ALAGAPPA UNIVERSITY

(A State University Established in 1985)

Karaikudi - 630003. Tamil Nadu, India

2017 Accredited with A+ Grade by NAAC (CGPA : 3.64)

2018 MHRD Graded as Category - I Granted Autonomy

2018 MHRD Swachh Campus Rank : 4

2021 nirf NATIONAL INSTITUTIONAL RANKING FRAMEWORK Rank : 33

2021 QS UNIVERSITY RANKINGS Asia Rank : 199

FACULTY OF SCIENCE

DEPARTMENT OF ANIMAL HEALTH AND MANAGEMENT

M.Sc., ZOOLOGY

REGULATIONS AND SYLLABUS

(For the candidates admitted from the Academic Year 2022 - 2023)

DEPARTMENT OF ANIMAL HEALTH AND MANAGEMENT
M.Sc., Zoology

REGULATIONS AND SYLLABUS

[For the candidates admitted from the Academic Year 2022 – 2023 onwards]

ALAGAPPA UNIVERSITY
(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle and Graded as Category-I University by MHRD-UGC)
Karaikudi -630003, Tamil Nadu.

Panel of Members-Broad Based Board of Studies

Chairperson: **Dr. B. Vaseeharan,** Professor and Head, Department of Animal Health and Management, Alagappa University, Karaikudi – 630 003, Tamil Nadu, India. **Professional Experience: Teaching** - 14 years; **Research** - 19 years. **Area of Research:** Invertebrate Immunotherapy, Nanopharmacology, and Biomaterials.	
Foreign Experts **Prof. Siti Azizah Mohd. Nor,** Principal Research Fellow, University Malaysia Terengganu. Email: s.aziah@umt.edu.my. **Professional Experience:** 30 Years. **Area of Research:** Population genetics and phylogeography.	
Indian Expert – I: **Prof. S. Janarthanam,** Professor and Head, Department of Zoology, University of Madras, Guindy Campus, Chennai. Email: janas.09@unom.ac.in. **Professional experience: Teaching** - 21 Years; **Research:** 26 years. **Area of Research:** Entomology.	
Indian Expert – II: **Prof. Ramasubramaniya**, Professor, Department of Zoology, Bharathiar University, Coimbatore. Email: vramans68@buc.edu.in. **Professional Experience:** Teaching - 22 years; Research - 22 years. **Area of research:** Fish Immunology and Aquaculture	
Expert from Industry: **Mr. P. K. Senthil Kumar,** Chief - Project, Poseidon Biotech, No. 2, 3, PKM cross street, Padasalai road, Mel Ayanampakkam, Chennai. **Chief –** Aquaculture Projects, **Co-ordinator:** Society of Aquaculture Professionals. **Professional Experience:** 29 years. **Area of Research:** Aquaculture and seafood Processing.	
Member: **Dr. P. Srinivasan**, Professor, Department of Animal Health and Management, Alagappa University, Karaikudi – 630 003, Tamil Nadu, India. **Professional Experience:** Teaching – 16 years; Research – 16 years. **Area of Research:** Aquaculture Biotechnology, Phage therapy for Vibrio spp control in Aquaculture, Cancer biology.	
Member: **Dr. N. M. Prabhu**, Assistant Professor, Department of Animal Health and Management, Alagappa University, Karaikudi – 630 003, Tamil Nadu, India. **Professional Experience:** Teaching - 14 years; Research - 14 years; Industrial - 9 years. **Area of Research:** Disease Control and Prevention, Alternative medicine.	
Member: **Dr. M. Biruntha**, Assistant Professor, Department of Animal Health and Management, Alagappa University, Karaikudi – 630 003, Tamil Nadu, India. **Professional Experience:** Teaching - 13 Years; Research - 7 years. **Area of Research:** Vermitechnology.	
Member: **Dr. V. Nithya,** Assistant Professor, Department of Animal Health and Management, Alagappa University, Karaikudi – 630 003, Tamil Nadu, India. **Professional Experience:** Teaching - 13 years; Research - 13 years. **Area of Research:** Pharmacognosy.	
Member: **Dr. P. Kumar**, Assistant Professor, Department of Animal Health and Management, Alagappa University, Karaikudi. **Professional Experience:** Teaching – 7; Research - 7 years, Area of Research: Molecular Cancer biology.	
Alumni: **Dr. B. David Jeyaselan,** Assistant Professor, Department of Microbiology, Nehru Arts and Science College, Coimbatore. **Professional Experience:** Teaching – 7; Research - 5 years. **Area of Research:** Animal Health - Microbiology	

ALAGAPPA UNIVERSITY
DEPARTMENT OF ANIMAL HEALTH AND MANAGEMENT
Science Campus, Karaikudi -630003, Tamil Nadu.

REGULATIONS AND SYLLABUS - (CBCS-University Department)
[For the candidates admitted from the Academic Year 2022 – 2023 onwards]

Name of the Department : Animal Health and Management

Name of the Programme : M.Sc., Zoology

Duration of the Programme : Full Time (Two Years)

Choice-Based Credit System

A Choice-Based Credit System is a flexible system of learning. This system allows students to gain knowledge at their tempo. Students shall decide on electives from a wide range of elective courses offered by the University Departments in consultation with the Department committee. Students undergo additional courses and acquire more than the required number of credits. They can also adopt an inter-disciplinary and intra-disciplinary approach to learning, and make the best use of the expertise of available faculty.

Programme: Master of Science in Zoology (M.Sc.,)

"Programme" means a course of study leading to the award of a degree in a discipline. M.Sc., Zoology is a postgraduate programme and duration is two year that spread over four semesters. The course deals with the study animal diversity, the function of living systems, from the cell and molecular biology to genetics, as well as evaluation, fishery biology, ecology, and conservation biology.

Courses

„ Course‟ is a component (a paper) of a programme. Each course offered by the Department is identified by a unique course code. A course contains lectures/ tutorials/laboratory work/seminar/project work / practical training/report writing /Viva-voce, etc or a combination of these, to meet effective teaching and learning needs.

Credits

The term "Credit" refers to the weightage given to a course, usually in relation to the instructional hours assigned to it. Normally in each of the courses credits will be assigned on the basis of the number of lectures/tutorials/laboratory and other forms of learning required completing the course contents in a 15-week schedule. One credit is equal to one hour of lecture per week. For laboratory/field work one credit is equal to two hours.

Semesters

An academic year is divided into two Semesters. In each semester, courses are offered in minimum of 15 teaching weeks and the remaining 3-5 weeks are to be utilized for conduct of examination and evaluation purposes. Each week has 30 working hours spread over 5 days a week.

Medium of Instruction:

English

Departmental committee

The Departmental Committee consists of the faculty of the Department. The Departmental Committee shall be responsible for admission to all the programmes offered by the Department including the conduct of entrance tests, verification of records, admission, and evaluation. The Departmental Committee determine the deliberation of courses and specifies the allocation of credits semester-wise and course-wise. For each course, it will also identify the number of credits for lectures, tutorials, practical, seminars etc. The courses (Core/Discipline Specific Elective/Non-Major Elective) are designed by teachers and approved by the Departmental Committees. Courses approved by the Departmental Committees shall be approved by the Board of Studies. A teacher offering a course will also be responsible for maintaining attendance and performance sheets (CIA -I, CIA-II, assignments and seminar) of all the students registered for the course. The department coordinators for Non-major elective (NME) and MOOCs (SLC) courses are responsible to submit the performance sheet to the Head of the department. The Head of the Department consolidates all such performance sheets of courses pertaining to the programmes offered by the department. Then forward the same to be Controller of Examinations.

Programme Educational Objectives (PEO)

PEO1	Develop proficient graduates in the field of Zoology with international standards.
PEO2	Build individuals with scientific knowledge in Zoology to compete professional demands at global and national level.
PEO3	Prepare highly motivated students to engage in scientific research in contemporary areas of Zoology.
PEO4	Gain and transform multi-dimensional aspects of bio-analytical techniques in the areas of Zoology.
PEO5	Equip young minds in solving issues related to Zoological research by critical thinking and teamwork.
PEO6	Enhance self-employment and entrepreneurship with strong interpersonal skills in the field of Zoology.
PEO7	Create social values and professional ethics in protecting nature by adopting conservation strategies.
PEO8	Able to transform innovative ideas in Zoology for animal production and product design towards the welfare of society.
PEO9	Expand interdisciplinary research by generating vital theories and concepts to revolutionize national economy.
PEO10	Encourage to pursue intellectual careers at regional, national and international higher educational institutions

Programme Specific Objectives (PSO)

PSO1	To understand the modern taxonomy, structure and function of invertebrates and vertebrates.
PSO2	To inculcate basic knowledge on the key concepts of organisms at cell and molecular level.
PSO3	To strength the concepts of bio-molecular evolution, on importance of environment, indigenous and exotic fish biology.
PSO4	To familiarize the mechanism of physiological process, developmental stages, microbial diversity and defense mechanism of animals.
PSO5	To provide hands-on experience in good laboratory practices, entrepreneurship and employability in contemporary fields of Zoology.

Programme Outcome (POs)

PO1	Demonstrate a deep understanding of the biological principles and concepts related to the study of animals.
PO2	Develop critical thinking abilities and be able to apply their knowledge to analyse and solve zoological problems.
PO3	Familiar with the classification of various animal species and understand the principles and methods of taxonomy and systematics.
PO4	Acquire practical skills related to fieldwork, data collection, and scientific research in the context of zoological studies.
PO5	Proficient in using laboratory equipment, conducting experiments, and analyzing data related to zoological research.
PO6	Understand the processes of evolution and adaptation and how they have shaped animal diversity.
PO7	Aware of the importance of conservation efforts and possess knowledge about biodiversity and its preservation.
PO8	Adhere to ethical guidelines and demonstrate professionalism in the treatment of animals and in conducting research.
PO9	Able to effectively communicate scientific concepts and research findings both in written and oral forms.
PO10	Equipped with the ability to adapt to new challenges and continue learning throughout their professional careers.

Programme Specific Outcomes (POs)

PSO-1	Demonstrate key concepts of modern taxonomy, structure and its functions in animals.
PSO-2	Apply basic ideas in the key ideas of organisms at cell and molecular level.
PSO-3	Discuss the concept of evolution, importance of environment and fish biology.
PSO-4	Compare the physiology, developmental process, microbes and defense mechanism of animals.
PSO-5	Design research plan and transform ideas in contemporary fields of Zoology.

Eligibility for admission

A candidate who has passed UG Degree with Zoology/Biological Sciences/Life sciences [except Botany] as the main subject of study from any University/colleges shall be permitted to appear and qualify for the M.Sc. Zoology course.

Minimum Duration of Programme

The programme is for a period of two years. Each year shall consist of two semesters viz. Odd and Even semesters. Odd semesters shall be from June / July to October / November and even semesters shall be from November / December to April / May. Each semester there shall be 90 working days consisting of 6 teaching hours per working day (5 days/week).

Teaching Methods

The classroom teaching would be through conventional lecture, use of OHP, PowerPoint presentation, novel innovative teaching ideas like television, smart board and computer-aided instructions. Periodic field visit enables the student for gathering the practical experience and up to date industrial scenario. Student seminars would be arranged to improve their

communicative skills. In the laboratory, safety measures instruction would be given for thesafe handling of chemicals and instruments. The lab experiments shall be conducted with special efforts to teach scientific knowledge among students. The students shall be trained to handle advanced instrumental facilities and shall be allowed to do experiments independently. The periodic test will be conducted for students to assess their knowledge. Slow learners would be identified and will be given special attention by remedial coaching. Major and electives would be held in the Department and for Non-major electives students have to undertake other subjects offered by other departments.

Components

A PG programme consists of a number of courses. The term "course" is applied to indicate alogical part of the subject matter of the programme and is invariably equivalent to the subject matter of a "paper" in the conventional sense. The following are the various categories of thecourses suggested for the PG programmes:

A. Core courses (CC) - "Core Papers" means "the core courses" related to the programme concerned including practical"s and project work offered under the programme and shall cover core competency, critical thinking, analytical reasoning, and research skill.

B. Discipline-Specific Electives (DSE) means the courses offered under the programme related to the major but are to be selected by the students, shall cover additional academic knowledge, critical thinking, and analytical reasoning.

C. Non-Major Electives (NME) - Exposure beyond the discipline

- ✓ Students have to undergo a total of two Non Major Elective courses with 2 credits offered by other departments (one in II Semester another in III Semester).
- ✓ A uniform time frame of 3 hours on a common day (Tuesday) shall be allocatedfor the Non-Major Electives.
- ✓ Non Major Elective courses offered by the departments pertaining to a semester should be announced before the end of previous semester.
- ✓ Registration process: Students have to register for the Non-Major Elective course within 15 days from the commencement of the semester either in the department or NME portal (University website).

D. Self-Learning Courses from MOOCs platforms.

- ✓ MOOCs shall be on voluntary for the students.
- ✓ Students have to undergo a total of 2 Self Learning Courses (MOOCs) one in II semester and another in III semester.
- ✓ The actual credits earned through MOOCs shall be transferred to the credit plan of programmes as extra credits. Otherwise 2 credits / course be given if the Self Learning Course (MOOCs) is without credit.
- ✓ While selecting the MOOCs, preference shall be given to the course related to employability skills.

E. Dissertation (Maximum Marks: 200)

The candidate shall undergo Dissertation Work during the fourth semester. The candidate should prepare a scheme of work for the dissertation and should get approval from the guide. The candidate, after completing the dissertation, shall be allowed to submit it to the university departments at the end of the final semester. If the candidate is desirous of availing the facility from other departments/universities/national laboratories (IIT, IISc, ICAR, CSIR, NGOs / INGOs and other reputed organizations) they will be permitted only after getting approval from the guide and HOD. In such a case, the candidate shall acknowledge the same in their dissertation.

Format to be followed for dissertation by the study are given below

- Title page
- Certificate
- Acknowledgment
- Content as follows:

Chapter No.	Title	Page No.
1	Introduction	
2	Aim and objectives	
3	Review of Literature	
4	Materials and Methods	
5	Results	
6	Discussion	
7	Summary and Conclusion	
8	References	

Format of the title page

Title of Dissertation

Dissertation submitted in partial fulfillment of the requirement for the degree of Master of Science in Zoology to the Alagappa University, Karaikudi -630003.

By
(Student Name)
(Register Number)

University Logo

Department of Animal Health and Management
Alagappa University
(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle and Graded as Category-I University by MHRD-UGC, 2019: QS ASIA Rank-216, QS BRICS Rank-104, QS India Rank-20) Karaikudi - 630003
(Year)

Format of certificates

Certificate (Guide)

This is to certify that the Dissertation entitled "----------" submitted to Alagappa University, Karaikudi-630 003 in partial fulfilment for the degree of Master of Science in ---------- by Mr/Ms ----------(Reg No:----------) under my supervision. This is based on the results of studies carried out by him/her in the Department of----------, Alagappa University, Karaikudi-630 003. This dissertation or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar titles or record of any University or Institution.

Research Supervisor

Place:
Karaikudi Date: .

Certificate (HOD)

This is to certify that the thesis entitled " " submitted by Mr/Miss ---------- (Reg No) to the Alagappa University, in partial fulfilment for the award of the degree of Master of --------in ---------- is a bonafide record of research work done under the supervision of Dr……., Assistant Professor, Department of----------, Alagappa University. This is to further certify that the thesis or any part thereof has not formed the basis of the award to the student of any degree, diploma, fellowship, or any other similar title of any University or Institution.

Head of the Department

Place: Karaikudi

Date:

Declaration (student)

I hereby declare that the dissertation entitled " " submitted to the Alagappa University for the award of the degree of Master of -------- in ---------- has been carried out by me under the guidance of Dr. , Assistant Professor, Department of----------, Alagappa University, Karaikudi – 630 003. This is my original and independent work and has not previously formed the basis of the award of any degree, diploma, associateship, fellowship, or any other similar title of any University or Institution.

(……..)

Place: Karaikudi
Date:

F. Internship

The students shall undergo Internship /industrial training in the reputed organizations minimum of two weeks to aquire industrial knowledge during the summer vacation of second semester. The student has to find industry related to their discipline (Public limited/Private Limited/owner/NGOs etc.,) in consultation with the faculty in charge/Mentor and get approval from the Head of the Department and Departmental Committee before going for an internship / industrial training.

Format to be followed for Internship report
The format /certificate for internship report to be followed by the student are given below

Title page

Title of internship report

Internship report submitted in partial fulfilment of the requirement for the
Master of degree in zoology to the Alagappa University, Karaikudi -630003.

By (Student Name)
(Register Number)

University Logo

Department of Animal Health and Management
Alagappa University
(*A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle and Graded as Category-I University by MHRD-UGC, 2019: QS ASIA Rank- 216, QS BRICS Rank-104,QS India Rank-20*)
Karaikudi – 630003
(**Year**)

Format of certificate

(Faculty in-charge)

This is to certify that the report entitled " " submitted to Alagappa University, Karaikudi-630 003 in partial fulfilment for the Master of Science in ----------by Mr/Miss---------- (Reg No:----------) under my supervision. This is based on the work carried out by him/her in the organization M/S ----------. This Internship report or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar record of any University or Institution.

Research Supervisor

Place:
Date:

(HOD)

This is to certify that the Internship report entitled " " submitted by Mr/Miss.----------(Reg No:----------) to the Alagappa University, in partial fulfilment for the award of the Master of Science in ------- is a bonafide record of Internship report done under the supervision of , Assistant Professor, Department of ----------, Alagappa University and the work carried out by him/her in the organization M/S ----------. This is to further certify that the thesis or any part thereof has not formed the basis of the award to the student of any degree, diploma, fellowship, or any other similar title of any University or Institution.

Head of the Department

Place: Karaikudi
Date:

(**Company supervisor or Head of the Organization**)

This is to certify that the Internship report entitled " " submitted to Alagappa University, Karaikudi-630 003 in partial fulfilment for the Master of Science in ----------by Mr/Miss---------- (Reg No:----------) under my supervision. This is based on the work carried out by him/her in our organization M/S ---------- for the period of --. This Internship report or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar record of any University or Institution.

Supervisor or In charge

Place:
Date:

(Student Declaration)

I hereby declare that the Internship Report entitled " " submitted to the Alagappa University for the award of the Master of Science in ---------- has been carried out by me under the supervision of----------, Assistant Professor, Department of----------, Alagappa University, Karaikudi – 630 003. This is my original and independent work carried out by me in the organization M/S ---------- for the period of and has not previously formed the basis of the award of any degree, diploma, associateship, fellowship, or any other similar title of any University or Institution.

