (2+0)

Objectives

1. To have an understanding the epigenetics; its manifestation and consequences
2. To study the forms of DNA and histone modifications and their role in gene regulation
3. To study the influence of epigenetics on the small RNAs

Theory

DNA methylation and histone modifications. DNA methylases, methyl binding proteins and histone modifiers. Epigenetic changes in response to external stimuli leading to changes in gene regulation. Role of DNA methylation in plant development: mutant case studies.

Introduction to small RNAs. History, biogenesis. In silico predictions, target gene identification, methylation of heterochromatin by het associated siRNAs. Gene regulation by small RNA and other classes of siRNAs. Role in epigenetics. Jacob Monod model, RNA editing, genome imprinting.

Suggested Reading

1. Sambrook JF and Russell DW (Ed), 2001, Molecular Cloning: A Laboratory Manual, 3rd edn, Vols 1, 2 and 3, Cold Spring Harbor Laboratory Press.
2. Mohanpuria P, Kumar V, Mahajan M, Mohammad H and Yadav SK, 2010, Gene Silencing: Theory, Techniques and Applications: Genetics-Research and Issues, Nova Science Publishers.

IPR, BIOSAFETY AND BIOETHICS 2 (2+0)

Objectives

1. To study the importance and forms of IPR.
2. To study the role of IPR in connection with biodiversity and research outcomes.
3. To study the biosafety guidelines for handling the GMOs.

Theory

Introduction to Intellectual Property, concepts and types. International treaties for the protection of Ips. Indian Legislations for the protection of various types of intellectual property. Patent search, filing process. Material transfer agreements.

Biodiversity definition, importance and geographical causes for diversity. Species and population biodiversity, maintenance of ecological biodiversity hot spots in India. Convention on biological diversity. Cartagena protocol of bio-safety, and risk management for GMO's. Bio-safety guidelines, rules and regulations and regulatory framework for GMOs in India.

Suggested Reading

1. Deepa G and Shomini P, 2013. IPR, Biosafety and Bioethics, Pearson Education.
2. Singh BD, 2021, Biotechnology Expanding Horizons, Kalyani Publishers.

COMPUTATIONAL BIOLOGY **3 (2+1)**

Objectives

1. To study the basics of web-based servers and software in genome analysis.
2. To study the procedure and steps in DNA/RNA/protein sequence submission
3. To study the methods of analysing the sequences for similarity and phylogenetics

Theory

Introduction to computational biology. Web-based servers and software for genome analysis. Ensembl, UCSC genome browser, MUMMER, BLASTZ. Sequence submission: sequence submission, whole genome sequence submission; NGS: basics and types. Introduction to bioprogramming; Perl, Python and R development of web server; basic concepts.

Protein interaction databases: BIND, DIP, GRID, STRING, PRIDE. Principles of Protein structure prediction. Fold Recognition (threading). Homology modeling. SCOP, CATH, PDB, PROSITE, PFAM. Methods for comparison of 3D structures of proteins.

Phylogenetic analysis. Evolutionary models, tree construction methods, statistical evaluation of tree methods; PHYLIP, dendroscope, MEGA; DNA barcoding database-BOLD.

Practical

Application of Genome browsers in genomic research. Exploring protein-protein interaction databases. Working with protein structural classification databases. SNP and SSR identification tools; PHYLIP.

Suggested Reading

1. Creighton TE, 1993, Proteins: Structures and Molecular Properties, 2nd edn, W. H. Freeman.
2. Dov S, 2003, Microarray Bioinformatics, 1st edn, Cambridge University Press.
3. Malcolm Campbell A and Laurie JH, 2007, Discovering Genomics, Proteomics and Bioinformatics. 2nd edn, Benjamin Cummings.
4. Mount D, 2001, Bioinformatics: Sequence and Genome Analysis, 2nd edn, Cold Spring Harbor Laboratory Press.
5. Setubal J and Meidanis J, 2004, Introduction to Computational Molecular Biology, PWS Publishing Company.

INTRODUCTION TO ANIMAL BREEDING **3 (2+1)**

Objectives

1. To study the developments and goals of animal breeding
2. To study population genetics

3. To study the methods of animal breeding

Theory

Population and population genetics; Hardy- Weinberg law; Hardy Weinberg equilibrium. Approaching to equilibrium for sex-linked trait; linkage equilibrium. Effect of linkage on HWequilibrium. Stochastic and deterministic forces acting on population; mutation; migration; selection.

Dissection of phenotype into its components. Transmitting ability, substitution effect of allele. Breeding value. Definition, concept. Heritability: definition, concept, estimation of heritability from regression of offspring to parents. Resemblance among relatives. Repeatability. Definition, concept and estimation. Correlated traits. Phenotypic and genetic correlation, environmental correlation, selection index. Basic concept and types. Basis of selection. Selection differential and genetic gain.

Breeding strategies in large ruminants (cattle, buffalo), small ruminants (sheep, goat) and swine. Poultry breeding. Lab animal breeding. Breed improvement program conducted in India. Molecular breeding: complementation of traditional breeding strategies with molecular genetics.

Practical

Chi-squared test for determining goodness of fit for HW-equilibrium. Estimation of effect of allelic substitution. Estimation of heritability, regression of offspring on parents. Estimation of repeatability. Phenotypic correlation, genetic correlation, environmental correlation. Chi-squared test for determining goodness of fit for HW-equilibrium. Linkage analysis from pedigree data. Selection index.

