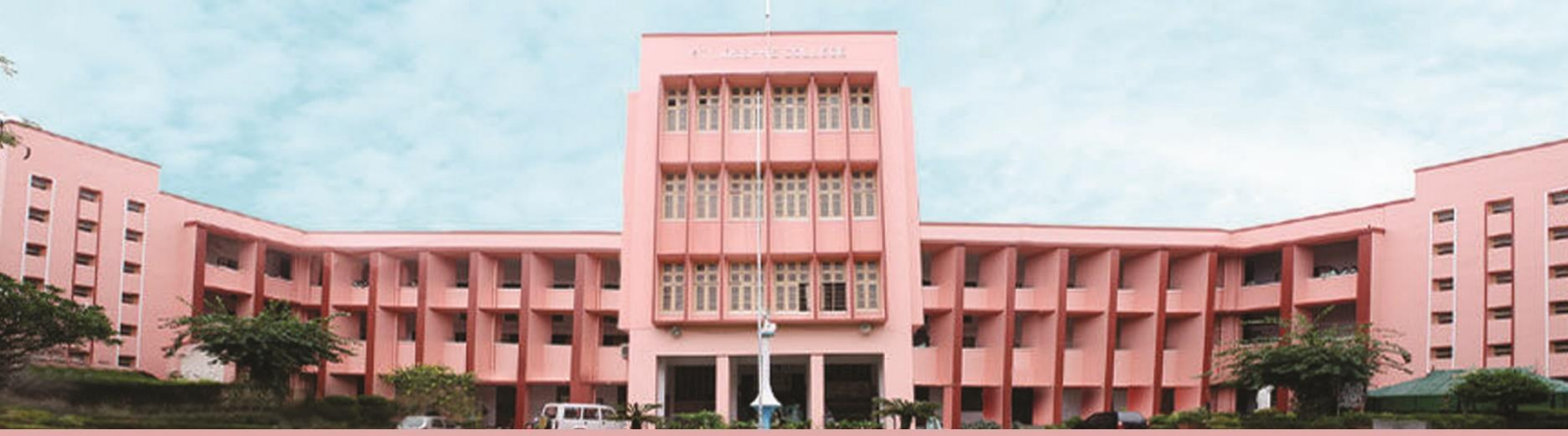

ST. JOSEPH'S COLLEGE (AUTONOMOUS)

IRINJALAKUDA

CURRICULA AND SYLLABI FOR

B.Sc. ZOOLOGY

(CORE & COMPLEMENTARY PROGRAMMES)

Under Choice Based Credit & Semester System

2023 Admissions

St. Joseph's College (Autonomous), Irinjalakuda

Board of Studies in Zoology

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FOREWORD

Higher Education scenario in Kerala has been going through turbulent transformations in recent times with the grant of autonomy to colleges by the State Government. There is no doubt about the qualitative worth of the institutions handpicked for autonomy. However, there are apprehensions about the absorption and implementation of the package of autonomy. St. Joseph's College was given autonomy in the year 2016, and has since then been endeavouring to reinvent itself.

Academic autonomy has given us the freedom to recreate our own curriculam and syllabus keeping in mind the challenges and changing needs of the society, the nation, the industry and the world. Hence, structured feedback on the requirements of the new millennium was sought from all the relevant stakeholders of the institution- students, faculty, alumnae, parents, industry experts, employers etc.

The suggestions of the stakeholders were incorporated into the curricula and syllabi, and presented in the respective Boards of Studies for discussion. The changes pointed out were duly considered and the restructured syllabi are then presented to, and ratified by, the Academic Council.

The role of the IQAC of the college in the above exercise is laudatory. The Cell spearheads all the quality enhancement endeavours, including that of curriculum and syllabus redesigning. By organizing workshops, seminars and hands on training sessions, the cell has facilitated a smooth conduct of the restructuring process. At the end of the year, an evaluation of the syllabi followed is also undertaken, with suggestions noted down for future changes.

As an institution that wishes seriously to provide enhanced quality education to young women students in order to empower them to be fit for the changing world, St. Joseph's College is bravely facing the challenges even as it is happily handling the possibilities, that autonomy has brought to it. Academic enriching programmes, skill – based micro credentials, ICT up gradations, promotional activities for a culture of research, etc are a few of the multifarious responsibilities invested with the college in its restructuring of curriculam and redesigning of syllabus.

I specially thank the IQAC, the Heads of various departments the faculty, and staff, directly in charge of the syllabus updation, for their sincere and dedicated efforts.

Principal

CONTENT

STUDENT ATTRIBUTES

The motto of the institution is "Light, Life, Love"
Light for the illumination of the heart and mind
Life for the fullness of growth – physical, mental, intellectual and spiritual
Love for fellowship with the Supreme & with one another

The motto enshrines the vision of the Founders for the students and constitutes the foundation for the acquisition of the following student attributes envisioned by the institution.

- Empowerment
- Life Long Learning
- Holistic Development
- Value Orientation
- Social Responsibility
- Nation Building Capacity
- Green Thinking
- Creativity & Innovation
- Acquiring Life Skills
    - Discipline
    - Leadership / Team skills
    - Problem solving skills
    - Communicability

The above Student Attributes will be attained in the span of their student life at St. Joseph's College through various activities such as

- Curricular, Co-curricular & extra-curricular
- Sports, games, fine arts and cultural
- Enrichment / certificate courses
- Extension / outreach programmes
- Healthy / Best practices

PROGRAMME OUTCOMES

At the end of a UG programme, a student would have:

1. acquired adequate knowledge of the subject
2. crafted a foundation for higher learning
3. been initiated into the basics of research
4. imbibed sound moral and ethical values
5. become conscious of environmental and societal responsibilities
6. attained skills for communication and career
7. learned to tolerate diverse ideas and different points of view
8. become empowered to face the challenges of the changing universe

PROGRAMME SPECIFIC OUTCOME

	Program Specific Outcomes
PSO1	Understand and identify animal diversity through systematic classification and evolutionary significance with an emphasis on environment conservation and sustainable development.
PSO2	Analyze and understand the concepts and principles of genetics, cell biology, biochemistry, molecular biology, bioinformatics and the pattern of inheritance in human traits.
PSO3	Understand various aspects and concepts of human physiology, reproductive and developmental biology, gender studies, immunology, microbiology and biotechnology.
PSO4	Perform laboratory techniques and procedures as per standard protocols, to understand and develop technical skills in the areas of animal diversity, environmental biology, ethology, evolution, cell biology, genetics, molecular biology, bioinformatics, physiology, developmental biology, immunology, biotechnology, microbiology and biostatistics.

AIMS AND OBJECTIVES

First Semester

Aim: To provide the students with an in-depth knowledge of the diversity in form, structure and habits of invertebrates of Kingdom Protista, Phylum Porifera, Cnidaria, Platyhelminthes, Nematoda and minor phyla such as Rotifera and Gastrotricha.

Objectives:

- To learn the basics of systematics and understand the hierarchy of different categories.
- To learn the diagnostic characters of Kingdom Protista, Phylum Porifera, Cnidaria, Platyhelminthes, Nematoda and minor phyla such as Rotifera and Gastrotricha.
- To obtain an overview of economically important invertebrate fauna.

Second Semester

Aim: To provide the students with an in-depth knowledge of the diversity in form, structure and habits of invertebrates of Phylum Annelida, Arthropoda, Mollusca, Echinodermata, Hemichordata and minor phyla such as Phoronida, Ectoprocta and Echiura.

Objectives:

- To learn the basics of systematic and understand the hierarchy of different categories.
- To learn the diagnostic characters of different phyla Annelida, Arthropoda, Mollusca, Echinodermata, Hemichordata and minor phyla such as Phoronida, Ectoprocta and Echiura, through brief studies of examples.
- To obtain an overview of economic importance of invertebrate fauna.

Third Semester

Aim: To provide the students with an in-depth knowledge of the diversity in form, structure and habits of chordates.

Objectives:

- To learn the unique characters of urochordates, cephalochordates, pisces, amphibians and reptiles.
- To understand the structural features of a urochordate, cephalochordate, fish, amphibian and reptile.
- To understand the classification of phylum Chordata and identify the diversity in pisces, amphibians and reptiles.

Fourth Semester

Aim: To provide the students with an in-depth knowledge of the diversity in form, structure and habits of chordates.

Objectives:

- To give the student a comprehensive idea of chordate diversity- birds and mammals, their structure and functions.
- The type studies are intended to provide an understanding of the typical vertebrate body structure.
- To understand the diversity in aves and mammals.

Fifth Semester

Aim: To educate the student on the fundamentals of cell biology, genetics, biotechnology, microbiology, immunology, biochemistry, molecular biology, and methodologies adopted in biosciences, biostatistics and bioinformatics.

Objectives:

- To understand the ultrastructure of prokaryotic and eukaryotic cell.
- To educate the students on the underlying genetic mechanism operating in man and bio-techniques.
- To enable the student to understand the principles and mechanisms of immunology.