( )

Place: Karaikudi
Date:

Acknowledgment

Content as follows:

Chapter No.	Title	Page No.
1	Introduction	
2	Aim and objectives	
3	Organization Profile / Details	
4	Methods / Work	
5	Observation and Knowledge gained	
6	Summary and outcome of the Internship Study	
7	References	

No. of copies of the dissertation/internship report

The candidate should prepare three copies of the dissertation/report and submit the same for the evaluation of examiners. After evaluation, one copy will be retained in the departmentlibrary, one copy will be retained by the guide and the student shall hold one copy.

Attendance

Students must have earned 75% of attendance in each course for appearing the examination. Students who have earned 74% to 70% of attendance need to apply for condonation in the prescribed form with the prescribed fee. Students who have earned 69% to 60% of attendanceneed to apply for condonation in the prescribed form with the prescribed fee along with the Medical Certificate. Students who have below 60% of attendance are not eligible to appear for the End Semester Examination (ESE). They shall re-do the semester(s) after completion of theprogramme.

Examination

The examinations shall be conducted separately for theory and practical‟s to assess (remembering, understanding, applying, analysing, evaluating, and creating) the knowledge required during the study. There shall be two systems of examinations viz., internal and external examinations. The internal examinations shall be conducted as Continuous Internal Assessment tests I and II (CIA Test I & II).

A. ***Internal Assessment***

The internal assessment shall comprise a maximum of 25 marks for each course. The following procedure shall be followed for awarding internal marks.

Theory - 25 marks

Sr. No	Content	Marks
1.	Average marks of two CIA test	15
2.	Seminar/Group Discussion/Quiz etc.	5
3.	Assignment/Field trip report case study reports	5
	Total	25

Practical – 25 marks

Sr. No.	Content	Marks
1	Average marks of two CIA test (Practical) Experiments –Major, Minor, and Spotter	15
2	Observation note book	10
	Total	25

Internship – 25 marks (assess by Guide/In charge/HOD/Supervisor

1	Presentation	15 Marks
2	Progress report	10 Marks
	Total	25 Marks

Dissertation – 50 Marks (Guide/HOD)

1	Two presentations (mid-term)	30 Marks
2	Progress report	20 Marks
	Total	50 Marks

B. ***External Examination***

- There shall be examinations at the end of each semester, for odd semestersin the month of October / November; for even semesters in April / May.
- A candidate who does not pass the examination in any course(s) may be permitted to appear in such failed course(s) in the subsequent examinations to be held in October / November or April / May. However candidates who have arrears in practical shall be permitted to take their arrear Practical examination only along with regular practical examination in the respective semester.
- A candidate should get registered for the first semester examination. If registrationis not possible owing to shortage of attendance beyond condonation limit / regulation prescribed OR belated joining OR on medical grounds, the candidates are permitted to move to the next semester. Such candidates shall re-do the missedsemester after completion of the programme.
- For the Dissertation Work the maximum marks will be 100 marks for thesis evaluation and for the Viva-Voce 50 marks.
- For the internship the maximum marks will be 50 marks for project report evaluation and for the Viva-Voce it is 25 marks.
- Viva-Voce: Each candidate shall be required to appear for Viva-Voce Examination (in defense of the Dissertation Work / internship).

C. ***Scheme of External examination (Question paper pattern)***

Theory - Maximum 75 Marks

Section A	10 questions. All questions carry equal marks. (Objective-typequestions)	10 x 1 = 10	10 questions – 2 each from every unit
Section B	5 questions Either/or type like 1. a (or) b. All questions carry equal marks.	5 x 5 = 25	5 questions – 1 each from every unit
Section C	5 questions Either/or type like 1. a (or) b. All questions carry equal marks.	5 x 8 = 40	5 questions – 1 each frome very unit

Practical - Maximum 75 marks

Section A	Major experiment	15 Marks
Section B	Minor experiment	10 Marks
Section C	Experimental setup	5 Marks
Section D	Spotters- (5 spotters x 5 marks)	25 Marks
Section E	Record Note	10 Marks
Section F	Viva-voce	10 Marks

Dissertation

Dissertation Thesis	100 marks
Viva voce	50 Marks

Internship report

Internship Report	50 Marks
Viva voce	25 Marks

Passing minimum

- A candidate shall be declared to have passed in each course if he/she secures not less than 40% marks in the End Semester Examinations and 40% marks in the Internal Assessment and not less than 50% in the aggregate, taking Continuous assessment and End Semester Examinations marks together.

- The candidates not obtained 50% in the Internal Assessment are permitted to improve their Internal Assessment marks in the subsequent semesters (2 chances will be given) by writing the CIA tests and by submitting assignments.
- Candidates, who have secured the pass marks in the End-Semester Examination and in the CIA but failed to secure the aggregate minimum pass mark (E.S.E + C I.A), are permitted to improve their Internal Assessment mark in the following semester and/or in University examinations.

- A candidate shall be declared to have passed in the Project Work if he /she get not less than 40% in each of the Project Report and Viva-Voce and not less than 50% in the aggregate of both the marks for Project Report and Viva-Voce.

- A candidate who gets less than 50% in the Project Report must resubmit the Project Report. Such candidates need to take again the Viva-Voce on the resubmitted Project.

- Each student should have taken 60 credits as a core course, Internship course (core) 2, 9 credits as a major elective; 4 credits as non-major elective, 15 credits as dissertation work, in addition, MOOCs courses as extra credits, thus totaling least 90 + extra credits required to complete M.Sc. Zoology degree course. Each paper carries 4 /3/ 2 credits.

Grading of the Courses

The following table gives the marks, Grade points, Letter Grades and classifications meant toindicate the overall academic performance of the candidate.

Conversion of Marks to Grade Points and Letter Grade (Performance in Course / Paper)

RANGE OF MARKS	GRADE POINTS	LETTER GRADE	DESCRIPTION
90 - 100	9.0 – 10.0	O	Outstanding
80 - 89	8.0 – 8.9	D+	Excellent
75 - 79	7.5 – 7.9	D	Distinction
70 - 74	7.0 – 7.4	A+	Very Good
60 - 69	6.0 – 6.9	A	Good
50 - 59	5.0 – 5.9	B	Average
00 - 49	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

a) Successful candidates passing the examinations and earning GPA between 9.0 and 10.0and marks from 90 – 100 shall be declared to have Outstanding (O).

b) Successful candidates passing the examinations and earning GPA between 8.0 and 8.9and marks from 80 - 89 shall be declared to have Excellent (D+).

c) Successful candidates passing the examinations and earning GPA between 7.5 – 7.9 andmarks from 75 - 79 shall be declared to have Distinction (D).

d) Successful candidates passing the examinations and earning GPA between 7.0 – 7.4 andmarks from 70 - 74 shall be declared to have Very Good (A+).

e) Successful candidates passing the examinations and earning GPA between 6.0 – 6.9 andmarks from 60 - 69 shall be declared to have Good (A).

f) Successful candidates passing the examinations and earning GPA between 5.0 – 5.9 andmarks from 50 - 59 shall be declared to have Average (B).

g) Candidates earning GPA between 0.0 and marks from 00 - 49 shall be declared to haveRe-appear (U).

h) Absence from an examination shall not be taken as an attempt.

From the second semester onwards the total performance within a semester and continuous performance starting from the first semester are indicated respectively **by Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA).** These two are calculated by the following formulate:

GRADE POINT AVERAGE (GPA) = $\sum_i C_i G_i / \sum_i C_i$

GPA = Sum of the multiplication of Grade Points by the credits of the courses
Sum of the credits of the courses in a Semester

Classification of the final result

CGPA	Grade	Classification of Final Result
9.5 – 10.0	O+	First Class – Exemplary*
9.0 and above but below 9.5	O	
8.5 and above but below 9.0	D++	First Class with Distinction*
8.0 and above but below 8.5	D+	
7.5 and above but below 8.0	D	
7.0 and above but below 7.5	A++	First Class
6.5 and above but below 7.0	A+	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B+	Second Class
5.0 and above but below 5.5	B	
0.0 and above but below 5.0	U	Re-appear

The final result of the candidate shall be based only on the CGPA earned by the candidate.

a) Successful candidates passing the examinations and earning CGPA between 9.5 and 10.0 shall be given Letter Grade (O+), those who earned CGPA between 9.0 and 9.4 shall be given Letter Grade (O) and declared to have First Class –Exemplary*.

b) Successful candidates passing the examinations and earning CGPA between 7.5 and 7.9 shall be given Letter Grade (D), those who earned CGPA between 8.0 and 8.4 shall be given Letter Grade (D+), those who earned CGPA between 8.5 and 8.9 shall be given Letter Grade (D++) and declared to have First Class with Distinction*.

c) Successful candidates passing the examinations and earning CGPA between 6.0 and 6.4 shall be given Letter Grade (A), those who earned CGPA between 6.5 and 6.9 shall be given Letter Grade (A+), and those who earned CGPA between 7.0 and 7.4 shall be given Letter Grade (A++) and declared to have First Class

d) Successful candidates passing the examinations and earning CGPA between 5.0 and 5.4shall be given Letter Grade (B), those who earned CGPA between 5.5 and 5.9 shall be given Letter Grade (B+) and declared to have passed in Second Class.

e) Candidates those who earned CGPA between 0.0 and 4.9 shall be given Letter Grade (U) and declared to have Re-appear.

f) Absence from an examination shall not be taken as an attempt.

CUMULATIVE GRADE POINT AVERAGE (CGPA) = $\sum_n \sum_i C_{ni} G_{ni} / \sum_n \sum_i C_{ni}$

CGPA = Sum of the multiplication of Grade Points by the credits of the entire Programme
Sum of the credits of the courses for the entire Programme

Where „**Ci**" is the Credit earned for Course i in any semester; „**Gi**" is the Grade Point obtained by the student for Course i and „n" refers to the semester in which such courses were credited.

CGPA (Cumulative Grade Point Average) = Average Grade Point of all the Courses passed starting from the first semester to the current semester.

Note: * The candidates who have passed in the first appearance and within the prescribedSemesters of the PG Programme are alone eligible for this classification.

Village Extension Programme (VEP)

The Sivaganga and Ramnad districts are very backward districts where a majority of people lives in poverty. The rural mass is economically and educationally backward. Thus the aim of the introduction of this Village Extension Programme is to extend out to reach environmental awareness, social activities, hygiene, and health to the rural people of this region. The students in their third semester have to visit any one of the adopted villages within the jurisdiction of Alagappa University and can arrange various programs to educate the rural mass in the following areas for three days.

1. Environmental awareness
2. Hygiene and Health

A minimum of two faculty members can accompany the students and guide them.

M. Sc., ZOOLOGY- PROGRAMME STRUCTURE

S. No	Course Code	Title of the Course		T/P	Credits	Hours/ Week	Marks		
		I Semester					**I**	**E**	**Total**
1	509101	Core 1	Structure and Functions of Invertebrates	T	4	4	25	75	100
2	509102	Core 2	Comparative Anatomy of Vertebrates	T	4	4	25	75	100
3	509103	Core 3	Biochemistry	T	4	4	25	75	100
4	509104	Core 4	Cell and Molecular Biology	T	4	4	25	75	100
5	509105	Core 5	Lab-I: Structure and functions of Invertebrates, Comparative Anatomy of Vertebrates, Biochemistry, Cell and Molecular Biology	P	4	8	25	75	100
6	509501 509502 509503	DSE-1	Endocrinology/ Animal Cell Culture Technology / Business Skills inZoology	T	3	3	25	75	100
		Library / Yoga/ counseling/Field trip				3			
					23	**30**	**150**	**450**	**600**
		II Semester							
7	509201	Core 6	Animal Physiology	T	4	4	25	75	100
8	509202	Core 7	Immunology	T	4	4	25	75	100
9	509203	Core 8	Developmental Biology	T	4	4	25	75	100
10	509204	Core 9	Microbiology	T	4	4	25	75	100
11	509205	Core 10	Lab-II: Animal Physiology, Immunology, Developmental Biology, Microbiology.	P	4	8	25	75	100
12	509206	Core 11	Internship		2	*	25	75	100
13	509504 509505 509506	DSE-2	Food Processing Technology/ Methods in Biology/ Animal Biotechnology	T	3	3	25	75	100
14		Non-Major Elective-I		T	2	3	25	75	100
15		Self-learning course (SLC) –MOOCs			Extra credit				
					27	**30**	**200**	**600**	**800**
		III Semester							
16	509301	Core 12	Genetics	T	4	4	25	75	100
15	509302	Core 13	Evolution	T	4	4	25	75	100
16	509303	Core 14	Ecology and Conservation Biology	T	4	4	25	75	100
17	509304	Core 15	Fishery Biology and Aquaculture	T	4	4	25	75	100
18	509305	Core 16	Lab-III: Genetics, Evolution, Ecology and Conservation Biology, FisheryBiology and Aquaculture	P	4	8	25	75	100
19	509507 509508 509509	DSE-3	Entomology/ Environmental Management/ Applied Biology	T	3	3	25	75	100
20		Non-Major Elective –II		T	2	3	25	75	100
21		Self-learning course (SLC) –MOOCs			Extra credit				
					25	**30**	**175**	**525**	**700**
		IV Semester							
22	509999	Dissertation Work			15	30	50	150	200
			Total		**90+ extra credits**		**550**	**1650**	**2300**

Non-Major Elective –Courses offered to the other Department to other Departments

S. No	Semester	Title of the paper	T/P	Credits	Hours/ Week	Marks		
						I	E	T
1	II	Business Skills in Zoology	T	2	3	25	75	100
2	III	Food Processing Technology	T	2	3	25	75	100

Courses:

I	Semester	=	23 Credits	(Core: 20; Discipline Specific Elective: 3)
II	Semester	=	27 Credits	(Core: 20; Discipline Specific Elective: 3; Non-Major Elective: 2; Internship: 2)
III	Semester	=	25 Credits	(Core: 20; Discipline Specific Elective: 3; Non-Major Elective: 2)
IV	Semester	=	15 Credits	(Dissertation Work: 15)
Total credits		**=**	**90+ Extra credits**	**(Core: 60; Discipline Specific Elective: 9; Non-Major Elective: 4; Internship: 2; Dissertation Work: 15; MOOCs extra credits)**

I-SEMESTER					
Core	**Course code 509101**	**Structure and Functions of Invertebrates**	**T**	**Credits: 4**	**Hours: 4**

UNIT - I

Objective 1	To study the classification and phylogeny of Invertebrates.	
Diversity of Animal Kingdom: Linnaeus and the origin of classification, taxonomic characters and reconstruction of phylogeny, Levels of organization - Unicellularity - multicellularity, Colonization and organization of germ layers - Division of labour and organization of tissues - ectoderm, mesoderm and endoderm - Development of coelome and Acoelomata organization - symmetry - Segmentation and cephalization.		
Outcome 1	Provide the students a comprehensive knowledge of animal diversity.	**K3**

UNIT - II

Objective 2	To understand the general characteristics, classification and functions of Invertebrates.	
Locomotion and Nutrition of Animals: Movement and locomotion -Amoeboid movement – Ultrastructure of cilia and ciliary movements - Action of muscles. Nutrition - Types of nutrition: Autotrophic and heterotrophic. **Apparatus for nutrition:** Food vacuole - Animals without alimentary canal - incomplete - complete alimentary canal. Brief account of physiology of digestion in invertebrates.		
Outcome 2	Develop an understanding of the characters used to differentiate the organisms.	**K2**

UNIT - III

Objective 3	To make a detailed comparison of the anatomy of Invertebrates.	
Diversity of organ System of Invertebrates: Overview of the Circulatory systems, Respiratory systems, Excretory systems, Nervous and sensory system and Reproductive systems of animals.		
Outcome 3	Realize physiological mechanisms in diverse organisms	**K3**

UNIT - IV

Objective 4	To highlight the complexity of structure and function of invertebrates.	
Evolution and characteristics of important Invertebrates taxa: Organization and affinities in fossils. Affinities of living fossils. Polymorphism and colony formation. Parasitic adaptations and life cycle patterns in parasites belonging to different taxa. The parasites listed by World Health Organization under preventive programmes. Invertebrate model organisms and their importance.		
Outcome 4	Understand the relative position of individual organs and associated structures	**K2**

UNIT - V

Objective 5	To give an overview of life processes and adaptive radiations in non-chordates	
Integument and Skeletal Systems of Animals: General features of the Integument Dermis and Epidermis. Phylogeny - Specialization of the Integument-Skeletal System.		
Outcome 5	Demonstrate the invertebrate and their structure representation	**K2**

Suggested Readings :

Anderson, D. T. (2001). *Invertebrate zoology*. Oxford University Press Publishing Company.

Robert. D Barnes, R. D. (1987). *Invertebrate zoology* 5th edition. Saunders College Publishing Company.Ekambaranatha Ayyar, M. (1976). *Manual of Zoology* . S. Viswanathan Publishing Company.

Hickman, C., Keen, S., Larson, A., & Eisenhour, D. (2018). *Animal diversity*. 9th Edition McGraw-Hill LLCPublishing Company.

Sandhu, G. S. (2005). Objective Invertebrate Zoology, Campus Books International, New Delhi PublishingCompany.

Verma, P. S. (2001). Invertebrate Zoology. S. Chand Publishing Company.

Online Resources

https://ncert.nic.in/textbook/pdf/kebo104.pdf

https://www.britannica.com/animal/invertebrate

K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr. B. Vaseeharan

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	M (2)	S (3)	M (2)	L (1)	M (2)	M (2)	L (1)	M (2)	L (1)
CO2	S (3)	M (2)	S (3)	M (2)	L (1)	M (2)	M (2)	L (1)	M (2)	L (1)
CO3	S (3)	M (2)	S (3)	M (2)	L (1)	M (2)	M (2)	M (2)	M (2)	L (1)
CO4	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	M (2)	M (2)
CO5	S (3)	M (2)	M (2)	L (1)	L (1)	M (2)	S (3)	M (2)	M (2)	M (2)
W.AV	**3**	**2**	**2.8**	**2**	**1.4**	**2.2**	**2.4**	**1.6**	**2**	**1.4**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M (2)	L (1)	M (2)	M (2)
CO2	S (3)	M (2)	L (1)	M (2)	M (2)
CO3	S (3)	M (2)	L (1)	M (2)	M (2)
CO4	S (3)	M (2)	L (1)	M (2)	M (2)
CO5	M (2)	M (2)	L (1)	M (2)	M (2)
W.AV	**2.8**	**2**	**1**	**2**	**2**

S –Strong (3), M-Medium (2), L- Low (1)

I-SEMESTER					
Core	**Course Code 509102**	**Comparative Anatomy of Vertebrates**	**T**	**Credits: 4**	**Hours: 4**

UNIT - I

Objective 1	To study the classification and phylogeny of vertebrate animals.

Taxonomy: Principles of taxonomy Nomenclature - Binomial, Trinomial nomenclature. New trends in taxonomy - Systematic and taxonomy. Species concept, clades. Nomenclature and utility of scientific names. Morphological and evolutionary classification. Relationship of taxa: phylogenetics and cladistics with special reference to Paraphyly, monophyly, apomorphy, plesiomorphy and phenoplasticity.