Suggested Reading

1. Brah GS, 2014, Animal Genetics: Concepts and Implications, 2nd edn, Kalyani Publishers.
2. Mackay TFC and Falconer DS, 2009, Introduction to quantitative genetics, 4th edn, Pearson.

BIOSTATISTICS **2 (1+1)**

Objectives

1. To study the variables and descriptive statistics
2. To study various distributions
3. To study experimental data analysis and interpretation

Theory

Random variables: expected value and its variance; probability distribution of random variables. Conditional probability. Baye's theorem and its applications. Introduction to uniform, binomial, poisson, normal, exponential and gamma probability distributions.

Random mating populations, Hardy-Weinberg Law. Introduction to poisson process and Markov chains. Transition probability matrix, n-step transition probabilities, steady state. Random walk models. Sensitivity and specificity. Positive and negative predictive values.

Chi-square test: testing heterogeneity, use in the genetic experiment, detection of linkage, linkage ratios and its estimation. Analysis of variance. One-way and two-way classification with interaction. Analysis of covariance. Incomplete block designs. Estimation and significance of genotypic and phenotypic variation.

Practical

Expected value and variance of discrete and continuous distributions. Uniform, binomial, poisson, normal, nxponential and namma probability distributions. Hardy-Weinberg Law. Construction of transition probability matrix in Markov Chains. Calculation of sensitivity and specificity. Positive and negative predictive values. Detection and linkage using chi-square test; oneway and two-way analysis of variance. Analysis of covariance. Incomplete block designs. Estimation of heritability.

Suggested Reading

1. Gupta SC, Kapoor VK, 2007, Fundamentals of applied statistics, 4th edn, S Chand and Sons.
2. Kaps M and Lamberson WR, 2017, Biostatistics for Animal Science, 3rd edn, CABI.
3. Triola MM, Triola MF and Roy J, 2017, Biostatistics for the Biological and Health Sciences, 2nd edn, Pearson.

FOOD SCIENCE AND PROCESSING 3 (2+1)

Objectives

1. To study food and nutrition for good health
2. To study food spoilage, processing and preservation
3. To study the methods of assessing physical and chemical qualities

Theory

Definition: Food and nutrition. Food production and consumption trends in India. Major deficiencies of calories, proteins, vitamins and micronutrients. Food groups and concept of balanced diet. RDA, biotoxins, anti-nutritional factors and metabolites.

Causes of food spoilage. Principles of processing and preservation of food by heat, low temperature, drying and dehydration, chemicals and fermentation. Preservation through ultraviolet and ionizing radiations.

Post-harvest handling and technology of fruits, vegetables, cereals, oilseeds, milk, meat and poultry. Food safety, adulteration and food laws. Status of food industry in India

Practical

Physical and chemical quality assessment of cereals, fruits, vegetables, egg, meat and poultry. Value-added products from cereals, millets, fruits, vegetables, milk, egg and meat. Visit to local processing units.

Suggested Reading

1. Potter NN and Hotchkiss JH, 1995, Food Science, Chapman and Hall Publishers.
2. Swaminathan M, 2005, Handbook of Foods and Nutrition, Ganesh and Co. Pvt. Ltd.
3. Swaminathan M, 1990, Food Science, Chemistry and Experimental Foods, BAPPCO.
4. Vaclavik VA and Christian EW, 2003, Essentials of Food Science, 2nd edn, Kluwer Academic/ Plenum Publishers, New York.

Semester VII

ELECTIVE COURSE - ANIMAL BIOTECHNOLOGY

PRINCIPLES AND PROCEDURES OF ANIMAL CELL CULTURE 4 (3+1)

Objectives

1. To study the principles and importance of animal cell culture
2. To study the basic requirements for animal cell culture
3. To study the techniques in cryopreservation and applications of animal cell culture

Theory

History, importance and development of animal cell culture techniques. Basic requirements for animal cell culture. Sterilization procedures for cell culture work. Different types of cell culture media, growth supplements, serum-free media and other cell culture reagents.

Different cell culture techniques including primary and secondary cultures; continuous cell lines, suspension culture, organ culture etc. Commonly used animal cell lines: CHO, HeLa, BHK-21, VERO, Sf9, C636, their origin and characteristic, growth kinetics of cells in culture, differentiation of cells. Characterization and maintenance of cell lines. Applications of animal cell cultures.

Cryopreservation and revival of cells. Hybridoma technology. Scaling up methods, bioreactors. Overview of insect cell culture. Stem cell culture and its application, overview of induced pluripotent stem cells (iPSCs). Common cell culture contaminants and their management.

Practical

Basic equipments used in animal cell culture laboratories. Washing, packing and sterilization of glass and plastic wares for cell culture. Preparation of media and reagents for cell culture. Primary culture technique of chicken embryo fibroblast/any other animal tissue. Culture and sub-culturing of continuous cell lines. Viability assay by trypan blue dye exclusion method. Isolation and cultivation of lymphocytes. Cryopreservation of primary cultures and cell lines. Cytopathic effect of viruses on cultured mammalian cells.