- To get a broad understanding of microbes and their economic importance.
- To learn the structure and functions of bio-molecules and their role in metabolism.
- To study to apply scientific methods independently.
- To learn the nature, application and scope of Bioinformatics.

Sixth Semester

Aim: To educate the student on various aspects of physiology, endocrinology, reproductive and developmental biology, environmental and conservation biology, ethology, evolution and zoogeography.

Objectives

- To study the different systems in the human body and the inherent disorders/ deficiencies.
- To study the various stages involved in the developing embryo.
- To inculcate interest in nature, its conservation and its importance in sustainable development.
- To study the inherent morphological and physiological bases of behavioural pattern exhibited by organisms.
- To gain knowledge of evolution with special reference to man.

COURSE DESIGN

The B.Sc. Zoology programme includes

i. Common Courses
ii. Core courses
iii. Complementary courses
iv. Open Course
v. Audit courses

The number of Courses for the B.Sc. Zoology programme contains 15 compulsory core courses and one elective course from the frontier area of the core courses, one open course and a project; 5 complementary courses, from the relevant subjects for complementing the core of study. There are ten common courses which includes the English and Additional Language of study. Project Work and/or Viva-voce are mandatory for B.Sc. Zoology programme and these shall be done in the end of sixth semester. The student shall select any Choice based course offered by the department which offers the core courses, depending on the availability of teachers and infrastructure facilities, in the institution. Open course shall be offered in any subject and the student shall have the option to do courses offered by other departments.

Duration of the programme

The minimum duration for completion of a four semester UG Programme is 3 years. The duration of each semester will be 90 working days, inclusive of examinations, spread over five months. The odd semesters (1, 3, 5) shall be from June to October and the even semesters (2, 4, 6) shall be from November to March subject to the academic calendar of St. Joseph's College (Autonomous) Irinjalakuda.

Programme structure

A student is required to acquire a minimum of 140 credits for the completion of the UG programme, of which 120 credits are to be acquired from class room study and shall only be counted for SGPA and CGPA. Out of the 120 credits, 38 (22 for common (English) courses + 16 for common languages other than English) credits shall be from common courses, 2 credits for

project/corresponding paper and 3 credits for the open course. (In the case of LRP Programmes 14 credits for common courses (English), 8 credits for additional language courses and 16 credits for General courses). The maximum credits for a course shall not exceed 5. Audit courses shall have 4 credits per course and a total of 16 credits in the entire programme. The maximum credit acquired under extra credit shall be 4. If more Extra credit activities are done by a student, that may be mentioned in the Grade card. The credits of audited courses or extra credits are not counted for SGPA or CGPA.

Course	**Credit**	**Number**	**Total credits**
Common Courses	3, 4	2, 8	38
Core courses	2, 3, 4	3, 6, 7	52
Complementary courses	2, 4	8, 2	24
Open Course	3	1	3
Audit courses	4	4	16
Project, Field study	2, 1	1,1	3
Extra credit	4	1	4
Total			140

Common Courses

UG student should undergo 10 common courses (total 38 credits) for completing the programme:

A01. Common English Course 1 A02. Common English Course II A03. Common English Course III A04. Common English Course IV A05. Common English Course V A06. Common English Course VI	English courses A01-A06 applicable to BA/BSC Regular pattern English courses A01-A04 applicable to Language Reduced Pattern (LRP) Programmes B.com, BBA, BBA (T), BBM, B.Sc. (LRP), BCA etc.

A07. Additional Language Course I A08. Additional Language Course II A09.Additional Language Course III A10.Additional Languag Course IV	Addl. Language courses A07-A10 applicable to BA/B.Sc Regular Pattern Addl. Language courses A07-A08 applicable to Language Reduced Pattern (LRP) Programmes

Common courses A01-A06 shall be taught by the department of English and A07-A10 by teachers of additional languages respectively.

Common Courses in B.Sc.Zoology programme

No.	Programme	Semester I	Semester II	Semester III	Semester IV
1	B.Sc. Zoology	A01, A02, A07	A03, A04, A08	A05, A09	A06, A10

Core courses

Core courses are the courses in the major subject of the B.Sc. programme chosen by the student. Elective course shall be in the Sixth Semester. Project work and Field study may be conducted as a part of the Programme.

Semester	***Code No.***	***Course Title***	***Total Hours***	***Credit***
I	SJZOL1B01T	Core Course I – Animal Diversity: Non-Chordata Part I	36	2
		Practical I*A	36	*
II	SJZOL2B02T	Core Course II – Animal Diversity: Non-Chordata Part II	36	2
		Practical I*B	36	*
III	SJZOL3B03T	Core Course III – Animal Diversity: Chordata Part I	54	3
		Practical I*C	36	*
IV	SJZOL4B04T	Core Course IV – Animal Diversity: Chordata Part II	54	3
		(Practical I*D)	36	*
	SJZOL4B05P	Core Course V - Core Practical - I		4
V	SJZOL5B06T	Core Course VI – Cell Biology and Genetics	54	4
	SJZOL5B07T	Core Course VII – Biotechnology, Microbiology & Immunology	72	4
		Practical II*A	72	**
	SJZOL5B08T	Core Course VIII – Biochemistry & Molecular Biology	72	4
	SJZOL5B09T	Core Course IX – Methodology in Science, Biostatistics and Bioinformatics	54	4
		Practical II*B	72	**
VI	SJZOL5B10T	Core Course X – Physiology & Endocrinology	54	3
	SJZOL5B11T	Core Course XI – Reproductive & Developmental Biology	54	3
		Practical III*A	72	**
	SJZOL5B12T	Core Course XII – Environmental & Conservation Biology	54	3
	SJZOL5B13T	Core Course XIII – Ethology, Evolution & Zoogeography	54	3
	SJZOL6B14(E)01 SJZOL6B14(E)02 SJZOL6B14(E)03	Core Course XIV – Elective Course*** Human Genetics & Gender Studies Aquaculture, Animal Husbandry & Poultry Science Applied Entomology	54	3
		Practical III*B	72	**
	SJZOL6B15P	Core Course XV – Core Practical II (II*A+II*B)		4

	SJZOL6B16P	Core Course XVI – Core Practical III (III*A+III*B)		4
	SJZOL6B17PF	Core Course XVII – Project Work & Field Study		2+1
* Exam will be held at the end of 4th semester ** Exam will be held at the end of 6th semester *** A department can choose any one among the three courses.				

Complementary courses

Complementary courses cover one or two disciplines that are related to the core subject and are distributed in the first four semesters.

Semester	***Code No.***	***Course Title***	***Total Hours***	***Credit***
I	SJZOL1C01T	Complementary Course I - Animal Diversity & Wildlife Conservation	36	2
		Complemetary Course Practical I*A	36	*
II	SJZOL2C02T	Complementary Course II – Economic Zoology	36	2
		Complemetary Course Practical I*B	36	*
III	SJZOL3C03T	Complementary Course III – Physiology & Ethology	54	2
		Complemetary Course Practical I*C	36	*
IV	SJZOL4C04T	Complementary Course IV – Genetics & Immunology	54	2
	SJZOL4C05P	Complemetary Course Practical I*D Zoology Complementary Practical (I*A+I*B+I*C+I*D)	36	* 4
		Total		**12**

* Exam will be held at the end of 4th semester.

Open courses

There shall be one open course in core subjects in the fifth semester. The open course shall be open to all the students in the institution except the students in the parent department. The students can opt that course from any other department in the institution. Each department can decide the open course from a pool of three courses creditallotted for open course is 3 and the hours allotted is 3.

Semester	***Code No.***	***Course Title***	***Total Hours***	***Credit***
V	SJZOL5D01T SJZOL5D02T SJZOL5D03T	Open Course – (Any One) Reproductive Health & Sex Education Nutrition, Health & Hygiene Applied Zoology	54	3

Ability Enhancement courses/ Audit courses

These are courses which are mandatory for a programme but not counted for the calculation of SGPA or CGPA. There will be one Audit course each in the first four semesters. These courses are not meant for class room study. The students can attain only pass (Grade P) for these courses. At the end of each semester there will be examination conducted by the college from a pool of questions (Question Bank) set by the College. The students can also attain these credits through online courses like SWAYAM, MOOC etc. (optional). The list of courses in each semester with credits are given below.

Course with credit	Credit	Semester
Environment Studies	4	1
Disaster Management	4	2
Human Rights/Intellectual Property Rights/ Consumer Protection	4	3
Gender Studies/Gerontology-	4	4

Extra credit Activities

Extra credits are mandatory for the programme. Extra credits willbe awarded to students who participate in activities like NCC, NSS and Swatch Bharath. Those students who could not join in any of the above activities have to undergo Social Service Programme offered by the College. Extra credits are not counted for SGPA or CGPA.