Outcome 1	Understand the emergence and diversity of chordates.	**K2**

UNIT - II

Objective 2	To understand the general characteristics of Protochordata and fishes

Protochordata: Primitive Chordates and their affinities. Hemichordates, Urochordates and Cephalochordates - Organization, phylogenetic considerations, and their larval forms. Retrogressive metamorphosis in Urochordata. Advent of vertebrates: Cyclostomes, their evolutionary status and affinities. **Fishes** - Basic organization and diversity of fishes, their evolutionary transitions. From Water to Land invasion - Early Tetrapodes - Migration in fishes, Osmoregulation.

Outcome 2	Realize the relevance of prochordates and fishes in evolution.	**K3**

UNIT - III

Objective 3	To study the structural and functional adaptations of Amphibians and reptiles.

Amphibians: Definition, general characters, Amphibians diversity and adaptability to dual mode of life - Adaptive features of Anura, Urodela & Apoda - Parental care in Amphibians. **Reptiles:** structural andfunctional adaptations of reptiles - Identification of poisonous and non-poisonous snakes of South India.

Outcome 3	Study the structural modifications of Amphibians and reptiles	**K4**

UNIT - IV

Objective 4	To understand the process of adaptation of birds and animals.

Aves: Birds as glorified reptiles. The fossil history of birds. Palate in Birds. Flight Adaptations - Flightless birds and their distribution - Migration in birds. Adaptation from terrestrial to aerial mode of life. **Mammals:** Evolution of Mammals, Structural peculiarities of Prototheria, Metatheria, and Eutheria - Flying mammals - Dentition in Mammals - Aquatic mammals.

Outcome 4	Understand the different adaptation and their evolution of Aves and mammals.	**K2**

UNIT - V

Objective 5	To understand comparative anatomy chordates.

Comparative anatomy: Brain, Heart, Aortic Arches, Integument, Respiratory system, Digestive system and Urino-genital system of Vertebrates. Zoogeography.

Outcome 5	Understand the functional anatomy of vertebrates.	**K2**

Suggested Readings:

Anderson, D. T. (2001). *Invertebrate zoology*. Oxford University Press.

Ekambaranatha, A. (1976). *Manual of Zoology* . S. Viswanathan.

Ganguli, B. B., Sinha, A. K., Adhikari, S. (2018). Biology of Animals. India: New Central Book Agency. Hickman, C. P., Keen, S. L., Larson, A., & Eisenhour, D. J. (2018). *Animal diversity*. McGraw-Hill Education.Verma, P. S. (2001). Invertebrate Zoology. Italy: S. Chand Limited.

Waterman, A. J., Kluge, A. G., Frye, B. E. (1977). Chordate Structure and Function. UnitedKingdom: Macmillan.

Pandey, B. N, Mathur, Vartika. (2018). Biology of Vertebrate: PHI Learning Pvt. Ltd.

Online Resources

https://www.britannica.com/science/taxonomy

https://bio.libretexts.org/Bookshelves/Microbiology

K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by:Dr. M. Biruntha

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	M (2)	S (3)	M (2)	L (1)	M (2)	M (2)	M (2)	M (2)	M (2)
CO2	M (2)	M (2)	S (3)	M (2)	L (1)	M (2)	S (3)	M (2)	M (2)	M (2)
CO3	M (2)	M (2)	S (3)	M (2)	L (1)	M (2)	S (3)	M (2)	M (2)	M (2)
CO4	S (3)	M (2)	M (2)	S (3)	M (2)	M (2)	M (2)	M (2)	M (2)	M (2)
CO5	S (3)	M (2)	S (3)	M (2)	L (1)	M (2)	M (2)	M (2)	M (2)	M (2)
W.AV	**2.6**	**2**	**2.8**	**2.2**	**1.2**	**2**	**2.4**	**2**	**2**	**2**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M (2)	M (2)	M (2)	M (2)
CO2	M (2)	M (2)	S (3)	M (2)	M (2)
CO3	S (3)	M (2)	L (1)	M (2)	M (2)
CO4	S (3)	M (2)	L (1)	M (2)	M (2)
CO5	S (3)	M (2)	M (2)	M (2)	M (2)
W.AV	**2.8**	**2**	**1.8**	**2**	**2**

S –Strong (3), M-Medium (2), L- Low (1)

I-SEMESTER					
Core	**Course code 509103**	**Biochemistry**	**T**	**Credits: 4**	**Hours: 4**

UNIT - I

Objective 1	To provide knowledge about the biological importance of carbohydrates.

Carbohydrates: Classification, properties and biological importance. Reactions and properties of monosaccharides. **Carbohydrate metabolism:** Glycolysis, TCA cycle, HMP shunt, glycogenesis, glycogenolysis, glyconeogenesis and oxidative phosphorylation.

Outcome 1	Know the fundamental biochemical process of carbohydrates.	**K2**

UNIT - II

Objective 2	To understand the structure and function of protein.

Proteins: Classification, structure, properties of amino acids, amino acid metabolism, study the specific protein like haemoglobin and myoglobin. Ramachandran plot. **Protein metabolism:** Transamination, deamination, ureacycle.

Outcome 2	Understand and discuss the complexity of proteins and their function.	**K2**

UNIT - III

Objective 3	To acquire the synthesis and degradation of lipids in cells.

Lipids: Classification, structure, properties of fatty acids. **Lipid metabolism**: Lipolysis, β-oxidation, Lipogenesis (Denovo synthesis of Fatty acid), Biosynthesis of Triacylglycerol.

Outcome 3	Knowledge on the diverse group of lipids with different functions.	**K2**

UNIT - IV

Objective 4	To find the inherited characteristics of every living thing.

Nucleic acids: Structure of DNA, Different Forms of DNA - A, B, Z DNA, Structure of RNA, types of RNA - mRNA, tRNA, rRNA**. Nucleic acids metabolism**: Biosynthesis of purines and pyrimidines, Catabolism of Purines and Pyrimidines

Outcome 4	Acquire the essential roles of Nucleic acids in all cells.	**K3**

UNIT - V

Objective 5	To study chemical reactions of enzymes and vitamins in our bodies.

Enzymes: Types, classification and properties of enzymes, Derivation of Michaelis-Menten (MM) equation, Enzyme inhibition- competitive, noncompetitive, and uncompetitive, mechanism of enzymes action - Lock and key model, induced fit model. **Vitamins:** Classification, structure, functions of fat soluble vitamins and watersoluble vitamins.

Outcome 5	Able to discuss the mechanism of action about enzymes and vitamins.	**K4**

Suggested Readings:

Devlin, T. M. (2006). Textbook of Biochemistry. John Wiley & Sons, Incorporated.

Lehninger, A. L., Cox, U. M. M., Nelson, I. f. M. G. D. L., Cox, M. M., Nelson, D. L., Cox, M. M. (2005). Lehninger principles of biochemistry. United Kingdom: W. H. Freeman.

Murray, R. K. (2009). Harper's Illustrated Biochemistry, 28th Edition. UnitedKingdom: McGraw- HillEducation.

Rastogi, S. C. (1993). Biochemistry. India: Tata McGraw Hill Publishing Company.

Satyanarayana, U. (2017). Biochemistry. India: Elsevier Health Sciences.

Stryer, L., Tymoczko, J. L., Berg, J. M. (2002). Biochemistry. Spain: W.H. Freeman.

Online Resources

https://courses.lumenlearning.com/suny-ap2/chapter/carbohydrate-metabolism-no-content/

https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/health_science_students/medicalb iochemistry.pdf

K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr. V. Nithya

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M (2)	M (2)	L (1)	L (1)	M (2)	L (1)	L (1)	M (2)	S (3)	S (3)
CO2	M (2)	M (2)	L (1)	L (1)	M (2)	L (1)	L (1)	M (2)	S (3)	M (2)
CO3	M (2)	M (2)	L (1)	L (1)	M (2)	L (1)	L (1)	M (2)	S (3)	M (2)
CO4	M (2)	M (2)	L (1)	L (1)	M (2)	L (1)	L (1)	M (2)	S (3)	S (3)
CO5	M (2)	M (2)	L (1)	L (1)	M (2)	L (1)	L (1)	M (2)	S (3)	S (3)
W.AV	**2**	**2**	**1**	**1**	**2**	**1**	**1**	**2**	**3**	**2.6**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M (2)	S (3)	M (2)	M (2)	S (3)
CO2	M (2)	S (3)	M (2)	M (2)	S (3)
CO3	M (2)	S (3)	M (2)	M (2)	S (3)
CO4	M (2)	S (3)	M (2)	M (2)	S (3)
CO5	M (2)	S (3)	M (2)	M (2)	S (3)
W.AV	**2**	**3**	**2**	**2**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

I-SEMESTER					
Core	**Course code 509104**	**Cell and Molecular Biology**	**T**	**Credits: 4**	**Hours: 4**

UNIT - I		
Objective 1	To introduce the dynamic organization of cell and its organelles.	
Dynamic organization of cell: Structural and functional organization (basic information about cell organelles functions and cytoskeleton); bio-membranes: structure-function relationship; molecular mechanisms of membrane transport, nuclear transport, transport across mitochondria and chloroplasts; intracellular vesicular trafficking from endoplasmic reticulum through Golgi apparatus to lysosomes/cell exterior.		
Outcome 1	Understand the dynamic organization of cell and its organelles.	**K2**
UNIT - II		
Objective 2	To impart the knowledge of cellular process and their regulation.	
Cellular Process: Cell cycle and its regulation; cell-ECM and cell-cell interactions; cell motility and migration; cell death: different modes of cell death and their regulation (apoptosis, necrosis, necroptosis, autophagy, senescence etc.). **Cell reproduction, development and stem cell:** Gametes and fertilization, early development: Metabolic activation, cytoplasmic rearrangement, embryonic induction, cell lineages, pattern formation; committed cells and late development; Stem cells, Embryonic stem cells, differentiation		
Outcome 2	Acquired knowledge on cellular process and their regulation.	**K2**
UNIT - III		
Objective 3	To study the features of fundamental process by studying central dogma.	
Fundamental Processes: DNA replication, repair and recombination, Gene transcription and silencing by chromatin- Writers, -Readers and – Erasers; Transcriptional control: Structure and assembly of eukaryotic and prokaryotic RNA Polymerases, structures of promoters and enhancers, transcription factors as activators and repressors. Transcriptional initiation, elongation and termination; post-transcriptional control. Interference by small non-coding RNAs (miRNAs and siRNAs)**.** Protein translation machinery, ribosomes composition and assembly; universal genetic codes, degeneracy of codons, Wobble hypothesis; Iso-accepting tRNA; mechanism of initiation, elongation and termination; co and post- translational modifications, mitochondrial genetic code translation product cleavage, modification and activation.		
Outcome 3	Inculcate the features of fundamental process by studying central dogma.	**K3**
UNIT - IV		
Objective 4	To exemplify the significance of cell signalling and communications.	
Cell signalling: Hormones and their receptors, cell surfaces receptor, signalling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signalling pathways, bacterial chemotaxis and quorum sensing. **Cellular communications:** regulation of hematopoiesis, general principles of cell communication, celladhesions, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.		
Outcome 4	Excel in understanding the significance of cell signalling pathways.	**K2**
UNIT - V		
Objective 5	To explain effects of mutations leading to genomic instability.	
Genomic instability and Cell Transformation: Types of mutations; intra-genic and inter-genic suppression; transpositions- transposable genetic elements in prokaryotes and eukaryotes, role of transposons in genome; tumour cell vs. normal cell; viral and cellular oncogenes; tumour suppressor genes; structure, function and mechanism of action; activation and suppression of tumor suppressor genes; epigenetic changes in tumorigenesis; cell growth and death pathways; cell cycle and genome maintenance; EMT and Metastasis; cancer models: cultured cells and animal models e.g. transgenic mice.		
Outcome 5	Evaluate the concept of genomic instability and cell transformation.	**K5**

Suggested Readings:

Alberts, B., Morgan, D., Walter, P., Roberts, K., Lewis, J., Johnson, A. D., Raff, M. C. (2015). *Molecular Biology of theCell*. United Kingdom: Garland Science, Taylor and Francis Group.

Berk, A., Kaiser, C. A., Amon, A., Bretscher, A., Lodish, H., Martin, K. C., Ploegh, H., Krieger, M. (2016). *MolecularCell Biology*. United Kingdom: W. H. Freeman.

Goldstein, E. S., Kilpatrick, S. T., Krebs, J. E. (2017). *Lewin's GENES XII*. Japan: Jones & Bartlett Learning.Cooper, G. M., Hausman, R. E. (2013). *The Cell: A Molecular Approach*. United States: Sinauer Associates.

Hardin, J., Bertoni, G., Becker, W. M. (2017). *Becker's World of the Cell*. United Kingdom: Pearson Education, Limited.Watson. (2008). *Molecular biology of the gene (5th ed.)*. Menlo Park, CA: Benjamin/Cummings.

Online Resources

https://med.virginia.edu/cell-biology/our-research/cellular-dynamics/

https://onlinecourses.nptel.ac.in/noc23_bt32/preview

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. P. Srinivasan

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M (2)	M (2)	L (1)	L (1)	M (2)	L (1)	L (1)	M (2)	S (3)	S (3)
CO2	M (2)	M (2)	L (1)	L (1)	M (2)	L (1)	L (1)	M (2)	S (3)	M (2)
CO3	M (2)	M (2)	L (1)	L (1)	M (2)	L (1)	L (1)	M (2)	S (3)	M (2)
CO4	M (2)	M (2)	L (1)	L (1)	M (2)	L (1)	L (1)	M (2)	S (3)	S (3)
CO5	M (2)	M (2)	L (1)	L (1)	M (2)	L (1)	L (1)	M (2)	S (3)	S (3)
W.AV	**2**	**2**	**1**	**1**	**2**	**1**	**1**	**2**	**3**	**2.6**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M (2)	S (3)	M (2)	M (2)	S (3)
CO2	M (2)	S (3)	M (2)	M (2)	S (3)
CO3	M (2)	S (3)	M (2)	M (2)	S (3)
CO4	M (2)	S (3)	M (2)	M (2)	S (3)
CO5	M (2)	S (3)	M (2)	M (2)	S (3)
W.AV	**2**	**3**	**2**	**2**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

I-SEMESTER					
Core	**Course code 509105**	**Lab – I** Structure and functions of Invertebrates, Comparative Anatomy of Vertebrates, Biochemistry, Cell and Molecular Biology	**P**	**Credits: 4**	**Hours: 8**

UNIT - I

Objective 1	To impart the basics of structure and functions of Invertebrates.	
Structure and Functions of Invertebrates: Mounting – Cockroach – Mouthparts, Prawn – Appendages, Placoid scales – Shark. Dissection of cockroach: Digestive, reproductive & nervous systems. Earthworm body setae. Identification and study the larval forms all major phyla of Invertebrates.		
Outcome 1	Understand the basics of Invertebrates structure and functions.	**K2**

UNIT - II

Objective 2	To learn the comparative anatomy of vertebrates.	
Comparative anatomy of Vertebrates: Dissections: Understanding the anatomy of the frog using an Appropriate software package (CarolinaTM BiolabR–Frog).Study of the following skull types with Reference / Books to jaw suspensions: a). Fish b). Frog c). Calotes d). Rat / Rabbit		
Outcome 2	Analyze dissect vertebrates with the use of software.	**K4**

UNIT - III

Objective 3	To explain the basic concept of biochemistry.	
Biochemistry: Preparation of solutions (Molarity & Normality, Percentage), Determination of pH. Estimation of total protein by Lowry's method.		
Outcome 3	Acquire knowledge on the laboratory aspects of biochemistry.	**K1**

UNIT - IV

Objective 4	To demonstrate the techniques involved in the separation of biomolecules.	
Biochemistry Demonstration: Colorimeter, Separation of amino acid by paper chromatography, Separation of protein by electrophoresis - SDS.		
Outcome 4	Evaluate the advance instrumentation used in biochemistry.	**K5**

UNIT - V

Objective 5	To understand the concept of cell and molecular biology.	
Cell and Molecular Biology:- Onion root tip-squash preparation and study of mitosis, grasshopper testis- Squash preparation and study of meiosis, Chironomous larva- Squash preparation of giant chromosome and buccal mucosal epithelium-smear preparation to detect Barr body.		
Outcome 5	Fundamentals of cell and molecular biology with practical knowledge.	**K2**

Suggested Readings:

Amsath, A. (2010). Practical Manual in Zoology: M.M.A. Publications.

Jordan, E.L & Verma, P.S. (2014). Invertebrate Zoology. India: S. Chand & Co. Ltd.

Lundblad, R. L. & Macdonald, M.F. (2010). Practical Handbook of Biochemistry and Molecular Biology: CRC publications.

Malik, B.S. (2009). A Laboratory Manual of Veterinary Microbiology: CBS Publications.

Sambrook, J &Rusell, D, W. (2001). Molecular Cloning: A Laboratory Manual. U.S.A: Cold spring harbor laboratory press.

Sankara, S. (2008). Laboratory Manual for Biochemistry: Jaypee Brothers Medical Publishers.

Thompson, D. A & Thompson, C.C. (2011). Cell and Molecular Biology Lab Manual: Create Space Independent Publishing Platform.