Suggested Reading

1. Freshney I, 2016, Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications.

ANIMAL GENOMICS **4 (3+1)**

Objectives

1. To study the genome sequencing and organisation of the animal genome and chromosomal aberrations
2. To study the application of genomics in the development of molecular markers
3. To study the application of genomics and molecular markers in animals

Theory

Genome organization in eukaryotes. Satellite DNA: VNTRs and families, LINE and SINE. Sex determination: chromosomal basis of sex determination, molecular markers for sex determination, environmental sex determination. Chromosomal aberrations: euploidy, chromosomal nondisjunction and aneuploidy, polyploidy, induced polyploidy, syndromes, structural aberrations. Robertsonian translocations, position effect, chromosomal mosaics, Philadelphia chromosome, chromosomal aberrations and evolution.

Molecular markers: markers, genetic markers: RAPD, STR, DNA fingerprinting, SSCP, RFLP, SNP, EST; SNP Analysis. Karyotyping. Somatic cell hybridization, SNP-array. Radiation hybrid maps. FISH technique. Major histocompatibility complex. Concept and its relevance in disease resistance and immune response. Quantitative trait Loci. Marker Assisted Selection: concept, linkage equilibrium, application in animal sciences. Genomic selection: concept, linkage disequilibrium. Methodologies of genomic selection. Mitochondrial DNA analysis and its application in livestock; applying DNA markers for breed characterization, molecular signatures.

Practical

Extraction of genomic DNA from peripheral blood. Analysis of DNA by agarose or polyacrylamide gel electrophoresis. Checking the quality and quantity of genomic DNA. Restriction digestion and analysis. Sanger sequencing data analysis. Extraction of mitochondrial DNA. Extraction of RNA from PBMC. Quality checking of total RNA. cDNA synthesis.

Suggested Reading

1. Brown TA, 2006, Genomes. 5th edn, Wiley-Blackwell.
2. Dale JW, Schantz MV and Plant N, 2012, From Genes to Genomes: Concepts and Applications of DNA Technology, John Wiley and Sons.
3. Green and Sambrook JF and Russel DW, 2014, Molecular Cloning: A Laboratory Manual, 4th Ed, Vol I, II and III, Cold Spring Harbor Laboratory Press.
4. Reece RJ, 2004, Analysis of Genes and Genomes, Wiley.
5. Sue C, Heather BM, Scott DW and Melissa CS, 2019, Molecular Biology Techniques: A Classroom Laboratory Manual, Academic Press.

TRANSGENIC ANIMAL PRODUCTION 3(3+0)

Objectives

1. To study the historical developments of developing transgenic animals
2. To study the methods of animal transformation
3. To get acquainted with the methods used for analysing the transgenics
4. To study the applications of transgenic animals

Theory

History of transgenesis. Isolation of gene, preparation of gene construct. Methods of transgenic animal production. Calcium chloride mediated transfection, lipofection, electroporation, microinjection, nano delivery.

Production of gene knockouts: cre-lox, zinc finger nucleases; CRISPR; TALENs. Production of chimeric animals, gene silencing by lentivirus system.

Stem cell technology, isolation and characterization of stem cell lines from different sources: embryo, mesenchymal, induced pluripotent stem cell. Introduction to animal cloning. Application of stem cells in transgenesis and animal cloning.

Fundamental assays of transgenic products: confirmation of integration of transgene. Validation of transgenic products like isolation of transgenic protein from milk and characterization. Application of transgenics in production of disease resistance models and carcinogenesis. Regulatory issues associated with transgenic animal production.

Suggested Reading

1. Pinkert CA, 2014, Transgenic Animal Technology.

MOLECULAR VIROLOGY AND VACCINE PRODUCTION 3 (2+1)

Objectives

1. To study the viruses to develop vaccines
2. To study the antigens and methods of producing the vaccines
3. To study the properties of ideal vaccines

Theory

Properties of viruses. Classification of viruses. Virus replication. Cell transformations, cultivation of viruses, assay techniques for detection/quantification.

Important animal viruses. Virus-host interactions. Viral infections. Immune responses to viruses. Interferon and other cytokines. Bio-safety and bio-security principles.

Properties of an ideal vaccine. Classification of vaccines. Methods of inactivation and attenuation of viruses. New generation vaccines: subunit, synthetic, rDNA, marker and edible. Adjuvants and vaccine delivery systems. Novel immunomodulators and vaccine delivery using nanotechnology. Vaccine preparation. Stabilizers, preservatives and vehicles. Quality control and testing of vaccines. Sero-surveillance and sero-monitoring.

Practical

Outline of a virology lab and guidelines to work in a virology lab. Processing of clinical specimens for isolation of viruses. Cultivation of viruses in cell cultures and embryonated eggs. Harvesting of virus. Study of cytopathic effects. Titration of virus and estimation of TCID50. Haemagglutination and haemagglutination inhibition test. Detection of virus by SNT, AGID and ELISA.

Suggested Reading

1. Maclachlan NJ and Dubovi EJ, 2016, Fenner's Veterinary Virology, 5th edn, Elsevier.

EMBRYO TRANSFER TECHNOLOGIES 3 (2+1)

Objectives

1. To study the veterinary reproductive technologies used to obtain offspring from animals as an alternative to natural mating
2. To study the techniques in embryo transfer
3. To study gene transfer and biopharming in conjunction with embryo transfer

Theory

History, advantages, limitations and scope of embryo transfer technology. Estrus cycle and its detection in animals. Methodology of superovulation. Ovum pick up (OPU). Preparation of sperm for in vitro fertilization (IVF). Embryo grading and culture. Micromanipulation and immunomodulation for enhancement of fecundity.