Attendance

A student shall be permitted to appear for the semester examination, only if she secures not less than 75% attendance in each semester. Attendance will be maintained by the Department concerned. Condonation of shortage of attendance to a maximum of 10% in the case of single condonation and 20% in the case of double condonation in a semester shall be granted by College remitting the required fee. Benefits of attendance may be granted to students who attend the approved activities of the college with the prior concurrence of the Head of the institution. Participation in such activities may be treated as presence in lieu of their absence on production of participation/attendance certificate (within two weeks) in curricular/extracurricular activities (maximum 9 days in a semester). Students can avail of condonation of shortage of attendance in a maximum of four semesters during the entire programme (Either four single condonations or one double condonation and two single condonations during the entire programme). Less than 50% attendance requires Readmission.Readmission is permitted only once during the entireprogramme.

Grace Marks

Grace Marks may be awarded to a student for meritorious achievements in co-curricular activities (in Sports/Arts/NSS/NCC/Student Entrepreneurship) carried out besides the regular hours. Such a benefit is applicable and limited to a maximum of 8 courses in an academic year spreading over two semesters. In addition, maximum of 6 marks per semester can be awarded to the students of UG Programmes, for participating in the College Fitness Education Programme (COFE).

Project

Every student of a B. Sc Zoology programme shall have to work on a project of 2 credits under the supervision of a faculty member or shall write a theory course based on Research Methodology as per the curriculum.

Students are assigned to undertake a project work during 6th semester on problems pertaining to biological science. Scientific study on the topic selected is required to be carried out under the supervision and guidance of faculty members. A group consisting of not more than 12 students can undertake one research project. Each student has to actively participate in the project work. The problem/topic chosen by an earlier batch of students for their project work shall not be repeated by a latter batch. A certificate to this effect has to be attached by the Head of the department.

A well documented project report duly attested by the Supervising teacher and the Head of department must be submitted by each candidate for evaluation separately on the day of 3rd practical examination in the sixth semester. The project must contain the following components.

1. Introduction with citations of relevant literature
2. Objectives of the study
3. Methodology
4. Results
5. Discussion
6. References

COURSE CODE FORMAT

The following are the common guidelines for coding various courses in order to get a uniform identification. It is advisable to assign a nine Digit Code (combination of Alpha Numerical) for various courses as detailed below:

i. Common Courses (Code A)
ii. Core courses (Code B)
iii. Complementary courses (Code C)
iv. Open Course (Code D)
v. Audit courses (Code E).
    a. **First two digits** indicate the code of college SJ
    b. **Next three digits** indicate the Programme/discipline code (ZOL for Zoology)
    c. **Sixth digit** is the Semester indicator which can be given as 1, 2, 3 & 4 respectively for I, II, III & IV Semester (ZOL1, ZOL2, etc).
    d. **Seventh digit** will be the Course Category indicator.
    e. **Last two digits** indicate the serial number of the respective courses. If there is one digit it should be prefixed by '0'(Zero) eg: (01, 02, etc).
    f. If the number of courses in one category is only one (eg: Viva, Project etc.), assign the course serial number as 01.

Scheme- Core Course

The following table shows the structure of the programme which indicates course code, course title, instructional hours and credits.

Semester I						
Course Code	**Title of the course**	**Number of hours per week**	**Total Credit**	**Total hours/ semester**	**Marks**	
					CA	**ESE**
SJZOL1B01T	Animal Diversity: Nonchordata Part-I	2	2	36	15	60
	Practical I*A	2	*	36		
Semester II						
SJZOL2B02T	Animal Diversity: Nonchordata Part-II	2	2	36	15	60
	Practical I*B	2	*	36		
Semester III						
SJZOL3B03T	Animal Diversity: Chordata Part-I	3	3	54	15	75
	Practical I*C	2	*	36		
Semester IV						
SJZOL4B04T	Animal Diversity: Chordata Part-II	3	3	54	15	75
	(Practical I*D)	2	*	36		
SJZOL4B05P	Zoology Core Practical - I	8	4	144	20	80
Semester V						
SJZOL5B06T	Cell Biology and Genetics	3	4	54	20	80
SJZOL5B07T	Biotechnology, Microbiology and Immunology	4	4	72	20	80
	Practical II*A	4	**	72		
SJZOL5B08T	Biochemistry and Molecular Biology	4	4	72	20	80

SJZOL5B09T	Methodology in Science, Biostatistics and Bioinformatics	3	4	54	20	80
	Practical II*B	4	**	72		
Semester VI						
SJZOL5B10T	Physiology and Endocrinology	3	3	54	15	60
SJZOL5B11T	Reproductive and Developmental Biology	3	3	54	15	60
	Practical III*A	4	**	72		
SJZOL5B12T	Environmental and Conservation Biology	3	3	54	15	60
SJZOL5B13T	Ethology, Evolution and Zoogeography	3	3	54	15	60
	Practical III*B	4	**	72		
SJZOL6B15P	Core Course XV – Core Practical II (II*A+II*B)	8	4	144	20	80
SJZOL6B16P	Core Course XVI – Core Practical III (III*A+III*B)	8	4	144	20	80
SJZOL6B17PF	Project Work and Field Study	-	2+1	-	15	60

* Exam will be held at the end of 4th semester
** Exam will be held at the end of 6th semester

Scheme- Common Courses

Semester I						
Course Code	**Title of the course**	**Number of hours per week**	**Total Credit**	**Total hours/ semester**	**Marks**	
					CA	**ESE**
SJENG1A01	Common course I - English	4	4	72	20	80
SJENG1A02	Common course II - English	5	3	90	15	60
A07	Common course VII - Language other than English	4	4	72	20	80
Semester II						
SJENG2A03	Common course III - English	4	4	72	20	80
SJENG2A04	Common course IV - English	5	3	90	15	60
A08	Common course VIII - Language other than English	4	4	72	20	80
Semester III						
SJENG3A05	Common course V - English	5	4	90	20	80
A09	Common course IX - Language other than English	5	4	90	20	80
Semester IV						
SJENG4A06	Common course VI - English	5	4	90	20	80
A10	Common course X - Language other than English	5	4	90	20	80

Scheme- Open Course (Choose any one)

Semester V						
Course Code	**Title of the course**	**Number of hours per week**	**Total Credits**	**Total hours/ semester**	**Marks**	
					CA	**ESE**
SJZOL5D01T	Reproductive Health & Sex Education	3	3	54	60	15
SJZOL5D02T	Nutrition, Health & Hygiene					
SJZOL5D03T	Applied Zoology					

Scheme- Elective Courses (Choose any one stream)

Semester VI						
Course Code	**Title of the course**	**Numberof hours per week**	**Total Credits**	**Total hours/ semester**	**Marks**	
					CA	**ESE**
SJZOL6B14(E)01	Human Genetics and Gender Studies	3	3	54	15	60
SJZOL6B14(E)02	Aquaculture, Animal Husbandry and Poultry Science					
SJZOL6B14(E)03	Applied Entomology					

Scheme- Complementary Courses

Semester I						
Course Code	**Title of the course**	**Number of hours per week**	**Total Credits**	**Total hours/ semester**	**Marks**	
					CA	**ESE**
SJZOL1C01T	Animal Diversity and Wildlife Conservation	2	2	36	15	60
	Practical I*A	2	*	36	-	-
Semester II						
SJZOL2C02T	Economic Zoology	2	2	36	15	60
	Practical I*B	2	*	36	-	-
Semester III						
SJZOL3C03T	Physiology and Ethology	3	2	54	15	60
	Practical I*C	2	*	36	-	-
Semester IV						
SJZOL4C04T	Genetics and Immunology	3	2	54	15	60
	Practical I*D	2	*	36	-	-
SJZOL4C05P	Zoology Complementary Practical (I*A+I*B+ I*C+I*D)	-	4	144	20	80

* Exam will be held at the end of 4th semester.

EVALUATION AND GRADING

The evaluation scheme for each course will contain two parts; (a) Internal/Continuous Assessment (CA) and (b) External / End Semester Evaluation (ESE). Of the total, 20% weightage will be given to Internal evaluation/Continuous assessment and the remaining 80% to External/ESE and the ratio and weightage between Internal and External is 1:4.

CORE COURSE: SCHEME OF EVALUATION

A. CORE COURSE - THEORY

Internal Assessment

20% of the total marks in each course are for internal evaluation. The departments shall send only the marks obtained for internal examination to the Autonomous Exam section of the college. The internal assessment shall be based on a predetermined transparent system involving written tests, Class room performance based on attendance in respect of theory courses and lab involvement/records attendance in respect of Practical Courses. Internal assessment of the project will be based on its content, method of presentation, final conclusion and orientation to research aptitude.