Online Resources

https://www.mlsu.ac.in/econtents/758_PRACTICAL%20ZOOLOGY%20%20VERTEBRATE%20(%20PDFDr ive%20).pdf

http://www.zoologyresources.com/uploadfiles/books/dc64b77d8769325515d17c945e461b45.pdf

K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr. B. Vaseeharan, Dr. M. Biruntha, Dr. V. Nithya, Dr. P. Srinivasan

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	M (2)	S (3)	M (2)	L (1)	M (2)	M (2)	M (2)
CO2	S (3)	S (3)	S (3)	M (2)	S (3)	M (2)	L (1)	M (2)	M (2)	M (2)
CO3	S (3)	S (3)	L (1)	M (2)	S (3)	L (1)	L (1)	M (2)	M (2)	M (2)
CO4	S (3)	S (3)	L (1)	M (2)	S (3)	L (1)	L (1)	M (2)	M (2)	M (2)
CO5	S (3)	S (3)	L (1)	M (2)	S (3)	L (1)	L (1)	M (2)	M (2)	M (2)
W.AV	**3**	**3**	**1.8**	**2**	**3**	**1.4**	**1**	**2**	**2**	**2**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M (2)	M (2)	M (2)	L (1)
CO2	S (3)	M (2)	M (2)	M (2)	L (1)
CO3	L (1)	S (3)	M (2)	L (1)	S (3)
CO4	L (1)	S (3)	M (2)	M (2)	S (3)
CO5	L (1)	S (3)	M (2)	M (2)	S (3)
W.AV	**1.8**	**2.6**	**2**	**1.8**	**2.2**

S –Strong (3), M-Medium (2), L- Low (1)

I-SEMESTER					
Discipline Specific Elective – 1	**Course code 509501**	**Endocrinology**	**T**	**Credits: 4**	**Hours: 3**

UNIT - I		
Objective 1	To study the basics of hormone and its function	
Endocrinology: Introduction and Scope of study - functions of neuroendocrine systems - classification of hormones – Feedback control of hormone secretion – cause of hormone excess and deficiency.		
Outcome 1	Acquire general awareness on the endocrinology.	**K1**
UNIT - II		
Objective 2	To understand the role of hypothalamus, pineal, and pituitary glands	
Hypothalamus, Pineal, and Pituitary: Hypothalamus – structure and functions - Pineal gland - the structure and its functions. Pituitary - Hormones from anterior and posterior pituitary -Disorder of Pituitary.		
Outcome 2	Understand the functions of hypothalamus, pineal and Pituitary glands.	**K2**
UNIT - III		
Objective 3	To study the thyroid, parathyroid , and thymus glands	
Thyroid, Parathyroid, and Thymus Glands: Thyroid gland – Structure, function, and synthesis of thyroid hormone - Disorders of the thyroid gland - Parathyroid – Structure, and PTH – Calcitonin – Role of hormones in calcium and phosphate metabolism. Thymus gland – Structure and hormones – their functions and Disorders.		
Outcome 3	Evaluate functions and disorders of thyroid, parathyroid and thymus glands.	**K5**
UNIT - IV		
Objective 4	To learn the basics of gastrointestinal and adrenal hormones	
Gastrointestinal and Adrenal hormones: Gastrointestinal hormones - their secretion, control, and function –Insulin and glucagons – Obesity – Diabetes mellitus - Adrenal gland – Structure and functions of hormones – Gastrointestinal and adrenal hormone disorders.		
Outcome 4	Get clarity on Gastrointestinal and Adrenal hormones functions.	**K4**
UNIT - V		
Objective 5	To study the gonadal hormones	
Gonadal Hormones: Biosynthesis of hormones in the ovary and testis – Hormonal regulation of ovarian cycles in humans – Hormones in pregnancy and lactation. Menstrual disorder - Sexual dysfunction in female and male - a disorder of the testes – testicular cancer – Infertility and contraception.		
Outcome 5	Explain the gonadal hormones and functions.	**K2**

Suggested Readings :

Goswami, M.P. (2013). *Endocrinology and Molecular Cell Biology*, Gaurav book centre Pvt Ltd, Delhi. Griffing, G and Padilla, M. (2015). *Endocrinology: Specialty Review and Self-Assessmen*t, Stat PearlsPublishing, 3rd edition, USA.

Melmed, S., Polonsky, K., Larsen, R.P., Kronenberg, H. (2015). *Williams Textbook of Endocrinology*, Elsevier13th Edition.

Nussey, S. And Whitehead, S. (2001). *Endocrinology - An Integrated Approach*, Oxford: BIOS ScientificPublishers.

Botham, K. M., Bender, D., Rodwell, V. W., Weil, P. A., Kennelly, P. J. (2018). *Harper's IllustratedBiochemistry 31st Edition*. Greece: McGraw-Hill Education.

Larsen, P. R., Williams, R. H., Polonsky, K. S., Melmed, S., Kronenberg, H. M. (2011). *Williams Textbook ofEndocrinology*. United Kingdom: Elsevier/Saunders.

Yadav, P. R. (2009). *Text book of Endocrinology*. Sonali Publications, New Delhi.

Online Resources					
https://www.britannica.com/science/endocrinology https://academic.oup.com/endo,https://nptel.ac.in/courses/109104029					
K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***
Course designed by:Dr. N. M. Prabhu					

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	M (2)	S (3)	M (2)	L (1)	M (2)	M (2)	M (2)
CO2	S (3)	S (3)	S (3)	M (2)	S (3)	M (2)	L (1)	M (2)	M (2)	M (2)
CO3	S (3)	S (3)	L (1)	M (2)	S (3)	L (1)	L (1)	M (2)	M (2)	M (2)
CO4	S (3)	S (3)	L (1)	M (2)	S (3)	L (1)	L (1)	M (2)	M (2)	M (2)
CO5	S (3)	S (3)	L (1)	M (2)	S (3)	L (1)	L (1)	M (2)	M (2)	M (2)
W.AV	**3**	**3**	**1.8**	**2**	**3**	**1.4**	**1**	**2**	**2**	**2**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M (2)	M (2)	M (2)	L (1)
CO2	S (3)	M (2)	M (2)	M (2)	L (1)
CO3	L (1)	S (3)	M (2)	L (1)	S (3)
CO4	L (1)	S (3)	M (2)	M (2)	S (3)
CO5	L (1)	S (3)	M (2)	M (2)	S (3)
W.AV	**1.8**	**2.6**	**2**	**1.8**	**2.2**

S –Strong (3), M-Medium (2), L- Low (1)

I-SEMESTER					
Discipline Specific Elective - 1	**Course code 509502**	**Animal Cell Culture Technology**	**T**	**Credits: 3**	**Hours: 3**

UNIT - I

Objective 1	To introduce animal cell culture techniques to students.	
Introduction to animal cell culture techniques: Historical background, Advantages, Limitations of animal cell culture. Biology of cultured cells; Laboratory design, layout, equipments, culture vessels and substrates. Aseptic techniques. Safety, bioethics and validation. Application of Animal Cell Culture.		
Outcome 1	Know the basic of animal cell culture techniques.	**K1**

UNIT - II

Objective 2	To discuss the importance of cell culture based media and supplements.	
Defined media and supplements: Physiochemical properties of media. Balanced salt solutions. Composition of Complete Media. Importance of serum and other supplements. Serum free media and its types. Animal Protein – Free media. Preparation and sterilization of media. Storage of Media.		
Outcome 2	Understand the importance of cell culture based media and supplements.	**K2**

UNIT - III

Objective 3	To inculcate the knowledge on primary, subculture and cell lines.	
Primary Culture, Subculture and Cell lines: Initiation of primary cell culture and its disaggregation. Subculture and Propagation, choosing and routine maintenance of cell lines, Subculture. Cloning and Selection, Cell Separation, Characterization, Differentiation, Transformation, Immortalization, Contamination, Cryopreservation and Quantification.		
Outcome 3	Apply with the concepts of primary, subculture and cell lines.	**K3**

UNIT - IV

Objective 4	To explain various cytotoxicity assays involved in testing cell culture.	
Cytotoxicity assays: Viability, Toxicity and Survival. Application of cytotoxicity assays. Genotoxicity. Inflammations. **Cell culture of Specialized Cells:** Epithelial (Breast, Cervix, Liver), Mesenchymal (Connective tissue, Adipose tissue, Cartilage), Neuroectodermal (Neurons and Glial Cells), Hematopoietic, Gonads and Stem Cells.		
Outcome 4	Analyze compounds for cytotoxicity that involve animal cell culture.	**K4**

UNIT - V

Objective 5	To impart the culture of tumour cells and their three-dimensional culture.	
Culture of Tumor Cells: Problems of tumour cell culture, Development of Cell Lines, Xenografts. Specific tumour types (breast, lung, colon, cervix). **Three-Dimensional Culture:** Organotypic and Histotypic cultures – Types, Limitations and choice of Models. Scale-up in Suspension and Monolayer.		
Outcome 5	Evaluate development of fascinating 3D cell culture models.	**K5**

Suggested Readings :

Merten, O. W. (2006). *Introduction to animal cell culture technology*- past, present and future. Cytotechnology,50(1), 1-7.

Butler, M. 2004. *Animal cell culture and Technology*, BIOS Scientific Publishers.

Oyeleye, O. O., Ogundeji, S. T., Ola, S. I., &Omitogun, O. G. (2016). *Basic of animal cell culture: Foundationfor modern science*. Academic journals.

Al-Rubeai, M. (Ed.). (2015*). Animal cell culture.*

Beuvery, E.C., Zeijlemaker, W.P., &Griffiths,J.B. (Eds.). (2012). *Animal cell technology: Developmentstowards the 21st century*. Springer science & Business media.

Jenkins,N. (Ed.).(1999). *Animal cell biotechnology: methods and protocols* (Vol.8*).* USA: Humana press

Online Resources

https://microbenotes.com/animal-cell-culture/

https://www.qiagen.com/us/knowledge-and-support/knowledge-hub/bench-guide/animal-cell-culture

K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by:Dr. P. Kumar

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	M (2)	S (3)	M (2)	L (1)	M (2)	M (2)	M (2)
CO2	S (3)	S (3)	S (3)	M (2)	S (3)	M (2)	L (1)	M (2)	M (2)	M (2)
CO3	S (3)	S (3)	L (1)	M (2)	S (3)	L (1)	L (1)	M (2)	M (2)	M (2)
CO4	S (3)	S (3)	L (1)	M (2)	S (3)	L (1)	L (1)	M (2)	M (2)	M (2)
CO5	S (3)	S (3)	L (1)	M (2)	S (3)	L (1)	L (1)	M (2)	M (2)	M (2)
W.AV	**3**	**3**	**1.8**	**2**	**3**	**1.4**	**1**	**2**	**2**	**2**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M (2)	M (2)	M (2)	L (1)
CO2	S (3)	M (2)	M (2)	M (2)	L (1)
CO3	L (1)	S (3)	M (2)	L (1)	S (3)
CO4	L (1)	S (3)	M (2)	M (2)	S (3)
CO5	L (1)	S (3)	M (2)	M (2)	S (3)
W.AV	**1.8**	**2.6**	**2**	**1.8**	**2.2**

S –Strong (3), M-Medium (2), L- Low (1)

I-SEMESTER					
Discipline Specific Elective – 1	**Course code 509503**	**Business Skills in Zoology**	**T**	**Credits: 3**	**Hours: 3**

UNIT - I

Objective 1	To study the importance of agriculture and their livestock.	
Livestock: Commercially Important livestocks – cattle, goat, sheep, dog, and rabbit species. Beneficial insects for agriculture crop production: spider, mantis, ladybird beetle, damselfly, mealybug destroyer, soldier beetle, green lacewing, syrphid fly, tachinid fly, ichneumon wasp and Trichograma wasp.		
Outcome 1	Know the importance of agriculture and livestock.	**K1**

UNIT - II

Objective 2	To know more about dairy and poultry production.	
Dairy and poultry production: Status –national and international-dairy farming – types – production systems- farm management. Poultry –types –broiler and layer –type of farming and management.		
Outcome 2	Understand the merits in the dairy and poultry production.	**K2**

UNIT - III

Objective 3	To unravel the importance of sericulture and apiculture.	
Sericulture: Commercially important silkworm, earth worm and bees. Rearing of silkworm and silk production – current status– types of culture, trading and major disease. **Vermitechnology:** Vermicomposting – Different type of production - merits and demerits and trading. **Apiculture:** status and economics of honey production. Bee keeping accessories – honey production methods – honey collection – preservation and by –products of bees and its uses.		
Outcome 3	Develop sericulture, Vermicomposting and apiculture related economy.	**K3**

UNIT - IV

Objective 4	To explain the significance of freshwater aquaculture	
Freshwater aquaculture: cultivable species - Finfish and prawn hatchery - types and classification – nation and international status. Farming practices – monoculture, composite culture, polyculture. Ornamental fish culture – Status - economically important species, aqua-phonics, organic farming and spirulina culture.		
Outcome 4	Outline the importance of freshwater culture and production techniques.	**K2**

UNIT - V

Objective 5	To educate the students with integrated farming practices.	
Integrated farming: Importance – national and international status – a different type of integrated farming systems. Production cost – analysis of different integrated farming systems.		
Outcome 5	Explain the development of integrated farming.	**K5**

Suggested Readings :

Aminul, A. (2016). *A Textbook of Economic Zoology. India*: I.K. International Publishing House Pvt. Limited. Jabde, P.V. 2005 Text Book of Applied Zoology, Vermiculture, Apiculture, Sericulture, Lac-Culture, Agricultural Pests and Their Controls, Discovery Publishing Group

Jadhav, N. V., Siddiqui, M. F. (2007). *Handbook of Poultry Production and Management.* India: Jaypee Bros. Kotpal, R. L. 2000. *Modern Textbook of Zoology*, Rastogi Publications.

Pillay, T. V. R and Kutty, M. N. 2005. *Aquaculture: Principles and Practices 2nd Edition*, Wiley-Blackwell. Pradip. V Jabde, 2005. *Text Book of Applied Zoology*, Discovery Publishing House.

Shukla, G.S and Upadhyay, V.B. 2006. *Economic Zoology*, Rastogi

Online Resources

https://www.bls.gov/ooh/life-physical-and-social-science/zoologists-and-wildlife-biologists.htm

https://www.indeed.com/career-advice/resumes-cover-letters/zoology-degree-skills

K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr. N. M. Prabhu, Dr. M. Biruntha, & Dr. P. Kumar

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M (2)	S (3)	M (2)	M (2)	L (1)	L (1)	M (2)	S (3)	S (3)	S (3)
CO2	M (2)	M (2)	M (2)	M (2)	L (1)	L (1)	M (2)	S (3)	M (2)	S (3)
CO3	M (2)	M (2)	M (2)	M (2)	M (2)	L (1)	M (2)	S (3)	S (3)	S (3)
CO4	M (2)	M (2)	M (2)	M (2)	M (2)	L (1)	M (2)	S (3)	M (2)	S (3)
CO5	M (2)	M (2)	M (2)	M (2)	M (2)	L (1)	M (2)	S (3)	S (3)	S (3)
W.AV	**2**	**2.2**	**2**	**2**	**1.6**	**1**	**2**	**3**	**2.6**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L (1)	L (1)	M (2)	M (2)	S (3)
CO2	L (1)	L (1)	M (2)	M (2)	M (2)
CO3	L (1)	L (1)	M (2)	M (2)	S (3)
CO4	L (1)	L (1)	M (2)	M (2)	S (3)
CO5	L (1)	L (1)	M (2)	L (1)	S (3)
W.AV	**1**	**1**	**2**	**1.8**	**2.8**

S –Strong (3), M-Medium (2), L- Low (1)

II-SEMESTER					
Core	**Course code 509201**	**Animal Physiology**	**T**	**Credits: 4**	**Hours: 4**

UNIT - I

Objective 1	**To study the basic physiological principles of digestion, blood and respiratory system.**

Introduction to Physiology: Definition - division of physiology - Relationship of physiology with other science - significance of the study. **Digestive system:** Nutritional value, Digestion, absorption, energy balance, gastrointestinal enzymes. **Blood -** Blood corpuscles, plasma function, blood volume and regulation, blood groups, haemoglobin. **Respiratory system –** Respiratory pigments, transport, and exchange of respiratory gases, waste elimination.

Outcome 1	Understand the structure and functions of digestion and respiratory system.	**K1**

UNIT - II

Objective 2	**To understand the cardiovascular system and excretory system.**

Cardiovascular System: Anatomy of heart structure, myogenic heart, ECG - its principle and significance, heartbeat and cardiac cycle, blood pressure. **Excretory system -** kidney, structure and function of nephron, urine formation, urine concentration, waste elimination, regulation of water balance,electrolyte balance, acid – Base balance.

Outcome 2	Critically discuss the types and function of heart and kidney.	**K3**

UNIT - III

Objective 3	**To clarify the control processes of the muscle, nervous and sensory organs.**

Muscle contraction – General structure and types of muscles. Ultrastructure of skeletal muscle. Mechanism of muscle contraction. Chemical changes during muscle contraction. **Nervous system -** Neurons, nature of nerve impulse – resting potential and action potential, neurotransmitters central and peripheral nervous system, the structure of the synapse, mechanism of synaptic transmission. **Sensory organs -** Vision, hearing and tactile response.

Outcome 3	Understand the muscle contraction, nervous system and sensory organs.	**K4**

UNIT - IV

Objective 4	**To educate the homeostatic mechanisms in animals.**

Homeostatic Mechanisms - Thermoregulation in poikilotherms and homeotherms - Tolerance to high temperature, cold and freezing - Physiology of hibernation and aestivation. Osmotic and ionic regulation, Hormonal control of osmoregulation: Adaptation to pressure: High altitude - buoyancy.

Outcome 4	Understand the homeostatic mechanisms of animals.	**K4**

UNIT - V

Objective 5	**To introduce endocrine systems and animal behavior.**

Endocrinology and Animal behavior - Endocrine glands, basic mechanism of hormone action,hormones and diseases. **Animal behavior –** Biological clock – endogenous rhythm – the circadian rhythm – circannual and lunar periodicity.

Outcome 5	Acquire knowledge the endocrinology and animal behavior.	**K2**

Suggested Readings :

Linda S. Costanzo. (2017). *Physiology,6th Edition*. Elsevier.

Rastogi, S. T. (1988). *Essentials of Animal Physiology*. Wiley, Eastern Limited, Madras.

Richard W. Hill., Gorden A. Wyse., Anderson, M. (2008). *Animal Physiology*, 2nd edition, Sinauer Associates,Inc.

Richard W. Hill., Gorden A. Wyse., Anderson, M. (2012). *Animal Physiology,* 3rd Edition, Sinauer Associates,Inc.

Schmidt Nielson, K. (2002). *Animal Physiology – Adaptation and Environment*, Cabridge Press, Cambridge. Verma, P. S, Tyagi, B.S and Agarwal, U.V. (2005). *Animal Physiology*. S. Chand & Company Ltd, New Delhi.Williams S. Hoar. (1966). *General and Comparative Physiology*. Prentice Hall of India, New Delhi.

Online Resources https://nptel.ac.in/courses/102104058 https://bio.libretexts.org/Courses/Hanover_College/Comparative_Anatomy_and_Physiology_of_Animals/01%3 A_Fundamentals_of_Animal_Physiology					
K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***
Course designed by: Dr. M. Biruntha					

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	L (1)	M (2)	L (1)	S (3)	L (1)	M (2)	L (1)	L (1)
CO2	L (1)	L (1)	M (2)	L (1)	L (1)	S (3)	L (1)	M (2)	L (1)	L (1)
CO3	M (2)	M (2)	L (1)	L (1)	M (2)	S (3)	M (2)	M (2)	M (2)	L (1)
CO4	M (2)	M (2)	M (2)	L (1)	M (2)	S (3)	M (2)	M (2)	M (2)	L (1)
CO5	L (1)	L (1)	-	L (1)	M (2)	S (3)	M (2)	M (2)	M (2)	L (1)
W.AV	**1.8**	**1.6**	**1.2**	**1.2**	**1.6**	**3**	**1.6**	**2**	**1.6**	**1**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	S (3)	M (2)	L (1)	L (1)
CO2	M (2)	M (2)	M (2)	M (2)	M (2)
CO3	M (2)	M (2)	M (2)	L (1)	M (2)
CO4	M (2)	L (1)	M (2)	S (3)	M (2)
CO5	M (2)	L (1)	M (2)	S (3)	M (2)
W.AV	**2**	**1.8**	**2**	**2**	**1.8**

S –Strong (3), M-Medium (2), L- Low (1)

II-SEMESTER					
Core	**Course code 509202**	**Immunology**	**T**	**Credits: 4**	**Hours: 4**

UNIT - I

Objective 1	**To discuss the history, concepts and molecules of immune system.**

Introduction: History and scope of Immunology, Cells, tissues and organs of immune system - structure and function. Molecules of immune system - antibodies, complements, cytokines, interferon's - types, sources and functions. Antigen: classification & epitopes, Antibody: Structure, function, generation, diversity, antibody engineering. Antigen and antibody interaction.