Different methods of gene transfer and their limitations; embryo splitting; embryo sexing by different methods; production of transgenic livestock by nuclear transfer and its application. Animal Biopharming, animal gene bank; regulatory issues (social, ethical, religious and environmental). Cloning of domestic animals. Conservation of endangered species. Characterization of embryonic stem cells and applications.

Practical

Demonstration of estrus detection methods. Estrus synchronization. Superovulation. Oocyte collection from slaughterhouse ovaries. Grading of oocytes from slaughterhouse ovaries. Collection and preparation of semen samples. In vitro fertilization. Collection of embryos using non-surgical procedures. Grading and culture of embryos. Embryo sexing by different methods. Embryo splitting. Embryo freezing.

Suggested Reading

1. Gordon I, 2004, Reproductive Technologies in Farm Animals, CABI.
2. Hafez ESE, 2000, Reproduction in Farm Animals, Lippincott, Williams and Wilkins.

ANIMAL REPRODUCTIVE BIOTECHNOLOGY 3 (2+1)

Objectives

1. This course aims to study the basics of animal reproductive technologies used to analyse, understand and enhance the fertility of animals

2. To study male and female reproduction and methods of checking the quality of gametes
3. To study the direct and indirect methods of checking pregnancy

Theory

Follicle development, oogenesis, endocrinology of female reproduction, spermatogenesis, endocrinology of male reproduction, structure of spermatozoa and oocyte, semen: composition and contribution to semen by different accessory glands, capacitation of spermatozoa, acrosome reaction, estrus cycle, estrus detection.

Oocyte maturation analysis, methods of semen collection, semen analysis (morphological, microscopic, biochemical or molecular, computer assisted sperm analysis), semen extenders, cryopreservation of semen, oocytes and embryos (history and methods: slow, rapid/ vitrification), polyspermy. fertilization, embryo development, gastrulation, pregnancy diagnosis: different methods (direct and indirect).

Basic terms related to infertility, morphological abnormality in semen, male infertility: terms and causes (genetic and infectious), female infertility: terms and causes (genetic and infectious), artificial gametes, sex sorting of semen.

Practical

Semen collection by artificial vagina, semen analysis (color, volume etc., live dead staining, mass motility, progressive motility, concentration of semen, HOST, abnormality in semen, TUNEL assay, Free Radical Assay). Preparation of semen extender, calculation for semen doses preparation, semen doses preparation, oocyte Maturation assessment.

Suggested Reading

1. Dugwekar YG, 2006, Reproductive Biotechnology of Farm Animals, Agrotech Publishing Academy.
2. Hafez ESE and Hafez B, 2000, Reproduction in Farm Animals, 7th edn, Blackwell Publishing.
3. Y adav PS, Singh B, Singh I and Sethi RK, 2010, Reproductive Biotechnology in Buffalo, SSPH, ISBN: 8189304801.

MOOCs/ONLINE COURSES (10 credits)

The students will register for online courses of 10 credit hours (as per UGC guidelines for online courses) as a partial requirement for the comprising one or more courses at the approved portals during the third and fourth years with prior approval from the Head of the institution.

The courses will be non-gradial as separate certificates would be issued by institutes offering the courses. These can be taken any time during the duration of UG program, but preferably during the 3rd and 4th years.

Annexure-I

CASTE CERTIFICATE FOR SCHEDULED CASTE/TRIBE CANDIDATE

1. This is to certify that Shri/Smt/Kumari …… Date of Birth …….. Son/Daughter of …… of village/ town in …… District/Division of State/Union Territory……belongs to the …….. Caste/Tribe which is recognized as SC/ST under the constitution (Scheduled Caste) Order, 1950. The Constitution (Scheduled Caste) Union Territories Order, 1951. The Constitution (Scheduled Tribe) Union Territories Order, 1951, as amended by the SCs And STs List (Modification) Order, 1950; The Bombay Reorganization Act, 1960; The Punjab Reorganization Act, 1966; The State of HP Act, 1970; The North Eastern Areas(Reorganization) Act, 1971 and the SCs And STs Order (Amendment) Act, 1976. The Constitution (Jammu & Kashmir) SC Order, 1956. The Constitution (Andaman & Nicobar Islands) SC Order, 1959 as amended by SCs and STs Order, 1962. The Constitution (Dadra & Nagar Haveli) STs Order, 1962. The Constitution (Pondicherry) SC Order, 1964. The Constitution Scheduled Tribe (Uttar Pradesh) Order, 1967. The Constitution (Goa, Daman & Diu) SC Order, 1968. The Constitution (Nagaland) STs Order, 1970. The Constitution (Sikkim) SC Order, 1968.

2. Shri/Smt./Kumari …… and/or his/her family ordinarily resides in Village/town …….. of District …….. of State /Union Territory of ……..