The criteria and percentage of mark assigned to various components for internal evaluation are as follows:

Table 1. Criteria for Internal Evaluation of Theory courses

Sl. No.	**Criteria**	**Maximum Internal Marks – 15 (2/3 Credit Courses – Type 1)**	**Maximum Internal Marks – 20 (4/5 Credit Courses – Type 2)**
1	Test paper (1) (40%)	6	8
2	Assignment (20%)	3	4
3	Seminar (20%)	3	4
4	Attendance (20%)	3	4
Total Marks		**15**	**20**

Table 2. Pattern of Test paper for Type 1 [2/3 credit courses]

Duration	Pattern	Total no. of Questions	No. of questions can be answered	Marks for each question	Ceiling of Marks
1 Hour	Short answer	6	6	2	10
	Paragraph	3	3	5	10
	Essay	2	1	10	10
Total Marks					**30**

Table 3. Pattern of Test paper for Type 2 [4/5 credit courses]

Duration	Pattern	Total no. of Questions	No. of questions can be answered	Marks for each question	Ceiling of Marks
1.5 Hour	Short answer	6	6	2	10
	Paragraph	5	5	5	20
	Essay	2	1	10	10
Total Marks					**40**

Table 4. Split up of internal marks for Test Paper [40%]

Sl. No.	Range of Marks in Test Paper	Out of 6 [Maximum Internal Marks – 15]	Out of 8 [Maximum Internal Marks – 20]
1	85 to 100%	6	8
2	65 to below 85%	5	6
3	55 to below 65%	4	4
4	45 to below 55%	3	3
5	35 to below 45%	2	2
6	Below 35%	1	1

Table 5. Criteria for Internal Evaluation of Assignment [20%]

Sl. No.	Criteria	Out of 6 [Maximum Internal Marks – 15]	Out of 8 [Maximum Internal Marks – 20]
1	Submission in time	1	1
2	Content	2	3
	Total Marks	**3**	**4**

Table 6. Criteria for Internal Evaluation of Seminar [20%]

Sl. No.	Criteria	Out of 3 [Maximum Internal Marks – 3]	Out of 4 [Maximum Internal Marks – 4]
1	Excellent	3	4
2	Good	2	3
3	Average	1	1
	***Total Marks**	3	4

**Based on clarity, communication skills, use of AV aids and answer to questions.*

Table 7. Split up of Internal Marks for Classroom Participation (CRP) (Attendance) [20%]

Sl. No.	Range of CRP (Attendance)	Out of 3 [Maximum Internal Marks - 15]	Out of 4 [Maximum Internal Marks – 20]
1	85 and above	3	4
2	75 to below 85%	2	2
3	50 to below 75%	1	1
4	below 50%	0	0

To ensure transparency of the evaluation process, the internal assessment marks awarded to the students in each course in a semester shall be notified on the notice board at least one week before the commencement of external examination. There shall not be any chance for improvement for internal marks. The course teacher(s) shall maintain the academic record of each student registered for the course.

Examination /Test: For each course there shall be class test/s during a semester. Grades should be displayed on the notice board. Valued answer scripts shall be made available to the students for perusal.

Seminars / Presentation: Every student should deliver Seminar/Presentationas an internal built – in component of the curriculum transaction for every course and must be evaluated by the respective course teacher in terms of structure, content, presentation and interaction. The soft and hard copies of the seminar report are to be submitted to the courseteacher.

Assignment: Each student will be required to do assignment/s as an internal built – in component of the curriculum transactionfor each course. Assignments after valuation must be returned to the students. The teacher shall define the expected quality of the above in terms of structure, content, presentation etc. and inform the same to the students. Punctuality in submission is to beconsidered.

Lab Skill: Students in the science stream are required to combine their classroom methods with hands on practical sessions in the laboratories. The teacher shall assess the skills of the student and the quality of application of theoretical knowledge.

Records/viva: Records are submitted by science students for documenting the textual and classroom knowledge along with their practical lab skills. Neatness, accuracy and precision are also evaluated here. Viva voce is conducted to assess the grasp of knowledge gained by the student and to test their communication skills in the translation of the knowledge.

Practical Test: It is conducted for students in the science stream to assess their scientific temper and application of theoretical knowledge. The sense of precision and accuracy is also taken into account.

External Evaluation

External evaluation carries 80% of marks. The external question papers may be of uniform pattern with 80/60 marks. The courses with 2/3 credits will have an external examination of 2 hours duration with 60 marks and courses with 4/5 credits will have an external examination of 2.5 hours duration with 80 marks. The external examination in theory courses is to be conducted by the college with question papers set by external experts. The evaluation of the answer scripts will be done by examiners based on a well-defined scheme of valuation and answer keys will be provided by the College. The external examination in practical courses shall be conducted by two examiners – one internal and an external. The project evaluation with viva can be conducted either internal or external. After the external evaluation only, marks are to be entered in the answer scripts. All other calculations including grading are done by the College.

Pattern of Questions for External/ESE:

Questions will be set to assess the knowledge acquired, standard, and application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. Due weightage will be given to each module based on content/teaching hours allotted to each module. Different types of questions shall be given different weightages to quantify their range given in the following model:

Table 9. Pattern of Question Paper for Theory - Type 1 [60 Marks]

Duration	Pattern	Total no. of questions	No. of questions can be answered	Marks for each question	Ceiling of MArks
2 Hrs	Section A: Short answer	12	12	2	20
	Section B: Paragraph	7	7	5	30
	Section C: Essay	2	1	10	10
Total Marks					**60**

Table 10. Pattern of Question Paper for Theory - Type 2 [80 Marks]

Duration	Pattern	Total no. of questions	No. of questions can be answered	Marks for each question	Ceiling of MArks
2.5 Hrs	Section A: Short answer	15	15	2	25
	Section B: Paragraph	8	8	5	35
	Section C: Essay	4	2	10	20
Total Marks					**80**

B. CORE COURSE - PRACTICAL

End Semester Evaluation in Practical Courses will be conducted and evaluated by both Internal and External Examiners.

Practical corresponding to each core course will be conducted during the corresponding semesters. Internal evaluation of core course Practical I will be conducted at 4th Semester and Practical II & III at 6th Semester. Internal evaluation carries 20% of the total marks in each practical.

I. INTERNAL EVALUATION

Table 11. Criteria of Internal Evaluation for Practical I, II and III [20 marks for each practical]

Sl. No.	Criteria	Marks
1	Attendance	4
2	Lab involvement, Performance & Punctuality	4
3	Class test (1 No.)	8
4	Record	4
Total Marks		***20***

Table 11a. Attendance

Sl. No.	Attendance (%)	Marks
1	85 and above	4
2	75 to below 85%	2
3	50 to below 75%	1
4	below 50%	0

Table 11.b. Lab involvement, Performance & Punctuality

Sl. No.	Criteria	Marks
1	Excellent	4
2	Very Good	3
3	Good	2
4	Average	1
5	Below Average	0

Table 11.c. Class Test [1]

Sl. No.	Criteria	Marks
1	85 to 100%	8
2	65 to below 85%	6
3	55 to below 65%	4
4	45 to below 55%	3
5	35 to below 45%	2
6	Below 35%	1

Table 11.d. Record

Sl. No.	Criteria	Marks
1	Punctuality in submission	1
2	Contents	2
3	Scientific accuracy and neatness	1
	Total Marks	***4***

II. EXTERNAL EVALUATION

Practical corresponding to each core theory course will be conducted during the corresponding semesters. External evaluation will be done by a team consisting of **one internal examiner and one external examiner.**

A combined University practical examination related to the first four core theory courses (Practical I*A, I*B, I*C and I*D) will be conducted at the end of fourth semester and that will be designated as Practical I (ZOL4B05P). Practical related to V semester core theory courses (Practical II*A and II*B) form Practical II (ZOL6B15P) and Practical related to VI semester core theory courses, (Practical III*A, and III*B) form Practical III (ZOL6B16P). Practical II and III examinations will be conducted at the end of 6th semester. Credits for Practical I, II & III are 4 each.

All external practical examinations are of 4 hours duration.

Any candidate, who turns up for a practical examination, must submit a certified and bonafide record/ report of work done by him/ her duly attested by the Teacher- in -charge and the Head of the Department at the time of practical examinations.

For external evaluation of the record of Practical - I, One mark may be given to the local biodiversity report done by the students on Nonchordate group of animals during I or II semester and also one mark for local biodiversity report on Chordate groups during III or IV semester (1+1+14= Total 16 marks).

All practical examinations will have a viva voce, during which the examiner may ask questions based on the principles/methodology/concepts of the experiments performed during the practical examinations (3 marks).

Table 12. Scheme of question paper for Practical I

Question Nos.	Nature of Questions	Total no. of questions	Marks for each question	Marks	Duration
I : Q 1-6	Spotters: Identification and classification (upto order in the case of chordates and upto class in the case of non-chordates); habits/ habitat/ sketches/ descriptions/ peculiarities/ reasons/ significance etc.	6	3	18	4 hours
II: Q 7	Minor: Mountings/ Dissections/ Display/ Sketches	1	9	9	
III: Q 8	Minor: Mountings/ Dissections/ Display/ Sketches	1	12	12	
IV: Q 9	Major: Mountings/ Dissections	1	22	22	
	Viva-voce			3#	
V: Record		-	-	16*	
Total Marks					***80***

* For external evaluation of the Practical Record I, *One* mark may be given to the local biodiversity report done by the students on Nonchordate group of animals during I or II semester and also *one* mark for local biodiversity report on Chordate groups during III or IV semester (1+1+14= Total 16 marks).
# viva- voce: Examiner may ask questions based on the principles/ methodology/ concepts of the experiments performed during the practical examinations.