Outcome 1	Understand the concept of immunology.	**K2**

UNIT - II

Objective 2	**To truly understand the innate and adaptive immunology.**

Innate and adaptive immunity: Elements of immune system - Hematopoiesis, T-cells, B-cells, myeloid cells, antigen presenting cells, cell mediated subset of T-Cells, helper and suppressor cells, cell mediated and humoral immunity, antibody dependent cell mediated cytotoxicity, natural killer cells.

Outcome 2	Distinguish the elements of innate and adaptive immunity.	**K4**

UNIT - III

Objective 3	**To study in-depth on immune response and immunological disorders.**

Immune response: - Innate, acquired, active and passive immunity - mechanism of humoral and cell mediated immune responses - immunity to infections –immuno-prophylaxis, vaccines and immunization schedule. Autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies.

Outcome 3	Explain the mechanism of infection and immunity.	**K2**

UNIT - IV

Objective 4	**To impart knowledge on the various diseases and their immune response.**

Immunology of Disease: - Infectious diseases, hypersensitivity - Types I, II, III and IV; autoimmune disorder; immunodeficiency diseases. Tumour and transplantation immunology - Major histocompatibility complex (MHC), Functions of receptors and effectors, cell-mediate immunotherapy for the treatment of cancer.

Outcome 4	Analysis of various diseases and their immune responses.	**K4**

UNIT - V

Objective 5	**To introduce the length and breadth of immune techniques.**

Immune techniques: Immunocytochemistry, Antibody generation, detection of molecules using ELISA, RIA, western blot, immuno-precipitation, flowcytometry and immuno-fluorescence microscopy, Acquired Immuno Deficiency Syndrome (AIDS) test, hybridoma technology, radioimmuno assay.

Outcome 5	Assess principles and concepts on immune techniques.	**K5**

Suggested Readings :

Brostoff, J., Scadding, G., Male, D., Roitt, I.M., (2002). *Clinical Immunology.* Gower medical publishingLondon.

Murphy, K., Travers, P., Walport, M., and Janeway, C, (2012). *Janeway's Immunobiology*. Garland sciencepublishing New York.

Parham, P, (2009). *The Immune System*. Garland science publishing New York.

Paul, W.E., (2008). *Fundamental Immunology*. Lippincott Williams & Wilkins, Philadelphia PublishersAjoy Paul, (2016). *Text Book of Immunology*. Books and Allied Private Limited Publishers

P Madhavee Latha, (2012). A *Text Book of Immunology.* S. Chand Publishers.

Online Resources

https://www.immunology.org/public-information/what-immunology
https://onlinelibrary.wiley.com/journal/13652567

K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr. B. Vaseeharan

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	M (2)	L (1)	L (1)	M (2)	M (2)	L (1)	S (3)	S (3)	S (3)
CO2	S (3)	M (2)	L (1)	L (1)	M (2)	M (2)	L (1)	S (3)	S (3)	S (3)
CO3	S (3)	M (2)	L (1)	L (1)	M (2)	M (2)	L (1)	S (3)	S (3)	S (3)
CO4	S (3)	M (2)	L(1)	L (1)	M (2)	M (2)	M (2)	S (3)	S (3)	S (3)
CO5	S (3)	M (2)	L(1)	L (1)	M (2)	M (2)	M (2)	S (3)	S (3)	S (3)
W.AV	**3**	**2**	**1**	**1**	**2**	**2**	**1.4**	**3**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L (1)	S (3)	L (1)	S (3)	S (3)
CO2	L (1)	M (2)	L (1)	S (3)	S (3)
CO3	L (1)	M (2)	L (1)	S (3)	S (3)
CO4	L (1)	M (2)	L (1)	S (3)	S (3)
CO5	L (1)	M (2)	L (1)	S (3)	S (3)
W.AV	**1**	**2.2**	**1**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

II-SEMESTER					
Core	**Course code 509203**	**Developmental Biology**	**T**	**Credits: 4**	**Hours: 4**

UNIT - I

Objective 1 **To provide four-dimensional thinking on developmental biology.**

Basic concepts of development Biology: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; Stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenic in analysis of development.

Outcome 1 Summarize the fundamental concepts of development biology. **K2**

UNIT - II

Objective 2 **To truly understand the patterns and process of embryonic development.**

Gametogenesis and Fertilization: Spermatogenesis and oogenesis – Sperm structure and physiology, classification of eggs - Polarity and symmetry – Maturation of egg- egg envelops – Vitellogenesis, Types of eggs. Embryonic sac development. Egg recognition, gamete fusion and prevention of polyspermy, activation of egg metabolism. Zygote formation.

Outcome 2 Understand the transformation of egg cell into whole organisms. **K2**

UNIT - III

Objective 3 **To know more on early embryonic and cellular basis of morphogenesis.**

Early development: Cleavage – Types of cleavage – Factors affecting cleavage – Chemo-differentiation – Blastulation – Types of blastula – Presumptive organ forming areas in frog and chick – Fate maps. Gastrulation in invertebrates, fish, chick and mammals, epiboly, emboly. Germ cell determination and migration, morphogenetic movements, the cellular basis of morphogenesis, cell motility and differential cell affinity.

Outcome 3 Compare more on how cell behaves to intracellular signalling pathways. **K5**

UNIT - IV

Objective 4 **To study about model organisms relevance to developmental biology.**

Morphogenesis and organogenesis in animals:- Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in *Drosophila*, frog and chick; organogenesis – vulva formation in *Caenorhabditis elegans;* eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development – larval formation, metamorphosis; environmental regulation of normal development; sex determination.

Outcome 4 Know more on model organism's relevance to developmental biology. **K1**

UNIT - V

Objective 5 **To decode molecular and genetic methods to embryo development.**

Genes and development:- Nuclear transplantation, differential gene activation, developmental genetic defects, role of cell death in development, senescence, factors involved in teratogenesis, concept of assisted reproductive technologies (ART).

Outcome 5 Predict concepts that decode differential gene expression and defects. **K4**

Suggested Readings :

Barresi, M. J. F., Gilbert, S. F. (2020). *Developmental Biology*. United States: Oxford University Press.Berry A. K. 2007, *An Introduction to Embryology*, Emkay publication, New Delhi 51.

Gilbert, S. F &Knisely, K. (2009). *Developmental Biology*: Sinauer Associates, Inc. Hake S and Wilt F., 2003. *Principles of developmental biology*, W.W. Norton & Co.

Jonathan M. W. Slack, (2006). *Essential Developmental Biology*: Blackwell Publishing Ltd.

Krieger, M., Amon, A., Ploegh, H., Martin, K. C., Lodish, H., Berk, A., Kaiser, C. A., Bretscher, A. (2016). *MolecularCell Biology*. United Kingdom: W. H. Freeman.

Minelli, A. (2009). *Forms of Becoming: The Evolutionary Biology of Development*: Princeton University Press.

Online Resources

https://plato.stanford.edu/entries/biology-developmental/

https://www.khanacademy.org/science/biology/developmental-biology

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. P. Kumar

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	M (2)	L (1)	L (1)	M (2)	M (2)	L (1)	M (2)	M (2)	M (2)
CO2	M (2)	M (2)	L (1)	L (1)	M (2)	M (2)	L (1)	M (2)	M (2)	M (2)
CO3	S (3)	M (2)	L (1)	L (1)	M (2)	M (2)	L (1)	M (2)	M (2)	M (2)
CO4	S (3)	M (2)	L(1)	L (1)	M (2)	M (2)	M (2)	M (2)	M (2)	S (3)
CO5	S (3)	M (2)	L(1)	L (1)	M (2)	M (2)	M (2)	M (2)	M (2)	S (3)
W.AV	**2.8**	**2**	**1**	**1**	**2**	**2**	**1.4**	**2**	**2**	**2.6**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L (1)	S (3)	L (1)	S (3)	S (3)
CO2	L (1)	M (2)	L (1)	S (3)	S (3)
CO3	L (1)	M (2)	L (1)	S (3)	S (3)
CO4	L (1)	M (2)	L (1)	S (3)	S (3)
CO5	L (1)	M (2)	L (1)	S (3)	S (3)
W.AV	**1**	**2.2**	**1**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

II-SEMESTER					
Core	**Course code 509204**	**Microbiology**	**T**	**Credits: 4**	**Hours: 4**

UNIT - I

Objective 1	**To gain knowledge on microorganisms.**	
Scope of Microbiology: History, microbial diversity- microalgae, viruses, bacteria, fungi, and protozoans. Ultrastructure of bacteria, gram-positive and gram-negative bacteria. Virus structure and life cycle.		
Outcome 1	Understand the scope of microbiology.	**K2**

UNIT - II

Objective 2	**To learn techniques for handling microbes in the laboratory.**	
Growth and Nutrition: Types of culture media, nutritional requirements nutritional types for bacteria, fungi and virus. Bacteria, fungi and virus - isolation, identification- biochemical and molecular tools. Growth of microbes - Storage of microbes.		
Outcome 2	Ability to handle microbiology labs.	**K3**

UNIT - III

Objective 3	**To understand the bacterial and viral disease in animals.**	
Bacterial Disease: Major diseases causing pathogens in ruminant, small ruminant, poultry, swine – Introduction - history – symptoms - diagnosis – control. **Viral-associated diseases:** Major viral pathogens in ruminant, small ruminant, poultry, swine – Introduction - history – symptoms - diagnosis – control**.**		
Outcome 3	Evaluate the bacterial and viral disease in animal system.	**K5**

UNIT - IV

Objective 4	**To learn fungal disease and zoonotic disease in animals.**	
Fungal Associated Diseases: Major diseases causing fugal pathogens in ruminant, small ruminant, poultry, swine – Introduction - history – symptoms - diagnosis – control. **Zoonotic diseases** - Introduction – history – reported – emerging and remerging diseases – control measures. **Algae** - algal toxins and animal disease. **Protozoan** diseases in animals		
Outcome 4	Able to analysis the reasons for fungal and zoonotic diseases.	**K4**

UNIT - V

Objective 5	**To gain knowledge on role of microbes in the industry.**	
Beneficial Microbes: History and definition of Probiotic's, production and application in health management, prebiotics and symbiotic. Microbes of milk and food - Pasteurization and food poisoning; food preservation.		
Outcome 5	Outline the importance of beneficial microbes for industrial applications.	**K2**

Suggested Readings :

Carter, G.R., Darla, J. Wise. (2004). *Essentials of Veterinary Bacteriology and Mycology*, *6th edition*, Wiley-Blackwell Publishers.

Hirsh, D. C., Maclachlan, N. J., Walker, R.L. (2004). *Veterinary microbiology,* 2nd edition, Wiley - Blackwell Publishers.

James G. Fox, Lynn C. Anderson, Franklin M. Loew, and Fred W. Quimby. (2002). *Laboratory Animal Medicine*, 2nd edition (American College of Laboratory Animal Medicine), Animal Medicine Series.

Joanne M. Willey, Linda M. Sherwood, Christopher. (2011). *Prescott's Microbiology*.Eighth edition. Mcgraw. Hill International Edition

Knols, B.G.J and Louis, C. (2006). *Bridging Laboratory and Field Research for Genetic Control of Disease Vectors (Wageningen UR Frontis Series),* Springer, Netherlands.

Mettenleiter, T.C. and Sobrino, F. (2008). *Animal Viruses: Molecular Biology*, Caister Acaemic Press, Norfolk, UK.

Quinn, P.J., Markey, B. K., Leonard, F. C., Hartigan, P., Fanning, S., FitzPatrick, E.S. (2011). *Veterinary Microbiology and Microbial Disease*, 2nd Edition.

Online Resources

https://rlmc.edu.pk/themes/images/gallery/library/books/Microbiology/Text_Book_of_Microbiology.pdf https://ncert.nic.in/textbook/pdf/ievw104.pdf

K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr. N. M. Prabhu

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	-	M (2)	L(1)	M(2)	-	M (2)	M (2)	S (3)	S (3)
CO2	-	L (1)	-	L (1)	M (2)	-	L (1)	M (2)	S (3)	S (3)
CO3	-	L (1)	L (1)	L (1)	M (2)	-	M (2)	S (3)	S (3)	S (3)
CO4	-	L (1)	L (1)	L (1)	M (2)	-	M (2)	S (3)	S (3)	S (3)
CO5	-	L (1)	-	L (1)	M (2)	-	M (2)	S (3)	S (3)	S (3)
W.AV	**-**	**0.8**	**0.8**	**1**	**2**	**-**	**1.8**	**2.6**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	-	-	M (2)	S (3)
CO2	-	-	-	M (2)	S (3)
CO3	-	-	-	M (2)	S (3)
CO4	-	-	-	M (2)	S (3)
CO5	-	-	-	M (2)	S (3)
W.AV	**-**	**-**	**-**	**2**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

II-SEMESTER					
Core	**Course code 509205**	**Lab – II-** Animal Physiology, Immunology, Developmental Biology, Microbiology	**P**	**Credits: 4**	**Hours: 8**

UNIT - I		
Objective 1	**To understand the physiology of animals.**	
Animal Physiology: Estimation of salivary amylase activity, ammonia, urea, and Oxygen Consumption of Fish. Principles and application of Sphygmomanometer, Kymograph, Haemoglobinometer, ESR. Estimation of RBC and WBC. Estimation of Blood urea (DAM) and Cholesterol (ZAK"S) using commercially available kit.		
Outcome 1	Know the physiology of animals and their importance.	**K1**
UNIT - II		
Objective 2	**To study practical aspects of microbes and their culture.**	
Microbiology: Lab safety procedures and basic microbiological techniques, Methods of sterilization and culture media preparation, techniques for isolating bacteria from animal sources: different culture methods, identification - Colonymorphological characterization – differential straining.		
Outcome 2	Understand the issues pertaining microbiology.	**K2**
UNIT - III		
Objective 3	**To provide knowledge on practical aspects of immunology.**	
Immunology: ABO blood group identification, Haemagglutination assay. Study of lymphoid organs,		
Outcome 3	Apply the basics of immunology.	**K3**
UNIT - IV		
Objective 4	**To make aware on advanced immune-techniques.**	
Immuno-technology: Immunodiffusion – Single / Double, Immunoelectrophoresis, ELISA (Demo) and Western Blot (Demo).		
Outcome 4	Familiarize with advanced immuno techniques.	**K2**
UNIT - V		
Objective 5	**To understand the fundamental process of development.**	
Developmental Biology: Study of life cycle and developmental stages of Drosophila. 24 hrs, 36 hrs, 48 hrs, 72 hrs and 96 hrs developmental stages in the chick. ART / IVF Equipment (pictorial representation)		
Outcome 5	Compare the developmental stages of animals.	**K4**

Suggested Readings :

Frank C. Hay., Olwyn, M., Westwood, R. (2002). Practical Immunology, (4th ed.):
Blackwell Science, Ltd.Ghai, C, L. (2007). A textbook of practical physiology, (8th ed.):
Jaypee Brothers Medical Publishers.
GutaTalwar. (2006). A Handbook of Practical and Clinical Immunology, Volume II. New Delhi. CBS Publishers.
Miller, H.J. (1992). A short course in bacterial genetics – A laboratory manual and handbook for E. coli and relatedbacteria: Cold Spring Harbour Laboratory Press.
Nicholas H. Barton., Derek E. G. Briggs., Jonathan A. Eisen., David B. Goldstein., Nipam H. Patel. (2007). Evolution,(1st ed.): Cold Spring Harbor Laboratory Press.
Sambrook, J., Fritsch, E.F., Maniatis, T. (1989). Molecular cloning volumes-3: Cold Spring Harbour Laboratory. Talwar, G.P & Gupta, S.K. (2012). A Handbook of Practical and Clinical Immunology (2nd ed.). New Delhi: CBS Publishers.
Mary S. Tyler. (1994). Developmental Biology: A guide for experiment study: Sinauer Associates Inc.

Online Resources

http://www.wbnsou.ac.in/student_zone/courses/science/laboratory/zoology/20200203_Manual_Zoology%20Laboratory_ SoSci_NSOU.pdf

https://www.austincc.edu/sziser/Biol%201413/Zoology%20Lab%20Manual.pdf

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. M. Biruntha, Dr. N. M. Prabhu, Dr. B. Vaseeharan, Dr. P. Kumar

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	L (1)	M (2)	S (3)	L (1)	L (1)	M (2)	S (3)	S (3)
CO2	-	-	M (2)	-	M (2)	-	S (3)	M (2)	S (3)	S (3)
CO3	S (3)	S (3)	L (1)	M (2)	S (3)	L (1)	L (1)	M (2)	S (3)	S (3)
CO4	S (3)	S (3)	L (1)	M (2)	S (3)	L (1)	L (1)	M (2)	S (3)	S (3)
CO5	S (3)	S (3)	L (1)	M (2)	S (3)	L (1)	L (1)	M (2)	S (3)	S (3)
W.AV	**2.4**	**2.4**	**1.4**	**1.6**	**2.8**	**0.8**	**1.4**	2	3	3

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	M (2)	-	M (2)	S (3)
CO2	L (1)	-	-	M (2)	M (2)
CO3	-	S (3)	-	M (2)	S (3)
CO4	-	S (3)	-	M (2)	S (3)
CO5	-	M (2)	-	M (2)	S (3)
W.AV	**0.2**	**2**	**-**	**2**	**2.6**

S –Strong (3), M-Medium (2), L- Low (1)

II-SEMESTER					
Discipline Specific Elective – 2	**Course code 509504**	**Food Processing Technology**	**T**	**Credits: 3**	**Hours: 3**

UNIT - I

Objective 1	**To learn the fundamentals of dairy processing.**

Diary Processing: Milk collection – Pre-processing – Processing and Preservation -National and International status of dairy processing – Pasteurization – freezing –refrigeration – Drying and dehydration and nutritional standards - Quality Assurance (QA) and Quality Control (QC).