3 Applicable in the case of SC/ST persons who have migrated from State /Union Territory Administration to another State /Union Territory. The certificate is issued on the basis of the SC/ST Certificate to Shri/Smt. …….. Father/mother of Shri/Smt/ Kumari …….. of village/town …….. in District/Division …… of State/Union Territory …… who belongs to the …….. Scheduled Caste/Tribe in the State/ Union Territory issued by the …… (Name of the prescribed authority) vide their no. …… Dated ……

Signature
Designation with seal of Office)

Place…….. (State /Union Territory)

Date……..

*Please delete the words which are not applicable. Please quote specific presidential order.

NOTE: The term ordinarily reside(s) used here has the same meaning as in section 20 of the representation of the people's act, 1950.

List of Authorities Empowered to issue SC/ST Certificates

1. District Magistrate /Additional District Magistrate/ Deputy Commissioner/ Additional Deputy Commissioner/ Deputy Collector/1st Class Stipendiary Magistrate/ City Magistrate/Sub-divisional Magistrate/Taluka Magistrate/ Executive Magistrate/ Extra Assistant Commissioner not below the rank of 1st class stipendiary Magistrate.
2. Chief Presidency Magistrate/Additional Chief Presidency Magistrate/ Presidency Magistrate
3. Revenue Officers, not below the rank of Tehsildar
4. Sub-divisional Officer of the area where the candidate and /or his family normally resides
5. Administrator/Secretary to the Administrator/Development Officer (Lakshadweep Islands)

Annexure-II

CERTIFICATE TO BE PRODUCED BY OTHER BACKWARD CLASSES (OBC)

This is to certify that Shri/Smt/Kumari …… Date of Birth …….. Son/Daughter of …… of village/town in …… District/Division of State/Union Territory …….. belongs to the …….. community which is recognized as a backward class under:

i) Resolution No. 12011/68/93-BCC (C) dated 10/09/1993 published in the Gazetted of India Extraordinary Part I Section I No. 186 dated 13/09/1993.
ii) Resolution No. 12011/9/94-BCC dated 19/10/1994 published in the Gazetted of India Extraordinary Part I Section I No. 163 dated 20/10/1994.
iii) Resolution No. 12011/7/95-BCC dated 24/05/95 published in the Gazetted of India Extraordinary Part I Section I No. 88 dated 25/05/95.
iv) Resolution No. 12011/96/94-BCC dated 09/03/96.
v) Resolution No. 12011/44/96-BCC dated 06/12/96 published in the Gazetted of India Extraordinary Part I Section I No. 210 dated 11/12/96.
vi) Resolution No. 12011/13/97-BCC dated 03/12/97.
vii) Resolution No. 12011/99/94-BCC dated 11/12/97.
viii) Resolution No. 12011/68/98-BCC dated 27/10/99.
ix) Resolution No. 12011/88/98-BCC dated 06/12/99 published in the Gazetted of India Extraordinary Part I Section I No. 270 dated 06/12/99.
x) Resolution No. 12011/36/99-BCC dated 04/04/2000 published in the Gazetted of India Extraordinary Part I Section I No. 71 dated 04/04/2000.
xi) Resolution No. 12011/44/99-BCC dated 21/09/2000 published in the Gazetted of India Extraordinary Part I Section I No. 210 dated 21/09/2000.
xii) Resolution No. 12015/9/2000-BCC dated 06/09/2001.
xiii) Resolution No. 12011/01/2001-BCC dated 19/06/2003.
xiv) Resolution No. 12011/04/2002-BCC dated 13/01/2004.
xv) Resolution No. 12011/9/2004-BCC dated 16/01/2006 published in the Gazetted of India Extraordinary Part I Section I No. 210 dated 16/01/2006.
xvi) Resolution No. 12011/14/2004-BCC dated 12/03/2007 published in the Gazetted of India Extraordinary Part I Section 0-I No. 270 dated 12/01/2007.

Shri/Smt./Kumari …… and/or his family ordinarily reside(s) in the …… District/Division of …….. State. This is also to certify that he/she does not belongs to the persons/sections (creamy Layer) mentioned in Column 3 of the Schedule to the Government of India, Department of Personnel & Training O.M. No. 36012/22/93-Estt.(SCT) Dated 08/09/93 which is modified vide OM No. 36033/3/2004 Estt. (Res.) dated 09/03/2004.

Dated……..

DISTRICT MAGISTRATE/
DEPUTY COMMISSIONER, ETC.
SEAL

NOTE:

(a) The term ordinarily reside(s) used here has the same meaning as in section 20 of the representation of the people's act, 1950
(b) The authorities competent to issue Caste Certificate are indicated below:
    i. District Magistrate /Additional District Magistrate/ Collector/Deputy Commissioner/ Additional Deputy Commissioner/ Deputy Collector/1srt Class Stipendiary Magistrate/City Magistrate/Sub-divisional Magistrate/Taluka Magistrate/ Executive Magistrate/Extra Assistant Commissioner not below the rank of 1st class stipendiary Magistrate.
    ii. Chief Presidency Magistrate/Additional Chief Presidency Magistrate/ Presidency Magistrate
    iii. Revenue Officers, not below the rank of Tehsildar
    iv. Sub-divisional Officer of the area where the candidate and /or his family normally resides

Annexure-III

DECLARATION/UNDERTAKING- FOR OBC CANDIDATES ONLY

I, ……..…… Son/Daughter of Shri …… resident of Village/Town/City …….. District …….. State hereby declare that I belong to the …… Community which is recognized as a backward class by the Government of India for the purpose of reservation in services as per orders contained in Department of Personnel and Training Office Memorandum No. 36012/22/93-Estt.(SCT), dated 8/9/1993. It is also declared that I do not belongs to persons/sections (Creamy Layer) mentioned in Column 3 of the Schedule to the above referred Office Memorandum dated 8/9/93, is modified vide Department of Personnel & Training OM No. 36033/3/2004 Estt. (Res.) dated 09/03/2004.