Table 13. Scheme of question paper for Practical II and III

Question Nos.	Nature of Questions	Total no. of questions	Marks for each question	Marks	Duration
I : Q 1-6	Spotters from various core courses: slides/ specimens/ apparatus/ experimental setup etc.; Identification, sketches/ description/ reasons/ importance/ significance etc.	6	3	18	4 hours
II: Q 7	Minor expt: from various sections – results/ explanation/ graphs/ sketches etc.	1	9	9	
III: Q 8	Minor expt: from various sections – results/ explanation/ graphs/ sketches etc.	1	12	12	
IV: Q 9	Major expt: from various sections – results/ explanation/ sketches etc.	1	22	22	
	Viva-voce			3#	
V:Record				16*	
Total Marks					***80***

Viva voce – Examiner may ask questions based on the principles/methodology/concepts of the experiments performed during the practical examinations

C. CORE COURSE - PROJECT WORK & FIELD STUDY [2+1 = 3 CREDITS]

D. a. Project work (2 credits)

A well documented project report duly attested by the Supervising teacher and the Head of department must be submitted by each candidate for evaluation, separately on the day of 3rd practical examination during semester VI. Report of the project work has an internal and external evaluation.

Pass conditions

- Submission of the project report and presence of the student for viva are compulsory for internal evaluation. No marks shall be awarded to a candidate if she/ he fail to submit the Project Report for external evaluation.
- The student should get a minimum P Grade in aggregate of external and internal.
- There shall be no improvement chance for the marks obtained in the project report.

In the extent of student failing to obtain a minimum of Pass Grade, the project work may be re-done and a new internal mark may be submitted by the parent department. External examination may be conducted along with the subsequent batch.

b. Field Study (1 credit)

A detailed report of field study /study tour certified by the Teacher -in- charge and also by the Head of the Department specifying the places and institutions visited, date and time of visit, details of observations made etc. must be submitted by each student in **"hand written"** mode for evaluation during the day of 3rd practical examination in VI semester. The field study/study tour report is compulsory for each student appearing for practical examination. Evaluation of the field study also has both internal and external components.

Evaluation of the project report and field study report will be conducted after Practical III examination in the VI semester on a separate day. Each student shall appear for a **viva- voce** on the *project work and field study* before a team of **two external examiners**. The questions will be based on project report and field study. Marks shall be given according to their performance.

Table: 14. Evaluation of Project and Field study

Sl. No.	Components	External Marks	Internal Marks	Total Marks
1	Project	48	12	60
2	Field Study/ Study Tour	12	3	15
	Total Marks	***60***	***15***	***75***

I. INTERNAL EVALUATION (12+3=15 Marks)

The supervising teachers will assess the project report and field study report and award internal marks.

Table 15: Criteria for Internal evaluation of Project [12 Marks; 20%]

Sl. No.	Components	Marks
1	Originality	2
2	Methodology	2
3	Scheme/Organisation of Report	4
4	Viva-voce	4
Total Marks		***12***

Table 16: Criteria for Internal evaluation of Field study/ Study tour report [3 Marks; 20%]

Sl. No.	***Components***	***Marks***
1	Content of field study report	2
2	Viva-voce related to field study	1
	Total Marks	***3***

II. EXTERNAL EVALUATION (48+12 = 60)

Table 17: Project work & Field study: External Examination Scheme

	Project Work			**Project Total Marks (48)**	**Field Study**			**Field Study Total Marks (12)**	**Grand Total (60)**
Relevance of the topic, statement of objectives	Presentation, quality of analysis/ use of statistical tools, references	Findings and recommendations	Viva - voce		Field Study related to elective course	Visit to places of general biological and ecological interest	Viva-voce related to field study		
10 Marks	***10 Marks***	***14 Marks***	***14 Marks***		***2 Marks***	***8 Marks***	***2 Marks***		

OPEN COURSE: SCHEME OF EVALUATION

The evaluation scheme of the open course also has internal (20%) and external (80%) components.

I. INTERNAL EVALUATION [15 marks]

Table 19. Criteria for Internal Evaluation of Open course [15 marks]

Sl. No.	Criteria	Marks
1	Test Paper (1)	6
2	Assignment	3
3	Seminar	3
4	Attendance (Classroom Participation)	3
	Total Marks	***15***

Table 19.1. Pattern of Test paper [30 Marks]

Duration	Pattern	Total no. of questions	No. of questions can be answered	Marks for each question	Ceiling of Marks
1 Hour	Short Answer	6	6	2	10
	Paragraph	3	3	5	10
	Essay	2	1	10	10
Total Marks					***30***

Table 19.a. Split up of internal marks for Test Paper [40%]

Sl. No.	Range of Marks in Test Papers	Out of 6 [Maximum Internal Marks – 15]
1	85 to 100%	6
2	65 to below 85%	5
3	55 to below 65%	4
4	45 to below 55%	3
5	35 to below 45%	2
6	Below 35%	1

Table 19.b. Criteria for Internal Evaluation of Assignment [20%]

Sl. No.	Criteria	Out of 3 [Maximum Internal Marks – 3]
1	Submission in time	1
2	Content	2
	Total Marks	**3**

Table 19.c. Criteria for Internal Evaluation of Seminar [20%]

Sl. No.	Criteria	Out of 3 [Maximum Internal Marks – 3]
1	Excellent	3
2	Good	2
3	Average	1
	****Total Marks***	3

**Based on clarity, communication skills, use of AV aids and answer to questions.*

Table 19.d. Split up of Internal Marks for Classroom Participation (CRP) (Attendance) [20%]

Sl. No.	Range of CRP (Attendance)	Out of 3 [Maximum Internal Marks - 15]
1	85 and above	3
2	75 to below 85%	2
3	50 to below 75%	1
4	below 50%	0

II. EXTERNAL EVALUATION (60 Marks)

Table 20. Pattern of Question Paper for Open Course [Theory]

Duration	Pattern	Total no. of Questions	No. of questions can be answered	Marks for each question	Ceiling of Marks
2 Hours	**Section A:** Short Answer	12	12	2	20
	Section B: Paragraph	7	7	5	30
	Section C: Essay	2	1	10	10
Total Marks					***60***

COMPLEMENTARY COURSE: SCHEME OF EVALUATION

The evaluation scheme for each course contains two parts: *viz.*, internal evaluation and external evaluation. Maximum marks from each unit are prescribed in the syllabus.

A. COMPLEMENTARY COURSE – THEORY

INTERNAL EVALUATION

20% of the total marks in each course are for internal evaluation. The department shall send only the marks obtained for internal examination to the Autonomous Exam section of the college.

Table 21. Criteria for Internal Evaluation of Complementary Course [15 marks]

Sl. No.	Criteria	Marks
1	Test Paper (1)	6
2	Assignment	3
3	Seminar	3
4	Classroom participation (CRP) (Attendance)	3
Total Marks		***15***

Table 21.1. Pattern of Test Paper [30 Marks]

Duration	Pattern	Total no. of Questions	No. of questions can be answered	Marks for each question	Ceiling of Marks
1 Hour	Short Answer	6	6	2	10
	Paragraph	3	3	5	10
	Essay	2	1	10	10
Total Marks					***30***

Table 21.a. Split up of internal marks for Test Paper [40%]

Sl. No.	Range of Marks in Test Papers	Out of 6 [Maximum Internal Marks – 15]
1	85 to 100%	6
2	65 to below 85%	5
3	55 to below 65%	4
4	45 to below 55%	3
5	35 to below 45%	2
6	Below 35%	1

Table 21.b. Criteria for Internal Evaluation of Assignment [20%]

Sl. No.	Criteria	Out of 3
1	Submission in time	1
2	Content	2
	Total Marks	**3**

Table 21.c. Criteria for Internal Evaluation of Seminar [20%]

Sl. No.	Criteria	Out of 3
1	Excellent	3
2	Good	2
3	Average	1
	****Total Marks***	**3**

**Based on way of presentation, content, answer to question etc..*

Table 21.d. Split up of Internal Marks for Attendance [20%]

Sl. No.	Range of CRP (Attendance)	Out of 3
1	85 and above	3
2	75 to below 85%	2
3	50 to below 75%	1
4	below 50%	0

EXTERNAL EVALUATION

External evaluation carries 80% marks. End semester examinations will be conducted at the end of each semester.