Outcome 1	Able to assess the dairy production.	**K1**

UNIT - II

Objective 2	**To provide knowledge on meat and poultry processing.**

Meat and Poultry Processing: National and international status – Pre-processing –Processing and preservation – a different method of processing - nutritional standards –Quality - role of QA and QC.

Outcome 2	Understand meat and poultry processing.	**K2**

UNIT - III

Objective 3	**To create awareness on seafood processing.**

Seafood Processing: National and international status – Pre-processing – Processing – a different method of processing - Chilled fish processing – smoking - canning – drying – IQF - Nutritional standards – Quality - role ofQA and QC – HACCP

Outcome 3	Review and explain the seafood process.	**K2**

UNIT - IV

Objective 4	**To understand the concept on fruit and vegetable processing.**

Fruits and Vegetable Processing: Fruit - collection – pre-processing – Processing and storage – nutritional standards – vegetables - collection - pre-processing – Processing and storage - Quality - role of QA and QC –HACCP

Outcome 4	Evaluate the fruit and vegetable production process.	**K5**

UNIT - V

Objective 5	**To learn food safety.**

Food safety: History of food regulation – International and national standards - Food adulteration acts - meat foodproduction orders - Milk & milk product amendment regulations – Food quality assurance and control – sensory evaluations for various products, sanitary procedures – HACCP – GMP.

Outcome 5	Examine the quality control and quality assurance of the processed food.	**K4**

Suggested Readings :

Clark, S., Jung. & S., Lamsal, B. (Eds.). (2014). Food processing principles applications, (2nded.). US: WileyPublishers.

Fellows, P.J., (2000). Food processing technology. Principles and practices, (3rd ed.).Wood head Publishing:Elsevier.

Food safety and standards regulations (2010). Ministry of health and family.

John R. Campbell &Robert T. Marshall. (2016). Dairy Production and Processing: The Science of Milk and MilkProducts, (1st ed.): Waveland Press.

Pearson, A. M. (1994). Quality attributes and their measurements in meat poultry. Food Science & Nutrition:Springer.

Richardson, R. I & Mead, C. (1999). Poultry meat science, (1st ed.): CABI Publishing.

Walstra, P., Wouters, J.M. Jan, Geurts, J. T. (2005). Dairy Science and technology: CRC Press.

Online Resources

https://foodsci.oregonstate.edu/value-added-food-product-development/food-processing-technologies

https://www.foodprocessing-technology.com/

K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr. N. M. Prabhu

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	-	-	M (2)	-	-	-	M (2)	S (3)	S (3)
CO2	-	-	-	M (1)	-	-	-	M (2)	S (3)	S (3)
CO3	-	-	-	M (2)	-	-	-	M (2)	S (3)	S (3)
CO4	-	-	-	M (2)	-	-	-	M (2)	S (3)	S (3)
CO5	-	-	-	M (2)	-	-	-	M (2)	S (3)	S (3)
W.AV	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	-	-	-	S (3)
CO2	-	-	-	-	S (3)
CO3	-	-		-	S (3)
CO4	-	-	-	-	S (3)
CO5	-	-	-	-	S (3)
W.AV	**-**	**-**	**-**	**-**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

II-SEMESTER					
Discipline Specific Elective - 2	**Course code 509505**	**Methods in Biology**	**T**	**Credits: 3**	**Hours: 3**

UNIT - I		
Objective 1	**To understand the principles of molecular and recombinant DNA methods.**	
Molecular Biology and Recombinant DNA methods: Isolation and Purification of RNA, DNA and proteins. Electrophoresis. Molecular cloning of DNA and RNA in bacterial and eukaryotic system. Expression of recombinant proteins. Generation of genomic and cDNA libraries. In vitro mutagenesis and deletion techniques, gene-knock out. DNA sequencing methods. Gene expression studies at RNA and protein level. Micro array based techniques. Isolation, separation of carbohydrates and lipid molecules. RFLP, RAPD and AFLP techniques.		
Outcome 1	Recall theoretical knowledge on molecular biology related techniques.	**K1**
UNIT - II		
Objective 2	**To impart basic histology, microscopy and immuno techniques.**	
Histochemistry: Principles and application of Histology and Histochemistry. **Microscopy:** Visualization of cells and sub-cellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, canning and transmission microscopes. Image processing methods in microscopy. **Immuno-techniques:** Antibody generation, Detection of molecules using ELISA, RIA, Western blotting and flow cytometry. Detection of molecules in living cells, in situ localization by techniques such as FISH and GISH.		
Outcome 2	Illustrate and detect molecules by microscope and immuno techniques.	**K2**
UNIT - III		
Objective 3	Realize the basic of physics and electrophysical methods.	
Biophysical methods: UV visible, fluorescence, circular dichroism, NMR and ESR spectroscopy. Molecular structure determination using X-diffraction and NMR. Molecular analysis using light scattering, different types of mass spectrophotometery and surface plasma resonance methods. **Electrophysiological methods:** Single neuron recording, patch –clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT.		
Outcome 3	**To learn the principles of biophysical and electrophysiological methods.**	**K1**
UNIT - IV		
Objective 4	**To teach the basics of biochemical separation and radiolabelling techniques.**	
Biochemical separation techniques: Principles and use of Centrifuges, Chromatography (Paper, thin-layer, and column). Ion-exchange, size exclusion and affinity chromatography. **Radiolabelling techniques:** Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes inbiological tissues and cells, molecular imaging of radioactive materials and safety guidelines.		
Outcome 4	Examine the concepts of bio-based separation and radio-labelling methods.	**K4**
UNIT - V		
Objective 5	**To inculcate field knowledge and introduce biostatistics.**	
Methods in field biology: Methods of estimating population density of animals and plants, ranging patterns through direct, indirect and remote observations, sampling methods in the study of behaviour, habitat characterization, ground and remote sensing methods. **Statistical methods:** measure of central tendency and dispersion. Probability distribution; different between parametric and non-parametric statistics. Confidence levels. Errors. Level of significance. Regression and Correlation. t-test. ANOVA.		
Outcome 5	Obtain knowledge in field biology and biostatistics.	**K1**

Suggested Readings :

Alberts, B. (2010). Cell biology: the endless frontier. Molecular biology of the cell, 21(22), 3785-3785.

Wilson, K., & Walker, J. (Eds.). (2010).Principles and Techniques of Biochemistry and Molecular Biology. UnitedKingdom: Cambridge University Press.

Willardetal. (1999). Instrumental Methods of Analysis. United States: Wadsworth.

Cazes, J. (Ed). (2005). Analytical Instrumentation Handbook, Third Edition. United States: Taylor & Francis.Gurumani, N. (2019). Research Methodology: For Biological Sciences. India: MJP Publishers.

Online Resources

https://www.toppersnotes.com/wp-content/uploads/2021/02/8.CSIR-Life-science-sample-Methods-in-Biology.pdf

https://unacademy.com/goal/csir-ugc-net/BIZXQ/free-platform/methods-in-biology/SAWFX

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. P. Kumar

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	-		M(2)	M(2)			M(2)	S (3)	S (3)
CO2	-	-		M(2)	M(2)			M(2)	S (3)	S (3)
CO3	-			M(2)	M (2)	-	M (2)	M (2)	S (3)	S (3)
CO4	-	-		M (2)	M (2)	-	M (2)	S (3)	S (3)	S (3)
CO5	M (2)	M (2)	M(2)	M(2)	M (2)	M(2)	M (2)	S (3)	S (3)	S (3)
W.AV	**0.5**	**0.5**	**0.5**	**2**	**2**	**0.5**	**1.2**	**2.4**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M (2)	M (2)	-	L (1)	M (2)
CO2	M (2)	M (2)	-	L (1)	M (2)
CO3	M (2)	M (2)	-	-	M (2)
CO4	M (2)	M (2)	-	-	M (2)
CO5	M (2)	M (2)	-	S (3)	S (3)
W.AV	**2**	**2**	**-**	**1.2**	**2..2**

S –Strong (3), M-Medium (2), L- Low (1)

II-SEMESTER					
Discipline Specific Elective – 2	**Course code 509506**	**Animal Biotechnology**	**T**	**Credits: 3**	**Hours: 3**
UNIT - I					
Objective 1	**To introduce the basics of animal biotechnology.**				
Introduction to Animal Biotechnology: Definition - animal cell structure - macromolecules in the cell, concepts ofgenetic engineering, the scope of biotechnology, the principle of recombinant DNA technology, application of genetic engineering – GMO - transgenic animals - GEAC in India.					
Outcome 1	Educate the basics of animal biotechnology.				**K1**
UNIT - II					
Objective 2	**To impart knowledge on gene cloning and its methods.**				
Gene cloning: Definition- steps- types of vectors used – Cloning in yeast *Saccharomyces cerevisiae*. *E. coli* vectors - pBR322 and its derivatives, Cloning vectors for Gram-negative bacteria – Lambda bacteriophage vectors, filamentous phages, Cosmids, Plasmids, Phagemids. Genetic engineering tools. Nucleic acid manipulating enzymes. Promoters, Selectable markers and reporters used in rDNA, technology. Restriction digestion, Ligation, Transformation, Selection of Recombinants. Construction of gene libraries.					
Outcome 2	Acquire knowledge on gene cloning and its methods.				**K2**
UNIT - III					
Objective 3	**To know the nucleic acid and hybridization techniques.**				
Nucleic acid hybridization techniques; Molecular probes (Types of probes and its construction); probe labeling. Nick translation, End labeling and Random primer labeling. Polymerase chain reaction and its variants; DNA fingerprinting; DNA sequencing first generation sequencing methods (Maxam and Gilbert sequencing, Sanger‟s dideoxy sequencing, Pyrosequencing, PCR based sequencing and hybridization sequencing). Second generation sequencing methods. Site-directed mutagenesis; DNA microarray; chromosome walking and jumping. Molecular techniques in prenatal diagnosis gene therapy.					
Outcome 3	Know more on the nucleic acid and hybridization techniques.				**K2**
UNIT - IV					
Objective 4	**To teach the basics of Animal tissue culture.**				
Animal tissue culture:-History, animal cell culture media, cell type, cell growth kinetics, primary culture and subculture. Development of cell lines, types of culture methods - organ, histotypic, cell culture, stem cell culture, tissue engineering, scale-up - monolayer and suspension, Pharmaceutical products (Vaccine, Humulin, etc), valuable cell culture products - Insulin, tissue plasminogen activator, blood factors.					
Outcome 4	Explain the basics of Animal tissue culture.				**K5**
UNIT - V					
Objective 5	**To explain the concepts of transgenic technology.**				
Embryo transfer & transgenic animal technology:- Artificial insemination in cattle, superovulation, embryo transfer, mating, splitting, cryopreservation, stem cell method, targeted gene transfer - knock in and knock out technology, transgenic mice, goat, cattle - gene pharming & other applications**.**					
Outcome 5	Simplify novel concepts on transgenic technology.				**K4**
Suggested Readings : Alberts, B. (2010). Cell biology: the endless frontier. Molecular biology of the cell, 21(22), 3785-3785. Cazes, J. (Ed). (2005). Analytical Instrumentation Handbook, Third Edition. United States: Taylor & Francis.Gurumani, N. (2019). Research Methodology: For Biological Sciences. India: MJP Publishers. Rosner, B. (2016). Fundamentals of Biostatistics. United States: Cengage Learning.Willardetal. (1999). Instrumental Methods of nalysis. United States: Wadsworth.					

Wilson, K., & Walker, J. (Eds.). (2010).Principles and Techniques of Biochemistry and Molecular Biology. UnitedKingdom: Cambridge University Press.					
Online Resources https://dbtindia.gov.in/scientific-decision-units/animal-livestock-allied-sciences/animal-biotechnology https://www.iitg.ac.in/rakhi_chaturvedi/pdf/books/30-herbal%20medicine.pdf					
K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***
Course designed by: Dr. V. Nithya					

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M (2)	M (2)	-	L (1)	M (2)	-	L (1)	M (2)	S (3)	S (3)
CO2	M (2)	M (2)	-	L (1)	M (2)	-	L (1)	M (2)	S (3)	S (3)
CO3	M (2)	M (2)	-	L (1)	M (2)	-	L (1)	M (2)	S (3))	S (3)
CO4	M (2)	M (2)	-	L (1)	M (2)	L (1)	L (1)	M (2)	S (3)	S (3)
CO5	L (1)	L (1)	-	L (1)	M (2)	-	L (1)	M (2)	S (3)	S (3)
W.AV	**1.8**	**1.8**	**-**	**1**	**2**	**0.2**	**1**	**2**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L (1)	S (3)	M (2)	L (1)	S (3)
CO2	L (1)	S (3)	M (2)	L (1)	S (3)
CO3	L (1)	S (3)	M (2)	L (1)	S (3)
CO4	L (1)	S (3)	M (2)	L (1)	S (3)
CO5	L (1)	S (3)	M (2)	L (1)	S (3)
W.AV	**1**	**3**	**2**	**1**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

III - Semester					
Core	**Course code 509301**	**Genetics**	**T**	**Credits: 4**	**Hours: 4**

UNIT - I

Objective 1	**To study the scope of genetics.**	
Genetic concepts: Definition, scope of genetics, Mendalian principles and contribution, polygenic inheritance, multiple alleles, sex determination, sex linked inheritance and pedigree analysis, simple Mendalian traits in man, twin study.		
Outcome 1	Understand the concepts of molecular genetics.	**K2**

UNIT - II

Objective 2	**To analyze qualitative genetic data and describe the evolution of population.**	
Chromosomes: Chromosome mapping, aneuploidy, euploidy, haploidy and polyploidy, with practical applications. Human chromosome - Sex chromosome, heterochromatization, barr bodies and chromosomal abnormalities. Gene mapping methods, linkage maps, tetrad analysis, mapping with molecular markers.		
Outcome 2	Analyze the human chromosomes and abnormalities.	**K4**

UNIT - III

Objective 3	**To find the genetic regulation and development of eukaryotic and prokaryote**	
Molecular genetics: Concept of gene - gene expression, gene expression control in eukaryotic, prokaryotes and phages. **Mutation:** causes and detection, mutant types - lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis etc. **Structural alterations of chromosomes:** Deletion, duplication, inversion, translocation. **Recombination:** Homologous and non-homologous recombination, site-specific recombination.		
Outcome 3	Predict the genetic regulation, development and differentiation.	**K3**

UNIT - IV

Objective 4	**To identify the evolutionary and genetic concepts**	
Evolutionary genetics: Theory of natural selection - genetic and non-genetic variations - evidences for the role of natural selection - polymorphism and selection. Neo–Lamarckism - present concept of recapitulation. Origins of unicellular and multicellular organisms; major groups of animals; stages in primate evolution including Homosapiens.		
Outcome 4	Understand the polymorphism and evolutionary genetics.	**K2**

UNIT - V

Objective 5	**To examine the molecular divergence and population genetics**	
Quantitative genetics: Neutral evolution, molecular divergence and molecular clocks; origin of new genes and proteins, nucleotide sequence analysis - BLAST, protein sequence analysis - Protein Data Bank, phylogenetic analysis, gene duplication and divergence. Hardy-Weinberg law, random genetic drift, founder principle. Concepts, approaches and methods in study of behaviour, QTL mapping.		
Outcome 5	Know the quantitative analysis of genes.	**K4**

Suggested Readings :

Crew, F. A. (2006). Animal Genetics - The Science of Animal Breeding Home Farm Books; 1 edition.

Emmanuel, C., Ignacimuthu, S.J.S., Vincent, S. (2006). *Applied genetics: Recent trends and Techniques.* MJP Publishers; 1 edition.

Gahalain, S. S. (2004). Fundamentals of Genetics, Anmol Publications Pvt, India.

Hartwell, L., Hood, L., Goldberg, M., Reynolds, A. E., Silver, L. 2004. Genetics from genes to genomes, McGraw-Hill Education; 4th edition.

Joe Bearden H., John W. Fuquay and Scott T. Willard. (2003). *Applied Animal Reproduction,* 6th edition, Prentice Hall.

Richard M. Bourdon., (1999). *Understanding Animal Breeding*, 2nd Edition,

Prentice Hall. Terence A. Brown., (1998). *Genetics: a molecular approach,*

American Book Company.

Online Resources https://www.britannica.com/science/genetics https://www.cdc.gov/genomics/about/basics.htm					
K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*
					Course designed by: Dr. V. Nithya

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	M (2)	L (1)	L (1)	M (2)	M (2)	L (1)	M (2)	M (2)	M (2)
CO2	M (2)	M (2)	L (1)	L (1)	M (2)	M (2)	L (1)	M (2)	M (2)	M (2)
CO3	S (3)	M (2)	L (1)	L (1)	M (2)	M (2)	L (1)	M (2)	M (2)	M (2)
CO4	S (3)	M (2)	L(1)	L (1)	M (2)	M (2)	M (2)	M (2)	M (2)	S (3)
CO5	S (3)	M (2)	L(1)	L (1)	M (2)	M (2)	M (2)	M (2)	M (2)	S (3)
W.AV	**2.8**	**2**	**1**	**1**	**2**	**2**	**1.4**	**2**	**2**	**2.6**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L (1)	S (3)	L (1)	S (3)	S (3)
CO2	L (1)	M (2)	L (1)	S (3)	S (3)
CO3	L (1)	M (2)	L (1)	S (3)	S (3)
CO4	L (1)	M (2)	L (1)	S (3)	S (3)
CO5	L (1)	M (2)	L (1)	S (3)	S (3)
W.AV	**1**	**2.2**	**1**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

III-SEMESTER					
Core	**Course code 509302**	**Evolution**	**T**	**Credits: 4**	**Hours: 4**
UNIT - I					
Objective 1	**To educate the students with the basic concept of evolution**				
Basic Concepts of Evolution: Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis. **Origin of cells and unicellular evolution:** Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.					
Outcome 1	Understand the basic concept of evolution.				**K2**
UNIT - II					
Objective 2	**To introduce more about the paleontology and evolutionary history**				
Paleontology and Evolutionary History: The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants andanimals; Stages in primate evolution including Homo.					
Outcome 2	Identify more about the paleontology and evolutionary history.				**K3**
UNIT - III					
Objective 3	**To explain the importance of molecular evolution and their divergence**				
Molecular Evolution: Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of newgenes and proteins; Gene duplication and divergence.					
Outcome 3	Predict importance of molecular evolution and their divergence.				**K3**
UNIT - IV					
Objective 4	**To impart knowledge on the mechanism of population genetics**				
The Mechanisms of Population genetics: Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.					
Outcome 4	Analysis the mechanism of population genetics.				**K4**
UNIT - V					
Objective 5	**To gain knowledge on behaviour and evolution**				
Behavior and Evolution: Approaches and methods in study of behavior; Proximate and ultimate causation; Altruism and evolution-Group selection, Kin selection, Reciprocal altruism; Neural basis of learning, memory, cognition, sleep and arousal; Biological clocks; Development of behavior; Social communication; Social dominance; Use of space and territoriality; Mating systems, Parental investment and Reproductive success; Parental care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes.					
Outcome 5	Summaries behaviour and evolution.				**K2**

Suggested Readings :

Brian K. Hall. (2010). *Evolution: Principles and Processes*: Jones & Bartlett Publishers. Buss, D.M. (2003). *The evolution of desire. Strategies of human mating*: Basic Books. Futuyma, D. J. (2006). *Evolutionary biology*. Sinauer Associates Inc: Subsequent edition.