Signature of the Candidate

Place: ……

Date: ……..

- Declaration/undertaking not signed by candidate will be rejected.
- False declaration will render the applicant liable for termination of registration at any time.

Creamy Layer Definition

OBC Creamy layer is defined comprehensively at http://ncbc.nic.in/html/creamylayer.html

All candidates for the OBC reserved seats should make sure that they do not satisfy any of the creamy layer criteria as listed in the website. Some general exclusion for quick reference (no way comprehensive) are as follows:

1. Any of the parents holds a constitutional position in Govt. of India.
2. Any of the parents is a class I officer.
3. Both the parents are class II officers.
4. Any one of the parents is employed in an equivalent to class I officer or both parents equivalent to class II officer in public sector, insurance companies, banks, universities or in other Organizations
5. Land holdings on irrigated is 85% or more of the statutory ceiling area.
6. Parents' income is more than Rs. 4.5 lakhs per year or Government of India directives applicable at the time of counselling.

Annexure-IV

(Note: - The Surety Affidavit to be given on stamp paper worth Rs 100/- duly notarized)

AFFIDAVIT BY THE STUDENTS FOR NON-PARTICIPATION IN RAGGING

I, ... Son/D/o Mr./ Mrs. ....., having being admitted to ..... (Name of the Institute), have received a copy of UGC regulations on curbing the menace of ragging in higher educational Institution 2009, (hereinafter called "Regulations") carefully read and fully understood the provisions contained in the said regulations

2. I have, in particular, perused clause 3 of the Regulations and am aware as to what constitutes ragging.
3. I have also, in particular, perused clause 7 and clause 9.1 of the Regulations and am fully aware of the penal and administrative action that is liable to be taken against me in case I am found guilty of or abetting ragging, actively or passively, or being part of a conspiracy to promote ragging.
4. I hereby solemnly aver and undertake that
   a) I will not indulge in any behaviour or act that may be constituted as ragging under clause 3 of the Regulations.
   b) I will not participate in or abet or propagate through any act of commission or omission that may be constituted as ragging under clause 3 of the Regulations.
5. I hereby affirm that, if found guilty or ragging, I am liable for punishment according to clause 9.1 of the Regulations, without prejudice to any other criminal action that may be taken against me under any penal law or any law for the time being in force.
6. I hereby declare that I have not been expelled or debarred from admission in any institution in the country on account of being found guilty of, abetting or being part of a conspiracy to promote, ragging; and further affirm that, in case the declaration is found to be untrue, I am aware that my admission is liable to be cancelled.

Declared this _____ day of _____ month of _____ year,

_____

Signature of deponent

Name: .....

Annexure-V

(Note: - The Surety Affidavit to be given on stamp paper worth Rs 100/- duly notarized)

AFFIDAVIT BY THE PARENTS FOR NON- PARTICIPATION OF THEIR WARDS IN RAGGING

Mr./Mrs. ..... Father of/ Mother of ..... (Full Name of student with admission registration No.), having being admitted to ..... (Name of the Institute), have received a copy of UGC regulations on curbing the menace of ragging in higher educational Institution 2009, (hereinafter called "Regulations") carefully read and fully understood the provisions contained in the said regulations.

2. I have, in particular, pursued clause 3 of the Regulations and am aware as to what constitutes ragging.
3. I have also, in particular, perused clause 7 and clause 9.1 of the Regulations and am fully aware of the penal and administrative action that is liable to be taken against me in case He/She is found guilty of or abetting ragging, actively or passively, or being part of a conspiracy to promote ragging.
4. I hereby solemnly aver and undertake that
   a) My ward will not indulge in any behaviour or act that may be constituted as ragging under clause 3 of the Regulations.
   b) My ward will not participate in or abet or propagate through any act of commission or omission that may be constituted as ragging under clause 3 of the Regulations.
5. I hereby affirm that, if found guilty or ragging, I am liable for punishment according to clause 9.1 of the Regulations, without prejudice to any other criminal action that may be taken against my ward under any penal law or any law for the time being in force.
6. I hereby declare that my ward has not been expelled or debarred from admission in any institution in the country on account of being found guilty of, abetting or being part of a conspiracy to promote, ragging; and further affirm that, in case the declaration is found to be untrue, I am aware that the admission of my ward is liable to be Pcancelled.

Declared this _____ day of _____ month of _____ year,

_____

Signature of deponent

Name: .....

Address & Tel./Mobile No.