Table 22. Pattern of Question Paper for Complementary Course [Theory]

Duration	Pattern	Total no. of Questions	No. of questions can be answered	Marks for each question	Ceiling of Marks
2 Hours	**Section A:** Short Answer	12	12	2	20
	Section B: Paragraph	7	7	5	30
	Section C: Essay	2	1	10	10
Total Marks					***60***

A. COMPLEMENTARY COURSE – PRACTICAL

INTERNAL EVALUATION

Table 23. Criteria of Internal Evaluation for Complementary Practical [20 Marks]

Sl. No.	Criteria	Marks
1	Attendance	4
2	Lab involvement, Performance & Punctuality	4
3	Class test (1 No.)	8
4	Record	4
Total Marks		***20***

Table 23.a. Attendance

Sl. No.	Attendance (%)	Marks
1	85 and above	4
2	75 to below 85%	2
3	50 to below 75%	1
4	below 50%	0

Table 23.b. Lab involvement, Performance & Punctuality

Sl. No.	Criteria	Marks
1	Excellent	4
2	Very Good	3
3	Good	2
4	Average	1
5	Below Average	0

Table 23.c. Class Test [1]

Sl. No.	Criteria	Marks
1	85 to 100%	8
2	65 to below 85%	6
3	55 to below 65%	4
4	45 to below 55%	3
5	35 to below 45%	2
6	Below 35%	1

Table 23.d. Record

Sl. No.	Criteria	Marks
1	Punctuality in submission	1
2	Contents	2
3	Scientific accuracy and neatness	1
	Total Marks	***4***

EXTERNAL EVALUATION

Table 24. Scheme of question paper for Complementary Practical

Question Nos.	Nature of Questions	Total no. of questions	Marks for each question	Marks	Duration
I : Q 1-6	Spotters: from various sections of courses: Identification/ sketches/ descriptions/ reasons/ importance/ significance/ from Non chordata, Chordata, Histology, Osteology, Economic Zoology, etc.	6	3	18	

II: Q 7	Minor expt: from various courses – results/ explanation/ sketches etc.	1 (as per choice)	9	9	4 hours
III: Q 8	Minor expt: from various sections – (Non chordate/ Chordata/ Physiology/ Immunology etc.) Results/ explanation/ sketches etc.	1 (as per choice)	12	12	
IV: Q 9	Major expt: from Non chordate/ Chordata/ Physiology/ Immunology etc.	1	22	22	
	Viva-voce			#3	
V:Record		-	-	16*	
Total Marks					***80***

Viva voce – Examiner may ask questions based on the principles/ methodology/ concepts of the experiments performed during the practical examinations.

Evaluation of Audit Courses:

The examination and evaluation will be conducted by the college in MCQ model from the Question Bank and other guidelines provided by the University/BoS. The Question paper will be for minimum 100 mark and a minimum of 3-hour duration for the examination. The marks of audit courses one and two will be forwarded to Controller of Examinations of St. Joseph's College (Autonomous) Irinjalakuda in time of respective semesters. The result will be intimated / uploaded to the University during the Third Semester.

Revaluation

The prevailing rules of revaluation are applicable to CBCSS UG-2022. Students can apply for photocopies of answer scripts of external examinations. Applications for photocopies/ scrutiny/ revaluation should be submitted within 10 days of publication of results. The fee for this shall be as decided by the College.

INDIRECT GRADING SYSTEM

Indirect grading System based on a 10-point scale is used to evaluate the performance of students. Each course is evaluated by assigning marks with a letter grade (O, A+, A, B+, B, C, P, F or Ab) to that course by the method of indirect grading.Evaluation (both internal and external)

is carried out using Mark system. The Grade on the basis of total internal and external marks will be indicated for each course, for each semester and for the entire programme. Indirect Grading System in 10 -point scale is as below:

Ten Point Indirect Grading System

Percentage of Marks (Both Internal &External put together)	Grade	Interpretation	Grade point Average (G)	Range of grade points	Class
95 and above	O	Outstanding	10	9.5 -10	First Class with Distinction
85 to below 95	A+	Excellent	9	8.5 -9.49	
75 to below 85	A	Very good	8	7.5 -8.49	
65 to below 75	B+	Good	7	6.5 -7.49	First Class
55 to below 65	B	Satisfactory	6	5.5 -6.49	
45 to below 55	C	Average	5	4.5 -5.49	Second Class
35 to below 45	P	Pass	4	3.5 -4.49	Third Class
Below 35	F	Failure	0	0	Fail
Absent	Ab	Absent	0	0	Fail

An aggregate of P grade (after external and internal put together) is required in each coursefor a pass and also for awarding a degree. No separate grade/mark for internal and external will be displayed in the grade card; only an aggregate. Also the aggregate mark of internal and external are not displayed in the gradecard. A student who fails to secure a minimum grade for a pass in a course is permitted to write the examination along with the nextbatch. After the successful completion of a semester, Semester Grade Point Average (SGPA) of a student in that semester is calculated using the formula given below. For the successful completion of a semester, a student

should pass all courses. However, a student is permitted to move to the next semester irrespective of SGPAobtained.

SGPA of the student in that semester is calculated using the formula

$$\text{SGPA} = \frac{\textit{Sum of the credit points of all courses in a semester}}{\textit{Total credits in that semester}}$$

` The Cumulative Grade Point Average (CGPA) of the student is calculated at the end of a programme. The CGPA of a student determines the overall academic level of the student in a programme and is the criterion for ranking the students. CGPA can be calculated by the following formula.

$$\text{CGPA} = \frac{\textit{Total credit points obtained in six semesters}}{\textit{Total credits acquired (120)}}$$

SGPA and CGPA shall be rounded off to three decimal places. CGPA determines the broad academic level of the student in a programme and is the index for ranking students (in terms of grade points). An overall letter grade (cumulative grade) for the entire programme shall be awarded to a student depending on her CGPA.

B.Sc. ZOOLOGY DEGREE PROGRAMME COURSE STRUCTURE

Semester	Course Code	Course Title	Total Hrs	Credits
I	A01	Common Course I : English	72	3
	A02	Common Course II : English	90	3
	A07	Common Course III – Language other than English	72	4
	ZOL1B01T	Core Course I: Animal Diversity: Non-chordata Part-I	36	2
		Practical I*A	36	*
		Ist Complementary course: Chemistry	32	2
		Chemistry Practical	32	*
		IInd Complementary course: Botany	36	2
		Botany Practical	36	*
		Audit Course: Environmental Studies	-	4
		Total	**442**	**20**
II	A03	Common Course IV: English	72	4
	A04	Common Course V : English	90	4
	A08	Common Course III – Language other than English	72	4
	ZOL2B02T	Core Course II: Animal Diversity: Non-chordata Part-II	36	2
		Practical I*B	36	*
		Ist Complementary course: Chemistry	32	2
		Chemistry Practical	32	*
		IInd Complementary course: Botany	36	2
		Botany Practical	36	*
		Audit Course: Disaster Management	-	4
		Total	**442**	**22**
	A05	Common Course VI – English	90	4

III	A09	Common Course VIII - Language other than English	90	4
	ZOL3B03T	Core Course III: Animal Diversity: Chordata Part I	54	3
		Practical I*C	36	*
		Ist Complementary course: Chemistry	48	2
		Chemistry Practical	32	*
		IInd Complementary course: Botany	54	2
		Botany Practical	36	*
		Audit Course: Human Rights or Intellectual Property Rights or Consumer protection	-	4
		Total	**440**	**19**
IV	A06	Common Course IX – English	90	4
	A10	Common Course X - Language other than English	90	4
	ZOL3B03T	Core Course IV: Animal Diversity: Chordata Part II	54	3
		Practical I*D	36	*
	ZOL4B05P	Core course V: Zoology Core Practical – I [Practical I*A +I*B+ I*C+ I*D		4*
		Ist Complementary course: Chemistry	48	2
		Ist Complementary course: Chemistry Practical	32	4*
		IInd Complementary course: Botany	54	2
		Botany Practical	36	4*
		Audit Course: Gender studies or Gerontology	-	4
		Extra Credits		4
		Total	**440**	**35**
V	ZOL5B06T	Core course VI: Cell Biology and Genetics	54	4
	ZOL5B07T	Core Course VII: Biotechnology, Microbiology and Immunology	72	4
		Practical II*A	72	**

	ZOL5B08T	Core Course VIII: Biochemistry and Molecular Biology	72	4
	ZOL5B09T	Core Course IX: Methodology in Science, Biostatistics and Bioinformatics	54	4
		Practical II*B	72	**
		Open course: Any other streams	54	3
		Total	**450**	**19**
VI	ZOL6B10T	Core Course X: Physiology and Endocrinology	54	3
	ZOL6B11T	Core Course XI: Reproductive and Developmental Biology	54	3
		Practical III*A	72	**
	ZOL6B12T	Core Course XII: Environmental and Conservation Biology	54	3
	ZOL6B13T	Core Course XIII: Ethology, Evolution and Zoogeography	54	3
	ZOL6B14(E)	Core Course XIV: Elective course (Any one) 01T/ 02T/ 03T)	54	3
		Practical III*B	72	**
	ZOL6B15P	Core Course XV: Zoology Core Practical- II [Practical II*A + II*B]	-	4
	ZOL6B16P	Core Course XVI: Zoology Core Practical- III [Practical III*A+ III*B]	-	4
	ZOL6B17PF	Core Course XVII: Project Work and Field study	-	2+1
		Total	**414**	**25**

B.Sc. ZOOLOGY

CORE PROGRAMME SYLLABUS

Semester I

Course Code: SJZOL1B01T

Core Course I: ANIMAL DIVERSITY: NON-CHORDATA PART- I

36 hours (Credit - 2)