Harvey, P.H &Pagel, M.D. (1991). *The comparative method in evolutionary biology* (*Vol. 239)*. Oxford: Oxforduniversity press.

Monroe W. Strickberger. (2000). *Evolution*: Jones & Bartlett Publishers.

Nicholas H. Barton., Derek E. Briggs G., Jonathan A. Eisen., David B. Goldstein., Nipam H. Patel. (2007). *Evolution. Cold Spring, (1st ed.):* Harbor Laboratory Press.

Travis, J. (2016). Evolutionary *Biology: Genome Evolution, Speciation, Coevolution and Origin of Life*. PierrePontarotti (Eds.). Cham (Switzerland) and New York: Springer.

Online Resources

https://unacademy.com/content/wp-content/uploads/sites/2/2022/10/Evolution-3-min.pdf

https://www.gneet.com/aipmt_jee_notes/evolution.pdf

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. P. Srinivasan

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	L (1)	M (2)	L (1)	S (3)	M (2)	M (2)	M (2)	S (3)
CO2	S (3	S (3	L (1)	M (2)	L (1)	S (3)	M (2)	M (2)	M (2)	S (3)
CO3	S (3	S (3	L (1)	M (2)	L (1)	S (3)	M (2)	M (2)	M (2)	S (3)
CO4	S (3)	S (3)	L (1))	M (2)	L (1)	S (3)	M (2)	M (2)	M (2)	S (3)
CO5	S (3)	S (3)	L (1)	M (2)	L (1)	S (3)	M (2)	M (2)	M (2)	S (3)
W.AV	**3**	**3**	**1**	**2**	**1**	**3**	**2**	**2**	**2**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L (1)	L (1)	M (2)	L (1)	S (3)
CO2	L (1)	L (1)	M (2)	L (1)	S (3)
CO3	L (1)	L (1)	M (2)	L (1)	S (3)
CO4	L (1)	L (1)	M (2)	L (1)	S (3)
CO5	L (1)	L (1)	M (2)	L (1)	S (3)
W.AV	**1**	**1**	**2**	**1**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

III-SEMESTER					
Core	**Course code 509303**	**Ecology and Conservation Biology**	**T**	**Credits: 4**	**Hours: 4**

UNIT - I

Objective 1	**To educate students on the basic environmental concepts.**	
Fundamentals of Environmental Sciences: Definition, Principles and Scope of Environmental Science. Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere. Laws of thermodynamics, heat transfer processes, mass and energy transfer. Meteorological parameters. Wind roses. Biogeographic provinces of the world and agro-climatic zones of India. Natural resources and their assessment using Remote Sensing and GIS. Environmental education, awareness and ethics.		
Outcome 1	Know the fundamentals of basic environmental concepts.	**K2**

UNIT - II

Objective 2	**Identify knowledge of ecosystem structure and function.**	
Ecosystem Structure and functions: Structures - Biotic and Abiotic components. Functions - Energy flow in ecosystems, energy flow models, food chains and food webs. Biogeochemical cycles, Ecological succession. Species diversity, Ecosystem stability and factors affecting stability. Types of Ecosystem: Desert (hot and cold), forest, rangeland, wetlands, lotic, lentic, estuarine (mangrove), Oceanic. Concept, classification and distribution of biomes. Ecosystem services.		
Outcome 2	Understand the scientific study of ecology and its importance.	**K3**

UNIT - III

Objective 3	**To highlight certain key factors that affect population and community.**	
Habitat and Niche: Concept of habitat and niche; fundamental and realized niche; resource partitioning; character displacement**. Population ecology:** Characteristics of population, concept of carrying capacity, population growth and regulations. Population fluctuations, dispersion and metapopulation. Concept of „r" and „k" species. Keystone species. Interactions between species and their types. **Community ecology:** Community structure, attributes and its measurement; edges and ecotones. Biological invasions.		
Outcome 3	Assess with population and community ecology.	**K5**

UNIT - IV

Objective 4	**To raise awareness on environmental pollution, control and its ill effects.**	
Environmental Pollution and Control: Air (Sources, monitoring techniques (gaseous and particulates), standards (NAAQ), impact and their control devices), Noise (Sources, various indices, impact and their control), Water (Types, water quality parameters, standards, impact and their treatment strategies), Soil (properties, impact of industrial effluents, soil microbes, degradation of pesticides/synthetic fertilizers). Thermal (Sources, Heat Islands, and consequences), Marine (Sources, impact, and coastal management) and Radioactive (Source, effects, exposure, standards and protection).		
Outcome 4	Evaluate the environmental problems involving the interaction of human.	**K4**

UNIT - V

Objective 5	**To inculcate knowledge on biodiversity and its conservation**.	
Biodiversity and its conservation: Definition, types, importance and threats to biodiversity. Strategies for biodiversity conservation: *in situ*, *ex situ* and *in vitro* conservation. Concept and basis of identification of „Hotspots"; hotspots in India. Measures of biodiversity. National parks, Sanctuaries, Protected areas and Sacred groves in India. Concepts of gene pool, biopiracy and bio-prospecting. Concept of restoration ecology. Extinct, Rare, Endangered and Threatened flora and fauna of India.		
Outcome 5	Assesing biodiversity at local and global level.	**K5**

Suggested Readings :

Begon, M., Townsend, C. R. (2020). *Ecology: From Individuals to Ecosystems*. United Kingdom: Wiley. Chapman, J. L., Reiss, M. J. (2018). *Ecology: Principles and Applications.* India: Cambridge University Press. Chiras, D. D. (2014). *Environmental Science.* United States: Jones & Bartlett Learning, LLC.

Masters, G. M. (1998). Introduction to Environmental Engineering and Science. United

Kingdom: Prentice Hall. Spoolman, S., Miller, G. T. (2016). Environmental Science. Philippines: Cengage Learning. Odum, E.P. & Gary W, Barrett. (2004). *Fundamentals of Ecology*. USA:Cengage Learning (Thompson).
Online Resources https://www.slideshare.net/Bikramsingh106/conservation-biology-note-pdf https://bio.libretexts.org/Bookshelves/Botany/Botany(HaMorrow_and_Algiers)/05%3A_Ecology_and_Conserv ation

K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr. P. Kumar

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L(1)	L(1)	-	L(1)	-	L(1)	L(1)	M (2)	S (3)	S (3)
CO2	M (2)	M (2)	-	M (2)	-	M (2)	M (2)	M (2)	S (3)	S (3)
CO3	S (3)	S (3)	-	S (3)	-	M (2)	S (3)	M (2)	S (3)	S (3)
CO4	M (2)	M (2)	-	M (2)	-	M (2)	M (2)	M (2)	S (3)	S (3)
CO5	S (3)	S (3)	-	S (3)	-	M (2)	S (3)	M (2)	S (3)	S (3)
W.AV	**2.2**	**2.2**	**-**	**2.2**	**-**	**1.8**	**2.2**	**2**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	-	L (1)	-	S (3)
CO2	-	-	L (1)	-	S (3)
CO3	-	-	L (1)	-	S (3)
CO4	-	-	L (1)	-	S (3)
CO5	-	-	L (1)	-	S (3)
W.AV	**-**	**-**	**1**	**-**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

III-SEMESTER					
Core	**Course code 509304**	**Fishery Biology and Aquaculture**	**T**	**Credits: 4**	**Hours: 4**

UNIT - I		
Objective 1	**To familiarize basic information about fishery biology and their management.**	
Fishery Biology: General classification of fishes, economically important marine and freshwater fishes about their fishery potential. Indigenous and modern craft and gears used for capture fisheries. Morphometric and meristic characters of fishes, food and feeding habits, age and growth, reproduction and spawning - Migration in fishes - Fishery by-products.		
Outcome 1	Understand the fundamental concepts of fishery biology.	**K2**

UNIT - II		
Objective 2	**To provide technical knowledge in fishery conservation and processing technology.**	
Fishery conservation: Recent concepts in fisheries management - Endangered species management - Invasive species. *In situ* and *Ex-situ* conservation - Management of fisheries operations - **Post-harvesting technology** – Shrimp, crab lobster, squid, and finfish – pre-processing – processing – chilling – different type of freezing –canning – packing – storage - loading in container - Quality control – quality assurance – during processing - HACCP-Food safety.		
Outcome 2	Interpret fishery management and processing technology.	**K4**

UNIT - III		
Objective 3	**To educate recent developments in aquaculture.**	
Aquaculture: Definition - Status of aquaculture in the world and India. Cultivable organisms - various culture systems - types of culture. Aquaculture engineering – design and layout of Hatchery - Earthen ponds, cage, penstructure.		
Outcome 3	Analyze the recent treads in aquaculture.	**K4**

UNIT - IV		
Objective 4	**To learn the recent techniques in hatchery.**	
Hatchery Management: Type of hatchery – Shrimp and prawn hatchery – SPF brood stocks - quarantine section – induce breeding - larval production - feed management - water quality and disease management. Finfish hatchery – Milk fish, Sea bass, grouper, cobia and pompano.Live feed production. SPF seedproduction, Bio-security, HACCP, GMP systems in the hatchery.		
Outcome 4	Acquire knowledge on hatchery techniques.	**K2**

UNIT - V		
Objective 5	**To educate the recent techniques in farm management**.	
Farm Management – Prawn –Shrimp - Sea bass, grouper, cobia and pompano production – seed selection and purchase – stocking, water quality, feed and disease management – Recent culture techniques in finfish and shrimp - Biosecurity procedures, HACCP, GMP - open and closed culture systems, Biofloc technology.		
Outcome 5	Critically evaluate the recent trends in aquaculture farming practices.	**K5**

Suggested Readings :

Agarwal, S.C. (2007). *A Handbook of fish farming, (2nd ed.):* HB.

Chakrabarty, (2010). *Biology, Breeding and Farming of Important Food Fish*: HB.

Gopakumar, K. (2002). *Fish processing technology, ICAR.* New Delhi: Directorate of information andPublications of Agriculture, Indian Council of Agricultural Research.

Jean T. Nolan. (2009). *Offshore Marine Aquaculture*: Nova Science Pub Inc.

Khanna & Singh. (2012). *A Text Book of Fish Biology and Fisheries*:

Narendra Publication.Michael, K. (2007). *Fisheries Biology, Assessment and Management*: Blackwell Publishers.
Pillay, T. V. R & Kutty, M. N. (2005). *Aquaculture: Principles and Practices, (2nd ed.):*Wiley Black well.

Online Resources

http://ndl.ethernet.edu.et/bitstream/123456789/78614/2/Fisheries%20and%20Aquaculture%20Module%20Abeb e%20Getahun2.pdf

http://ledhyane.lecture.ub.ac.id/files/2015/09/HartReynolds_2002-HandbookOfFishBiologyAndFisheriesVol1.pdf

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. N. M. Prabhu

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M (2)	M (2)	M (2)	M (2)	L (1)	M (2)	M (2)	M (2)	S (3)	S (3)
CO2	M (2)	M (2)	M (2)	M (2)	L (1)	M (2)	M (2)	M (2)	S (3)	S (3)
CO3	L(1)	L (1)	L(1)	M (2)	L (1)	-	L (1)	M (2)	S (3)	S (3)
CO4	L (1)	L (1)	-	M (2)	L (1)	-	L (1)	M (2)	S (3)	S (3)
CO5	L (1)	L (1)	-	M (2)	L (1)	-	L (1)	M (2)	S (3)	S (3)
W.AV	**1.4**	**1.4**	**1**	**2**	**1**	**0.8**	**1.4**	**2**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	-	M (2)	L (1)	S (3)
CO2	L (1)	-	M (2)	L (1)	S (3)
CO3	L (1)	-	L (1)	L (1)	S (3)
CO4	-	-	L (1)	L (1)	S (3)
CO5	-	-	L (1)	L (1)	S (3)
W.AV	**0.8**	**-**	**1**	**1**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

III-SEMESTER					
Core	**Course code 509305**	**Lab – III** Genetics, Evolution, Ecology and Conservation Biology, Fishery Biology and Aquaculture	**P**	**Credits: 4**	**Hours: 8**

UNIT - I		
Objective 1	**To understand the practical concept of genetics**	
Genetics: Pedigree chart analysis, Pictorial representation of mutants of drosophila. Protein (PDB) and nucleic acid analysis (BLAST)		
Outcome 1	Acquire practical knowledge in genetics and its concept.	**K1**
UNIT - II		
Objective 2	**To educate the students with the importance of evolution**	
Evolution: Animals of evolutionary importance – Analogous and homologous organs, fossils, mimicry, coloration.		
Outcome 2	Understand the animal evolution and their importance.	**K2**
UNIT - III		
Objective 3	**To understand the practical aspects of ecology and conservation biology.**	
Ecology and Conservation biology: Estimation of dissolved oxygen, Salinity and Carbon dioxide in the given water samples. Constructing a food web in a given area. Animal associations. Threatened flora and fauna of India. Global Position system and Electrostatic Precipitators (pictorial representation).		
Outcome 3	Construct ideas to solve Environmental issues.	**K3**
UNIT - IV		
Objective 4	**To educate students in identifying commercially important fishes**	
Fishery Biology:-Identification of commercially important fin fishes, shellfishes, mollusks, lobsters and seaweed. Morphometric and meristic characters. Modern crafts and gears. Estimation of protein, lipid carbohydrate and salt content in fishes.		
Outcome 4	Compare morphological and biochemical characters of fish.	**K5**
UNIT - V		
Objective 5	**To teach them with aquaculture management practices**	
Aquaculture: Determination of stocking density and feed assessment, Method of transportation of seeds.		
Outcome 5	Understand the survival and biomass in aquaculture farms.	**K2**

Suggested Readings :

Glover, D.M & Hames, B.D. (1995). DNA Cloning, (2nd ed.), Volume - I, II, III. New York: IRL Press atOxford University Press.

Ian Freshney, R. (2005). Culture of Animal Cells: A Manual of Basic Technique, (5 th ed.): Wiley Publisher.Jean T. Nolan. (2012). Offshore Marine Aquaculture: Nova Science Pub Inc.

Michael King. (2007). Fisheries Biology, Assessment and Management: Wiley-Blackwell.

Pillay T. V. R.&Kutty M. N. (2005). Aquaculture: Principles and Practices, (2nd ed.): WileyBlackwell. Sambrook J., Fritsch, E.F., Maniatis, T. (1989). Molecular cloning volumes-3: Cold Spring Harbour Laboratory.

Online Resources http://www.zoologyresources.com/uploadfiles/books/dc64b77d8769325515d17c945e461b45.pdf http://www.wbnsou.ac.in/student_zone/courses/science/laboratory/zoology/20200203_Manual_Zoology%20Laboratory_SoSci_NSOU.pdf					
K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***
Course designed by: Dr. V. Nithya, Dr. P. Srinivasan, Dr. P. Kumar, Dr. N. M. Prabhu					

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	-	-	-	-	-	-	-	S (3)	S (3)
CO2	L (1)	L (1)	L (1)	L (1)	L (1)	S (3)	M (2)	L (1)	S (3)	S (3)
CO3	L (1)	L (1)	L (1)	L (1)	L (1)	S (3)	M (2)	L (1)	S (3)	S (3)
CO4	M (2)	M (2)	M (2)	M (2)	M (2)	M (2)	M (2)	M (2)	S (3)	S (3)
CO5	-	-	-	-	M (2)	-	-	M (2)	S (3)	S (3)
W.AV	**0.8**	**0.8**	**0.8**	**0.8**	**1.2**	**1.4**	**1.2**	**1.2**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	M (2)	-	-	S (3)
CO2	-	L (1)	M (2)	L (1)	S (3)
CO3	L (1)	L (1)	M (2)	L (1)	S (3)
CO4	M (2)	-	M (2)	L (1)	S (3)
CO5	-	-	L (1)	L (1)	S (3)
W.AV	**0.6**	**0.8**	**1.4**	**0.8**	**0.3**

S –Strong (3), M-Medium (2), L- Low (1)

III-SEMESTER					
Discipline Specific Elective - 3	**Course code 509507**	**Entomology**	**T**	**Credits: 3**	**Hours: 3**

UNIT - I		
Objective 1	**To understand the biology of insects and classify insects.**	
Classification of Insects - General characteristics of class Insecta and classification up to Order level – characteristics of each order with examples. Modern scheme of insect classification: Apterygota – Pterygota – Exopterygota: Diptera, Orthoptera, Hemiptera - Endopterygota: Coleoptera, Lepidoptera, Neuroptera, and Hymenoptera - Collection and preservation of insects.		
Outcome 1	Identify the key pest insects of the major horticultural crops.	**K3**
UNIT - II		
Objective 2	**To study the physiology of insect.**	
Insect Physiology: Structure and physiology of integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive and nervous system.		
Outcome 2	Understand the pest complexes of the agro-ecosystems.	**K2**
UNIT - III		
Objective 3	**To understand the pest of various crops.**	
Agricultural Entomology Biology, nature, the extent of damage and control measures of insect pests of some important crops – paddy, sugarcane, cotton, groundnut, coconut, mango and beverages. Pests of stored products and their Control measures.		
Outcome 3	Explain broad idea of chemical ecology and tritrophic interaction.	**K2**
UNIT - IV		
Objective 4	**To understand insect pest management techniques and controls.**	
Pest Management: Biological control: parasites, predators and microbial agents. Chemical control: Pesticides - mode of action, Biopesticides: Integrated Pest Management (IPM) – definition, Integration of methods – potential components–The need for IPM and uses.		
Outcome 4	Evaluate the importance the pest management.	**K2**
UNIT - V		
Objective 5	**To study the beneficial insects and vector insects.**	
Beneficial insects and Vector insects: Useful insects – Biology and control. Measures of important insect vectors – mosquitoes and houseflies.		
Outcome 5	Know the beneficial insects and vectors.	**K3**

Suggested Readings :

Awasthi, V.B. (2012). Introduction to General and Applied Entomology, (3rd rev. ed.): Scientific PublishersJournals Dept.

Chapman, R.F., Stephen J. Simpson, Angela E. & Douglas (Eds.) (2012). The insects: Structure and Function,(5thed.): Cambridge University Press.

David, B.V. (2016). Elements of Economic Entomology, (8th ed.): Brillion Publishing. Pruthi, H.S. (1969). Textbook on Agricultural Entomology. New Delhi: I.C.A.R. Publication.Saha, T. & Chandran, N. (2017). Fundamentals of Entomology: Write & Print Publications.