Annexure-VI

FORMAT FOR MEDICAL CERTIFICATE

(TO BE OBTAINED ONLY FROM A CHIEF MEDICAL OFFICER OF A DISTRICT or CHIEF MEDICAL SUPERINTENDENT OF GOVT. BASE HOSPITAL)

Name of candidate:		Age:	Sex:
Roll No.:	Category:	Subcategory:	
Merit Position:	Father's Name:		
(To be filled in by the candidate)			

L.T.			M.I.	**VISION**	Colour Vision
Height	Weight	Chest	Abdomen		Without glass With glass

History	Operation	Kock's	Colic's	BP
	Seizures	Asthma	Piles	Diabetes
EXAMINATION	Pulse	Tonsil	DNS	Hernia
	Pallor	Lymph Nodes	CSOM	Hydrocoele
	Cardiovascular		CNS	
	Respiratory		GIT	
	Genito urinary		Others	

Is the candidate Divyang: Yes/ No	
If yes: Type and extent of handicap	Please write: Type-I: One leg or hand defective Type-II: One leg missing Type-III One hand missing
Type:	
Extent: %	
Any other type of handicap (Please specify):	

Any Other Finding:
Final result (Fit/ Unfit)……..based on the medical standards given in the Prospectus for the purpose of Admission.

Signature of Candidate

Signature of Chief Medical Officer/

Chief Medical Supdt. of Govt. Base Hospital
(with official stamp)

Date:

Annexure- VII

MEDICAL STANDARDS

1. **General Requirement**

   The candidate should posses good general physique and should be free from any infectious or contagious disease. He/She should be free from any physical or mental illness or defect likely to interfere with the training in the University.

2. **Heart and lungs:** No significant abnormality should be present.
3. **Hernia, Hydrocele:** There should be no hernia or hydrocele. If present corrected before admission.
4. **Vision:** (a) Normal without glasses. Where defective, it must be corrected to 6/9 in better eye and 6/12 in the other eye. (b) There should be no colour blindness for major colours.
5. **Hearing:** Normal in the both ears. Where defective, it must be corrected beforehand.
6. **Speech:** There should be no major speech defects.
7. Following categories of physically handicapped candidates (having disability 40% or above) shall be eligible for admission to the various courses as shown against each under the **Physically Handicapped category.**

   (1) **One leg or hand defective:** B.Sc.Ag./ M.Sc.Ag./M.Sc. Agricultural Extension & Communication and Food Technology.

   (2) **One leg (defective or missing):** Mechanical/Electrical/Electronics & Communication/ Computer/ Production Engineering/Food Technology/B.Sc. (Home Science), M. Tech. Design and Production Engineering, Thermal Science/Electrical Energy System and M.Sc. in Home Science.

   (3) **One hand (defective or missing):** Civil/Mechanical/Production Engineering and B.Sc. Home Science, M. Tech. in Hydraulic Engineering/Soil Mechanics & Foundation Engineering/Structural Engineering/ Design and Production Engineering/Thermal Science and M.Sc. Home Science.

   The candidate claiming for above benefit should submit along with application form a certificate from Chief Medical Officer of the District certifying the extent of Physical Handicap.

Note 1.

The candidates are well advised to set themselves checked up for any defect and get the same rectified before taking admission to avoid rejection.

Annexure- VIII

NOTIFICATION REGARDING ANTI-RAGGING MEASURES: SUBMISSION OF AFFIDAVIT BY THE STUDENTS / PARENT / GUARDIAN

Dear Parents/Guardian/Student,

You are fully aware of the orders of the Government and of Hon'ble Supreme Court on the Anti-Ragging measures. As per the latest policy all students and parent/guardians are required to submit an affidavit before a student is allowed for admission in the College. The format of Affidavits can be obtained from College office on plain a paper. All parents/guardian/students may submit the same and get them duly attested by the Oath commissioner and bring it on the day of student's admission. Kindly note that there are two Affidavits as Annexure-IX & X. The Annexure-IX is to be signed by the student and Annexure-X shall be signed by the parent / guardian. In case a student does not submit the same he/she shall not be allowed to the classes. It is further, requested that this information be passed amongst friends.

Best wishes,

JOINT DIRECTOR (ACADEMIC)/ DEAN

(Note: - The Surety Affidavit to be given on stamp paper worth Rs 100/- duly notarized)

SURETY BOND TO BE EXECUTED BY A CANDIDATE WHO IS PURSUING B.Tech. (Biotechnology) IN ICAR-IVRI DEEMED TO BE UNIVERSITY

KNOW ALL MEN BY THESE PRESENT THAT I ..... Son/Daughter of ..... resident of .... District of ..... at present pursuing B.Tech. (Biotechnology) in ICAR-Indian Veterinary Research Institute deemed to be university under ICAR as undergraduate (hereinafter called the obligor) and Shri/Smt./Kum. ..... Son/daughter of ..... resident of .... (full address). (hereinafter called surety) do hereby jointly and severally bind ourselves and our-respective heirs, executors and administrators to pay to the Indian Council of Agricultural Research, a Society registered under the Societies Registration Act-1860 Krishi Bhawan, Dr. Rajendra Prasad Road, New Delhi- 110 001 (hereinafter called The ICAR") on demand the sum of **Rs. 50,000/- (Rupees Fifty Thousands only)** together with interest thereon from the date of demand of Government rates for the time being in force on Government loans (if payments is made in a country other than India, equivalent of the said amount in the currency of that country converted at the official rate of exchange between that country and India) and together with all costs between attorney and client and all charges and expenses that shall or may have been incurred by the ICAR-IVRI, Izatnagar.

WHEREAS the obligor has been pursuing B.Tech. (Biotechnology) of the ICAR-Indian Veterinary Research Institute with effect from academic session 2023-24.