Cos	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Describe the principles of classification and nomenclature.	PO1,PO2,PO3 PSO1	R	C	5
CO2	Explain the five-kingdom classification of living organisms.	PO1,PO2,PO3 PSO1	U	C	1
CO3	Understand the concepts of classification of animals.	PO1,PO2,PO3 PSO1	U	C	4
CO4	Explain the classification with examples and characteristic features of kingdom Protista and describe the morphology and structural organization of *Paramecium*.	PO1,PO2,PO3 PSO1	U	F	6
CO5	Describe the characteristic features of subkingdom Mesozoa.	PO1,PO2,PO3 PSO1	R	C	1
CO6	Explain the classification of phylum Porifera and elucidate the salient features of each class.	PO1,PO2,PO3 PSO1	U	F,C	3
CO7	Describe the characteristic features of phylum Cnidaria and Ctenophora, illustrate the classification of phylum Cnidaria down to classes and explain the structural organization of *Obelia*	PO1,PO2,PO3 PSO1	R	F,C	8
CO8	Explain the salient features of phylum Platyhelminthes and illustrate its classification down	PO1,PO2,PO3 PSO1	U	F,C	3
CO9	Explain the characteristic features and classification of	PO1,PO2,PO3 PSO1	U	F,C	3

	super-phylum Aschelminthes and phylum Nematoda.				
C010	Elucidate the characters of Pseudocoelomate minor phyla Rotifera and Gastrotricha.	PO1,PO2,PO3 PSO1	U	C	2

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

Section A. CONCEPTS OF CLASSIFICATION OF ORGANISMS

MODULE 1. Principles of classification and nomenclature (5 hrs)

Systematics: natural and classical. Nomenclature: Binomial and Trinomial nomenclature; International rules of Zoological nomenclature (brief account); Mention modern trends in systematics: Chemotaxonomy, Serotaxonomy, Cytotaxonomy, Evolutionary taxonomy, Numerical taxonomy (Phenetics), Cladistics (Phylogenetics), Molecular systematics, DNA barcoding.

[Short answers/paragraphs/Essays]

MODULE 2. Five kingdom classification of living organisms (1 hr)

Mention Cavalier-smith's eight kingdom classification also.

[Short answers/Paragraphs]

MODULE 3. Concepts of classification of animals (4 hrs)

Classification based on number of cells, tissue or organ system level of organization, development of germ layers, development of symmetry, development of coelom, segmentation, homology and analogy of organs and their origin, development of mouth and digestive tract (brief account).

[Short answers/Paragraphs]

Section B. CLASSIFICATION OF KINGDOM PROTISTA

MODULE 4. Kingdom: PROTISTA (6 hrs)

Characteristic features and classification of Kingdom Protista down to phyla. [*Salient features of the major groups of protists given below with notes on theexamples cited*]

Phylum: Rhizopoda	e.g.*Entamoeba*
Phylum: Dinoflagellata	e.g.*Noctiluca*
Phylum:Parabasilia	e.g.*Trichonympha*
Phylum: Apicomplexa [=Sporozoa]	e.g. *Plasmodium*
Phylum: Ciliophora	e.g.*Vorticella.*

Type ***Paramecium***: Morphology and structural organization [as revealed by compound microscopy]; locomotion, nutrition, excretion, osmoregulation and reproduction; conjugation in detail.

[Short answers/Paragraphs/Essays]

Section C. KINGDOM: ANIMALIA

Salient features of the Major Phyla of animals and their diversity.

[*Habits, habitat,morphology, functional anatomy and life history of representative types(wherever specified) and classification of each phylum down to classes, except otherwise mentioned, and examples thereof: Study of animal diversity with typical examples from each class, with emphasis on ecological and adaptive features, economic importance and such other points of biological interest expected. Only very brief account of each example is to be studied.*]

MODULE 5. Subkingdom: MESOZOA (1 hr)

A brief account of Dicyemid (=Rhombozoans) mesozoans [e.g. *Dicyema*] and Orthonectid mesozoans [e.g. *Rhopalura*]

[Short answers/Paragraphs]

MODULE 6. Subkingdom: PARAZOA (3 hrs)

Phylum: PORIFERA

Classification down to classes and salient features of each class.

Class Calcarea (=Calcispongiae)	e.g.*Leucosolenia*
Class Demospongiae	e.g.*Spongilla*
Class Hexactinellida (=Hyalospongiae)	e.g.*Euplectella*

Give an account of canal system (Asconoid, Syconoid, Leuconoid and Rhagonoid); Mention amphiblastula, parenchymula and sponge gemmule.

[Short answers/Paragraphs/Essays]

MODULE 7. Subkingdom: METAZOA (8 hrs)

Phylum CNIDARIA [=COELENTERATA] (7 hrs)

Classification of the phylum down to classes and salient features of each class.

Class Hydrozoa	e.g.*Halistemma, Physalia*
Class Scyphozoa	e.g.*Rhizostoma*
Class Anthozoa	e.g.*Adamsia, Zoanthus*, and *Madrepora*

Type ***Obelia***: Morphology and life cycle.

Polymorphism in cnidarians with special reference to siphonophores.

Reef building corals & coral reefs. (brief)

Phylum CTENOPHORA [=ACNIDARIA] (1 hr)

Unique features as exemplified by *Pleurobrachia*; mention cidippid larva.

[Short answers/Paragraphs/Essays]

MODULE 8. ACOELOMATA (3 hrs)

Phylum PLATYHELMINTHES

Classification down to classes and salient features of the following classes.

ClassTurbellaria	e.g.*Bipalium*
Class Trematoda	e.g.*Fasciola*
Class Cestoda	e.g.*Taenia*

Type ***Dugesia*** (Planaria):Structural organization, Digestive system, locomotion and reproduction.

[Short answers/Paragraphs/Essays]

MODULE 9. PSEUDOCOELOMATA (3 hrs)

Super Phylum: ASCHELMINTHES

Classification down to phyla; highlight the heterogeneous nature of animals of this group.

Phylum: NEMATODA

Characteristic features of *Ascaris*.
Examples: *Ancylostoma*, *Enterobius, Wuchereria*

[Short answers/Paragraphs/Essays]

MODULE 10. PSEUDOCOELOMATE MINOR PHYLA (2 hrs)

Salient features of the following pseudocoelomate minor phyla:

Phylum **Gastrotricha**	e.g.*Chaetonotus*
Phylum **Rotifera**	e.g.*Brachionus*

[Short answers/Paragraphs]

Topics for assignments/seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Nutrition in protozoans.
2. Reproduction in protozoans.
3. Parasitic protozoans of man.
4. Helminth parasites of man.

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Semester II

Course Code: SJZOL1B02T

Core Course II: ANIMAL DIVERSITY: NON-CHORDATA PART- II

36 hours (Credit - 2)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Explain the classification with examples and characteristic features of phylum Annelida and describe the morphology and structural organization of Neanthes	PO1, PSO1	R	F	7
CO2	Describe the distribution, peculiarities and affinities of phylum Onychophora	PO1, PSO1	R	F	2
CO3	Explain the classification of phylum Arthropoda;elucidate the salient features of each class and describe the morphology and structural organization of Penaeus	PO1, PSO1	U	F	11
CO4	Describe the characteristic features of phylum Mollusca, illustrate its classification down to classes and explain the structural organization of Pila globosa	PO1, PSO1	R	F	8
CO5	Explain the salient features of phylum Echinodermata and illustrate its classification down to classes	PO1, PSO1	U	F	4
CO6	Understand the salient features and affinities of phylum Hemichordata	PO1, PSO1	U	C	1
CO7	Elucidate the characters of coelomate minor phyla Phoronida, Ectoprocta and Echiura	PO1, PSO1	R	F	3

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

COELOMATA

MODULE 1. Phylum ANNELIDA (7 hrs)

Classification down to subclasses; salient features of the following classes and subclasses:

1. Class Polychaeta — e.g. *Arenicola*
2. Class Clitellata
   - Subclass Oligochaeta — e.g. *Megascolex*
   - Subclass Hirudinea — e.g. *Hirudinaria*, *Haemadipsa*

Type: ***Neanthes*** [Nereis]

[Morphology, body wall, digestive system, respiratory system, circulatory system, excretory system, sense organs and reproductive system. Mention Heteronereis stage and Trochophore larva.]

[Short answers/Paragraphs/Essays]

MODULE 2. Phylum ONYCHOPHORA (2 hrs)

Peripatus [distribution, peculiarities and affinities).

[Short answers/Paragraphs]

MODULE 3. Phylum ARTHROPODA (11 hrs)

Classification down to classes (mention the five subphyla and 16 arthropod classes); salient features of the following classes:

1. Class Trilobita — [brief account only]
2. Class Merostomata — e.g. *Limulus*
3. Class Arachnida — e.g. *Heterometrus* (*Palamnaeus*),*Heteropoda* (Huntsman spider, Order *Araneae*). Mention ticks and mites (Subclass *Acari*).
4. Class Chilopoda — e.g. *Scolopendra*, *Scutigera*
5. Class Diplopoda — e.g. *Spirostreptus*, *Julus*
6. Class Crustacea — e.g. *Sacculina*, *Eupagurus*
7. Class Insecta — e.g. *Lepisma*, *Mantis*, *Tabanus*, *Troides minos* (Southern Birdwing butterfly), *Papilio buddha* (Malabar Banded Peacock),*Apis*.