Temphare, D.B. (1984). A Text Book of Insect Morphology, Physiology and Endocrinology. New Delhi:S.Chand and Co.

Vasanthraj David, B. & Ramamurthy, V.V. (2012). Elements of Economic Entomology, (7th ed.). Chennai:Namrutha publications.

Online Resources					
https://www.rvskvv.net/images/I-Year-II-Sem_Fundamentals_Entomology_b_20.04.2020.pdf https://extension.unl.edu/statewide/douglas-sarpy/pdfs/ce/resources/ce-ec1588-introduction-to-entomology.pdf					
K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***
Course designed by: Dr. M. Biruntha					

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	S (3)	L (1)	M (2)	M (2)	M (2)	S (3)	S (3)
CO2	S (3)	S (3)	M (2)	M (2)	L (1)	S (3)	M (2)	M (2)	S (3)	S (3)
CO3	S (3)	S (3)	L (1)	M (2)	L (1)	S (3)	M (2)	M (2)	S (3)	S (3)
CO4	S (3)	S (3)	L (1)	M (2)	L (1)	S (3)	M (2)	M (2)	S (3)	S (3)
CO5	S (3)	S (3)	L (1)	M (2)	L (1)	S (3)	M (2)	M (2)	S (3)	S (3)
W.AV	**3**	**3**	**1.8**	**2.2**	**1**	**2.4**	**2**	**2**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M (2)	M (2)	L (1)	S (3)
CO2	M (2)	L (1)	L (1)	L (1)	S (3)
CO3	M (2)	L (1)	L (1)	L (1)	S (3)
CO4	M (2)	L (1)	M (2)	M (2)	S (3)
CO5	M (2)	-	M (2)	L (1)	S (3)
W.AV	**2.2**	**1**	**1.6**	**1.2**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

III-SEMESTER					
Discipline Specific Elective – 3	**Course code 509508**	**Environmental Management**	**T**	**Credits: 3**	**Hours: 3**

UNIT - I		
Objective 1	**To educate students the fundamentals of energy and environment.**	
Energy and Environment: Sun as source of energy; solar radiation and spectra characteristics. Fossil fuel. Principles of generation of hydro-electric power and their impact (tidal, thermal, wind power, geothermal, solar energy). Nuclear energy (fission and fusion). Bioenergy: methods to produce energy from biomass. Environmental implications of energy usage. CO_2 emission, radioactive forcing and global warming.		
Outcome 1	Know the fundamentals of basic of energy and environment.	**K1**
UNIT - II		
Objective 2	**To impart knowledge solid and hazardous waste management.**	
Solid and Hazardous Waste Management: Solid waste (types, sources, characteristics, generation rates, collection and transportation). Solid waste processing and recovery – electrical energy from solid waste (fuel pellets, refuse derived fuels). Composting, vermicomposting and biomethanation. Disposal of solid waste – sanitary land filling and its management, incineration. E-waste, Fly ash, Plastic waste handling and management.		
Outcome 2	Understand the importance of solid and hazardous waste management.	**K2**
UNIT - III		
Objective 3	**To raise awareness on various environmental policies and laws.**	
Environmental Assessment, Management and Legislation: Environmental Impact Assessment (EIA), Environmental Impact Statement (EIS), Environmental Management Plan (EMP). Procedure for reviewing EIA for developmental projects, Environmental audit and Environmental Planning. Environmental Management System Standards (ISO14000 series). EIA notifications and amendments. Overview of Environmental Laws, Policies Environmental Conventions and Agreements (time to time).		
Outcome 3	Predict with various environmental policies and laws.	**K3**
UNIT - IV		
Objective 4	**To develop knowledge on contemporary environmental issues.**	
Contemporary Environmental Issues: Risk assessment (Hazard identification, characterization and management). Global environmental issues (Biodiversity loss, climate change, ozone layer depletion, sea level rise). International efforts for Environmental Protection. National Action Plan on Climate Change (Eight National Missions). Epidemiological issues (fluorosis, aresnocosis, goiter and dengue). Environmental disasters (Minamata, Love Canal, Bhopal gas, Chernobyl and Fukasima Daiichi Nuclear Plant)		
Outcome 4	Analyse and plan with proper environmental strategies in future.	**K4**
UNIT - V		
Objective 5	**To understand the current environmental issues in India.**	
Current Environmental Issues in India: Environmental issues related to water resources projects. Water conservation – development of watersheds, rain water harvesting, ground water recharge. National river conservation plan. Eutrophication and restorations of lakes (wetlands and Ramsar sites in India). Soil erosion and its reclamation, desertification and its control. Forest conservation (various movements). People biodiversity register. Wildlife conservation projects. Carbon sequestration and Carbon credits. Sustainable Habitat.		
Outcome 5	Solve environmental hypothesis and put them in practice.	**K3**

Suggested Readings : Agerwal, B. (2009). Environmental Issues in India: A Reader. (2009). India: Pearson Education. Begon, M., Townsend, C. R. (2020). *Ecology: From Individuals to Ecosystems*. United Kingdom: Wiley. Masters, G. M. (1998). Introduction to Environmental Engineering and Science. United Kingdom: Prentice Hall. Spoolman, S., Miller, G. T. (2016). Environmental Science. Philippines: Cengage Learning. MoEF website for different Acts/ Rules and other environmental laws Odum, E.P. & Gary W, Barrett. (2004). *Fundamentals of Ecology*. USA:Cengage Learning (Thompson). Pickering, K. T., Owen, L. A. (2018). An Introduction to Global Environmental Issues Instructors Manual. United Kingdom: Taylor & Francis.
Online Resources https://uomustansiriyah.edu.iq/media/lectures/5/5_2020_03_04!03_12_11_PM.pdf https://oup.com.pk/pub/media/teaching-guides/Environmental%20Management/Environmental%20Management.pdf

K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr. P. Kumar

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L(1)	L(1)	-	L(1)	-	-	M(2)	M (2)	S (3)	S (3)
CO2	L(1))	L(1))	-	L(1))	-	-	M (2)	M (2)	S (3)	S (3)
CO3	L(1)	L(1)	-	L(1)	-	-	M (2)	M (2)	S (3)	S (3)
CO4	L(1)	L(1)	-	L(1)	-	-	M (2)	M (2)	S (3)	S (3)
CO5	L(1)	L(1)	-	L(1)	-	-	M (2)	M (2)	S (3)	S (3)
W.AV	**1**	**1**	**-**	**1**	**-**	**-**	**2**	**2**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	-	L (1)	-	S (3)
CO2	-	-	L (1)	-	S (3)
CO3	-	-	L (1)	-	S (3)
CO4	-	-	L (1)	-	S (3)
CO5	-	-	L (1)	-	S (3)
W.AV	**-**	**-**	**1**	**-**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

III-SEMESTER					
Discipline Specific Elective - 3	**Course code 509509**	**Applied Biology**	**T**	**Credits: 3**	**Hours: 3**

UNIT - I		
Objective 1	**To understand the principles and application of microbial fermentation process.**	
Microbial fermentation: Scope and historical overview of fermentation process, Industrial Fermentation - role of microorganisms, mode of operation, fermentation processes, production of commercially important organic acids - lactic acid and ethanol.		
Outcome 1	Know the industrial techniques of microbial fermentation.	**K1**
UNIT - II		
Objective 2	**To identify with recent techniques in genomics and proteomics.**	
Genomics: Genome sequencing strategies, Next Generation Sequencing. Tools for gene prediction; Whole genome analysis; DNA sequence in Genbank - bankIt, Sequin. **Proteomics:** Structural proteomics: Methods of sequence-based protein prediction, protein families – SCOP and CATH, Molecular visualization tool, Rasmol and pymol.		
Outcome 2	Understand the nucleotide and protein sequence analysis.	**K2**
UNIT - III		
Objective 3	**To study the applications of biosensor.**	
Biosensors: Introduction to environmental Biosensors - Overview of biosensors - glucometer applications - medicine; Microarray analysis to diagnose the cancer.		
Outcome 3	Identify the environmental biosensor and their applications.	**K3**
UNIT - IV		
Objective 4	**To know the environmental biotechnology related to microbes.**	
Environmental Biotechnology: Bioremediation - Introduction, Types (In situ, Ex situ), Techniques-Bioleaching and Biomining; Biofertilizers and Biogas. Microbial production of biofuels; Applications of stemcells.		
Outcome 4	Find the applications of environment biological techniques.	**K3**
UNIT - V		
Objective 5	**To learn the molecular techniques in transgenic animals.**	
Transgenic animal technology: Molecular techniques in gene therapy - types of gene therapy, stem cell therapy, targeted gene transfer - knock in and knock out technology, transgenic mice, goat, cattle - gene pharming & other applications**.** rDNA techniques for strain development. Animals Breeding including marker assisted selection.		
Outcome 5	Observe the rDNA techniques for transgenic animals.	**K4**

Suggested Readings :

A. Burny, R. Renaville, 2006. Biotechnology in Animal Husbandry. Netherlands: Springer Netherlands.Portner, R. 2021. Animal Cell Biotechnology: Methods and Protocols. United States: Springer US. Alberts, B. (2010). Cell biology: the endless frontier. Molecular biology of the cell, 21(22), 3785-3785. Scragg, A. (2004). Environmental biotechnology. Italy: OUP.

Joanne M. Willey, Linda M. Sherwood, Christopher. 2011. *Prescott's Microbiology*. Eighth edition. Mcgraw.

Hill International Edition.

Pal, P. (2017). Industrial Water Treatment Process Technology. United Kingdom: Elsevier Science.

Online Resources https://acetheraceonline.com/wp-content/uploads/2014/11/Unit-12-Applied-Biology-CSIR-UGC-NET-Life-Sciences.pdf https://static.prepp.in/public/image/Applied_Biology_31a63527e480d45870e11eb67e9bc629.pdf					
K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***
Course designed by: Dr. V. Nithya					

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	-	-	L (1)	M(2)	-	M(2)	M(2)	S (3)	S (3)
CO2	-	-	-	L (1)	M(2)	-	M(2)	M(2)	S (3)	S (3)
CO3	-			L (1)	M (2)		M (2)	M (2)	S (3)	S (3)
CO4	-	-	-	L (1)	M (2)	-	M (2)	M (2)	S (3)	S (3)
CO5	-	-	-	L (1)	M (2)	-	M (2)	M (2)	S (3)	S (3)
W.AV	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**2**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	-	L (1)	-	S (3)
CO2	-	-	L (1)	-	S (3)
CO3			L (1)		S (3)
CO4	-	-	L (1)	-	S (3)
CO5	-	M (2)	L (1)	L (1)	S (3)
W.AV	**-**	**0.4**	**1**	**0.2**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

II-SEMESTER					
Non-Major Elective	**Course code**	**Business Skills in Zoology**	**T**	**Credits: 2**	**Hours: 3**
UNIT - I					
Objective 1	**To study the importance of agriculture and their livestock**				
Livestock: Commercially Important livestocks – cattle, goat, sheep, dog, and rabbit species.					
Outcome 1	Know the importance of agriculture and livestock.				**K1**
UNIT - II					
Objective 2	**To know more about dairy and poultry production**				
Dairy and poultry production: Status – national and international - dairy farming – types – production systems - farm management. Poultry – types – broiler and layer – type of farming and management.					
Outcome 2	Understand the merits involved in the dairy and poultry production.				**K2**
UNIT - III					
Objective 3	**To unravel the importance of sericulture and apiculture**				
Sericulture: Rearing of silkworm and silk production – types of culture, trading and major disease. **Vermitechnology:** Vermicomposting – Different type of production - merits and demerits and trading. **Apiculture:** Bee keeping accessories – honey production methods – honey collection – preservation and by- products of bees and its uses.					
Outcome 3	Develop sericulture, Vermicomposting and apiculture related economy.				**K3**
UNIT - IV					
Objective 4	**To explain the significance of freshwater aquaculture**				
Freshwater aquaculture: cultivable species - Finfish and prawn hatchery - types and classification – production. Farming practices – monoculture, composite culture, polyculture. Ornamental fish culture – Status - economically important species, aqua-phonics, organic farming and spirulina culture.					
Outcome 4	Outline the importance of freshwater culture and production techniques.				**K2**
UNIT - V					
Objective 5	**To educate the students with integrated farming practices**				
Integrated farming: Importance–national and international status – a different type of integrated farmingsystems. Production cost-analysis of different integrated farming systems.					
Outcome 5	Explain themselves in the development of integrated farming.				**K5**
Suggested Readings : Aminul, A. (2016). *A Textbook of Economic Zoology. India*: I.K. InternationalPublishing House Pvt. Limited. Jabde, P.V. 2005 Text Book of Applied Zoology, Vermiculture, Apiculture, Sericulture, Lac-Culture, AgriculturalPests and Their Controls, Discovery Publishing Group Jadhav, N. V., Siddiqui, M. F. (2007). *Handbook of Poultry Production and Management.* India: Jaypee Bros.Kotpal, R. L. 2000.*Modern Textbook of Zoology*, Rastogi Publications. Pillay, T. V. R and Kutty, M. N. 2005. *Aquaculture: Principles and Practices 2nd Edition*, Wiley-Blackwell.Pradip. V Jabde, 2005. *Text Book of Applied Zoology*, Discovery Publishing House. Shukla, G.S and Upadhyay, V.B. 2006. *Economic Zoology*, Rastogi					
Online Resources https://www.bizcommunity.com/Article/196/520/175266.html https://www.prospects.ac.uk/job-profiles/fish-farm-manager					
K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***
Course designed by: Course designed by **Dr. N. M. Prabhu, Dr. M. Biruntha & Dr. P. Kumar**					

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M (2)	M (2)	M (2)	M (2)	-	L (1)	M(2)	M (2)	S (3)	S (3)
CO2	M (2)	M (2)	M (2)	M (2)	-	L (1)	M(2)	M (2)	S (3)	S (3)
CO3	M (2)	M (2)	M (2)	M (2)	-	L (1)	M(2)	M (2)	S (3)	S (3)
CO4	M (2)	M (2)	M (2)	M (2)	-	L (1)	M(2)	M (2)	S (3)	S (3)
CO5	M (2)	M (2)	M (2)	M (2)	-	L (1)	M(2)	M (2)	S (3)	S (3)
W.AV	**2**	**2**	**2**	**2**	**-**	**1**	**2**	**2**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M (2)	-	-	-	S (3)
CO2	-	-	-	-	S (3)
CO3	M (2)	-	-	L (1)	S (3))
CO4	M (2)	-	M (2)	L (1)	S (3)
CO5	M (2)	-	M (2)	L (1)	S (3)
W.AV	**1.8**	**-**	**0.8**	**0.6**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

III-SEMESTER					
Non-Major Elective	**Course code**	**Food Processing Technology**	**T**	**Credits: 2**	**Hours: 3**

UNIT - I		
Objective 1	**To learn the fundamentals of dairy processing.**	
Diary Processing: National and International status of diary processing – Pasteurization - freezing – refrigeration – Drying and dehydration and nutritional standards - Quality methods and marketing.		
Outcome 1	Gain knowledge on the methods of processing in diary.	**K2**

UNIT - II		
Objective 2	**To provide knowledge on meat and poultry processing.**	
Meat and Poultry processing: National and international status – Pre-processing –Processing and preservation – a different method of processing - nutritional standards –Quality methods and marketing.		
Outcome 2	Critically explain about meat processing.	**K2**

UNIT - III		
Objective 3	**To create awareness on seafood processing.**	
Seafood Processing: National and international status – Pre-processing – Processing and preservation – a different method of processing - nutritional standards – Chilled fish processing - smoking-canning – drying –IQF - Nutritional standards - Quality methods and marketing.		
Outcome 3	Distinguish different methods of preserving and processing in seafood.	**K3**

UNIT - IV		
Objective 4	**To understand the concept on fruit and vegetable processing.**	
Fruits and Vegetable processing: Fruit & Vegetable –pre-processing –Processing and storage-nutritional standards		
Outcome 4	Understand the fruit and vegetable processing methods.	**K2**

UNIT - V		
Objective 5	**To learn food safety.**	
Food safety: History of food regulation –International and national standards-Food adulteration acts—Food quality assurance and control- sensory evaluations for various products, sanitary procedures –HACCP –GMP.		
Outcome 5	Evaluate the Quality control and standardization.	**K5**

Suggested Readings :

Clark, S., Jung. & S., Lamsal, B. (Eds.). (2014). Food processing principles applications, (2nded.). US: WileyPublishers.

Fellows, P.J., (2000). Food processing technology. Principles and practices, (3rd ed.).Wood head Publishing:Elsevier.

Food safety and standards regulations (2010). Ministry of health and family.

John R. Campbell &Robert T. Marshall. (2016). Dairy Production and Processing: The Science of Milk andMilk Products, (1st ed.): Waveland Press.

Pearson, A. M. (1994). Quality attributes and their measurements in meat poultry. Food Science & Nutrition:Springer.

Richardson, R. I & Mead, C. (1999). Poultry meat science, (1st ed.): CABI Publishing. Walstra, P., Wouters, J.M. Jan, Geurts, J. T. (2005). Dairy Science and technology: CRC Press.

Online Resources

https://www.webpal.org/SAFE/aaarecovery/2_food_storage/Food%20Processing%20Technology.pdf

https://www.academia.edu/31540761/FOOD_PROCESSING_TECHNOLOGY_Principles_and_Practice_Second_Edition

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. N. M. Prabhu

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	-	-	M (2)	-	-	-	M (2)	S (3)	S (3)
CO2	-	-	-	M (1)	-	-	-	M (2)	S (3)	S (3)
CO3	-	-	-	M (2)	-	-	-	M (2)	S (3)	S (3)
CO4	-	-	-	M (2)	-	-	-	M (2)	S (3)	S (3)
CO5	-	-	-	M (2)	-	-	-	M (2)	S (3)	S (3)
W.AV	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	-	-	L (1)	S (3)
CO2	-	-	-	L (1)	S (3)
CO3	-	-	L (1)	L (1)	S (3)
CO4	-	-	-	L (1)	S (3)
CO5	-	-	-	L (1)	S (3)
W.AV	**-**	**-**	**0.2**	**1**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Core	Course Code: 509999	DISSERTATION	Credits:15	Hours:30
The dissertation will be conducted by the student, guided by mutual understanding, expertise, and interest from both the student and the research advisor. The student's work will be continuously evaluated to ensure progress. Research guide will provide instructions on how to write the dissertation, detailing the components, topics, materials, text, and issues to address in each section. The dissertation will include the following sections: Introduction, Review, Materials and Methods, Results and Discussion, Summary and Conclusion, and References. Appropriate statistical tools must be used for data analysis. The dissertation should also include well-prepared graphs, diagrams, and flow charts. An appendix may be included if necessary				

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