AND WHEREAS for the better protection of the ICAR-IVRI the obligor has agreed to execute this bond with such condition as here under is written.

AND WHEREAS the said surety has agreed to execute this bond as Surety on behalf of the above bounden .....

NOW THE CONDITION OF THE ABOVE WRITTEN OBLIGATION IS THAT in the event of the named obligor, Shri/Smt./Kum. ..... leaving the studies after taking admission in BVSc & AH without completion of B.Tech. (Biotechnology) or on his/her being rusticated/removed from the Deemed to be university, the obligor and/or the Surety shall forthwith pay either jointly or severally to the ICAR-IVRI as may be directed by the ICAR-IVRI on demand the sum of Rs. 50,000/- (Rupees Fifty Thousands) only together with interest thereon from the date of demand at Government rates for the time being in force on Government loans.

AND upon the obligor Shri/Smt./Kum. ..... and/ or Shri/ Smt./Kum ..... the surety aforesaid, making such payment the above written obligation shall be void and if no effect otherwise, it shall remain in full force and virtue.

PROVIDED ALWAYS that the liability of the surety hereunder shall not be impaired or discharged by reasons of time being granted or by any forbearance, act or omission of the ICAR-IVRI or any person authorized by them (whether with or without the consent or knowledge of the surety) nor shall it be necessary for the ICAR-IVRI to sue the obligor first before suing the surety Shri/Smt./Kum. ..... for amounts

due hereunder:

The bond shall in all respect be governed by the laws of India for the time being in force and the rights and liabilities hereunder shall, where necessary, be accordingly determined by the appropriate courts in India.

Signed and dated this..... day of ..... two thousand signed and delivered by the obligor above named Shri /Smt./Km., ... in the presence of ..... .

Witnesses:

(Signature, Name and Address)

1.

Signature of student

Obligor

2. Signed and delivered by the surety above named (surety) Shri/Smt./Kum .... in the presence of .....

Witnesses:

(Signature, Name and Address) **(Signature of Surety)**

1.

2.

ROLL NO……

(TO BE FILLED IN BLOCK LETTERS)

PARTICULARS FOR REGISTRATION TO B.Tech PROGRAMME

Affix your recent self attested passport size photo

1. Name of Student (as per matriculation) :

2. Name of programme joined at IVRI :

3. Degree programme :

4. Date of admission :

5. Father's / Husband's name :

6. Mother's name :

7. Permanent Home address :

8. Mailing address :

9. Contact no. : Tel:
   Mobile:
   Email:
   Fax:

10. Whether Urban / Rural / UPS :

11. Gender : Male/Female

12. Marital Status : Married/Unmarried

13. Date & Place of birth : _____

14. State of Domicile & Nationality : _____

15. Religion : _____

16. Category : SC/ST/OBC/UR/PH

17. Whether sponsored, if so, name of the sponsoring authority : _____

18. Whether In-service, if so, mention the kind of leave granted by the Dept. _____

19. Language Known-Speak/Read and Write. Please indicate up to which level you have studied Hindi. : _____

20. Details of the examination passed : _____

(Please also enclose attested copies)

Sl. No.	Name of the Examination	Name of Univ. / College	Year of passing	Max. Marks/ OGPA	Marks/ OGPA obtained	Division
1.	High School / SSLC (10^{th})					
2.	Intermediate / Higher Secondary (10+2)					

20. Please also indicate the standard up to which you have studied Hindi language : _____

21. Whether drawing any scholarship :

22. Details of fees deposited Amount : Rs……..

Receipt No. & Date : ……..

I, _____hereby declare that information furnished by me is correct and no relevant information has been suppressed. I also declare that if any information or document furnished by me in this application is found to be wrong, I shall have no objection to my selection/admission being cancelled. I also undertake to abide by all the rules and regulations of the IVRI Deemed University.

Date & Place **Signature of the candidate**

Guidyelines for B.Tech. (Biotech) Lateral Entry Admission to 3rd and 5th Semester

1. Eligibility Criteria

- U.G. Certificate in Biotechnology for entry into 3rd Semester / U.G. Diploma in Biotechnology for entry into 5th Semester
- Studied in Higher Agricultural Education Institutions (HAEI) recognized and accredited by ICAR, following the 6th Dean's Committee Report.
- GPA of 7.0 or above
- The student should not be on Academic Probation (A.P.) or Conduct Probation (C.P.) at the time of application
- The candidate must not have any academic backlog in their previous institution.
- Character certificate
- Students admitted through lateral entry must fulfill all course requirements and credit obligations as per the curriculum of the 6th Dean's Committee Report

2. Intake Capacity

- Lateral Entry Admissions are limited to 5% of the total sanctioned intake capacity or as per ICAR guidelines.

3. Application Procedure

- Application should be submitted to the university at least one month prior to the commencement of the semester.

4. Selection Process

- A Standing committee will review the application and recommend it for approval by the competent authority.

5. Course Commencement

- As per the academic calendar of the B.Tech. (Biotechnology) programme.

6. Important Notes

- Admission through lateral entry shall be provisional until all required documents are verified and approved.
- Fee structure, hostel accommodation, and other facilities will be applicable as per existing rules for regular B.Tech (Biotechnology) students.
- The final decision regarding admission will rest with the Competent Authority.