Type: ***Penaeus indicus*** [Prawn]

[Morphology, digestive system, respiratory system, blood vascular system, excretory system, nervous system, sense organs (statocyst, compound eye in detail), reproductive system and development] [Details of larval stages not expected].

[Short answers/Paragraphs/Essays]

MODULE 4. Phylum MOLLUSCA (8 hrs)

Classification down to classes; Mention Nudibranchs and *Nautilus*. Salient features of the following classes:

1. Class Aplacophora e.g. *Chaetoderma*
2. Class Polyplacophora (=Amphineura) e.g. *Chiton*
3. Class Monoplacophora e.g. *Neopilina*
4. Class Gastropoda e.g. *Turbinella*
5. Class Bivalvia (=Pelecypoda) e.g. *Perna*
6. Class Scaphopoda e.g. *Dentalium*
7. Class Cephalopoda (=Siphonopoda) e.g. *Sepia*

Type: ***Pila globosa*** [Apple Snail]

[Morphology, digestive system, respiratory system, blood vascular system, excretory system, nervous system, sense organs (osphradium in detail) and reproductive system].

Economic importance of molluscs (brief)

[Short answers/Paragraphs/Essays]

MODULE 5. Phylum ECHINODERMATA (4 hrs)

Classification down to classes [of extant forms only]; salient features of the following classes and brief account of examples:

1. Class Crinoidea e.g. *Antedon*
2. Class Asteroidea e.g. *Astropecten*
3. Class Ophiuroidea e.g. *Ophiothrix*
4. Class Holothuroidea e.g. *Holothuria*
5. Class Echinoidea e.g. *Echinus*

Structural peculiarities of *Asterias* (star fish); water vascular system in detail.

[Short answers/Paragraphs/Essays]

MODULE 6. Phylum HEMICHORDATA (1 hr)

Balanoglossus: Salient features and affinities.

[Short answers/Paragraphs]

MODULE 7. COELOMATE MINOR PHYLA (3 hrs)

Salient features of the following coelomate minor phyla; mention examples specified [structure and life history not required].

1. Phylum **Phoronida** e.g. *Phoronis*
2. Phylum **Ectoprocta** [**Bryozoa]** e.g. *Bugula*

3. Phylum **Echiura** e.g. *Bonellia*

[Short answers/Paragraphs]

Topics for Assignments/Seminars

(*Topics allotted for assignments/ seminars should be considered for internalassessments only, and can be subdivided among students*).

1] Larval forms in Crustacea and their significance.

2] Metamorphosis in insects.

3] Social organization in insects.

4] Insect vectors of human diseases.

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Semester III

Course Code: SJZOL3B03T

Core Course III: ANIMAL DIVERSITY: CHORDATA PART- I

54 hours (Credit - 3)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Explain the characteristics of chordates and outline classification of Phylum Chordata	PO1,PO2, PO3 PSO1	U	F,C	2
CO2	Describe the salient features and affinities of subphylum Urochordata and its classification down to classes; elucidate the morphology and structural organization of Ascidia	PO1,PO2, PO3 PSO1	U	F,C	5
CO3	Explain the salient features and affinities of subphylum Cephalochordata with reference to *Branchiostoma*	PO1,PO2, PO3 PSO1	R	F,C	4
CO4	Describe the salient features of subphylum Vertebrata, illustrate its classification down to classes and elucidate the characteristics of division Agnatha	PO1,PO2, PO3 PSO1	U	F,C	3
CO5	Enumerate the salient features of superclass Pisces and illustrate its classification down to orders and the morphology and structural organization of *Mugil cephalus*	PO1,PO2, PO3 PSO1	U, R	F,C	12
CO6	Describe the salient features and affinities of class Amphibia and its classification up to orders; explain the morphology and organ systems of *Hoplobatrachus tigerinus*	PO1,PO2, PO3 PSO1	U, R	F,C	13
CO7	Elucidate the characteristic features of the class Reptilia and its classification down to orders; describe the morphology and organ systems of *Calotes versicolor*.	PO1,PO2, PO3 PSO1	U, R	F,C	15

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

MODULE 1. Introduction [**2 hrs**]

Chordate characters (fundamental, general and advanced); chordates versus non-chordates; diversity of chordates; outline classification down to classes; salient features of each subphylum. ***[Short answers/Paragraphs]***

[*Type studies with special emphasis on morphologyand various functional systems such as integumentary, digestive, respiratory, circulatory, excretory, nervous and reproductive systems. Also mention the evolutionary significance*]

MODULE 2.Subphylum UROCHORDATA [Tunicata] [**5 hrs**]

Classification of the subphylum down to classes. Affinities of urochordates with cephalochordates and vertebrates.

Class Ascidiacea	e.g. *Herdmania*
Class Larvacea	e.g. *Oikopleura*
Class Thaliacea	e.g. *Doliolum*

Type: ***Ascidia*** [Morphology and retrogressive metamorphosis]; add a note on neoteny and paedogenesis.

[Short answers/Paragraphs]

MODULE 3.Subphylum CEPHALOCHORDATA [**4hrs**]

Type: ***Branchiostoma*** [=Amphioxus]

Morphology and anatomical features; digestive system in detail; primitive, degenerate and specialized features [affinities and systematic position to be emphasized).

[Short answers/Paragraphs]

MODULE 4. Subphylum VERTEBRATA [3 hrs]

Salient features of subphylum vertebrata and its outline classification down to classes

Division 1. AGNATHA

Characters, classificationdown to classes and examples: *Myxine; Petromyzon*
[mention Ammocoetes larva]

[Short answers/Paragraphs]

Division 2. GNATHOSTOMATA

MODULE 5. Superclass PISCES [12 hrs]

Classification of Pisces down to orders; salient features of the following extant groups:

Class Chondrichthyes [Cartilaginous fishes]

Subclass Selachii e.g.*Scoliodon, Trygon*
Subclass Holocephali e.g.*Chimaera*

Class Osteichthyes [Bony fishes]

Subclass **Sarcopterygii**

1. Order Crossopterygii [Coelacanths] e.g. *Latimeria*
2. Order Dipnoi [Lung fishes] e.g. *Neoceratodus*, *Protopterus*, *Lepidosiren* (Add a note on the distribution of lung fishes).

Subclass **Actinopterygii**

1. Superorder Chondrostei e.g. *Acipenser*
2. Superorder Holostei e.g. *Amia*, *Lepidosteus*
3. Superorder Teleostei [Spiny-rayed fishes] e.g. *Sardinella, Rastrelliger*

Type: ***Mugil cephalus*** (Grey Mullet)

[Morphology, body wall, digestive system, respiratory system, circulatory system, excretory system, sense organs (neuromast organ in detail) and reproductive system].

Sub-terranean fishes from Kerala: *Aenigmachanna Gollum* (Gollum Snakehead), *Kryptoglanis shajii, Horaglanis krishnai* (Blind Catfish) *& Monopterus digressus* (Blind cave eel). Mention recent addition to ornamental fish trade - *Sahyadria denisonii* (Miss Kerala).

[Short answers/Paragraphs/Essays]

Super class **TETRAPODA**

MODULE 6. Class AMPHIBIA [13 hrs]

Classification of Amphibia down to orders with examples [of extant forms only].

Subclass **Stegocephalia** (extinct)

Subclass **Lissamphibia**

1. Order Apoda (=Gymnophiona) e.g. *Ichthyophis, Uraeotyphlus*
2. Order Caudata (=Urodela) e.g. *Necturus, Ambystoma,* mention Axolotl larva.
3. Order Anura (=Salientia) e.g. *Duttaphrynus*, *Rhacophorus*

Type: ***Hoplobatrachus tigerinus*** (Indian Bullfrog)

[Morphology, body wall, skeletal system, digestive system, respiratory system, circulatory system, excretory system, sense organs and reproductive system].

Mention about the diversity of bush frogs, dancing frogs and night frogs in Western Ghats and the discovery of *Nasikabatrachus sahyadrensis* (Purple frog).

[Short answers/Paragraphs/Essays]

MODULE 7. Class REPTILIA [15 hrs]

Classification of class Reptilia down to orders and salient features of thefollowing orders (only extant forms):

Subclass I - **Anapsida**

1. Order Cotylosauria [stem reptiles] e.g.*Hylonomus*
2. Order Chelonia [common turtles, tortoises etc.] e.g. *Melanochelys*, *Chelone*

Subclass II – **Diapsida**

1. Order Rhynchocephalia e.g. *Sphenodon*
2. Order Squamata
   - Suborder Lacertilia (Lizards) e.g. *Chamaeleo, Hemidactylus*
   - Suborder Ophidia (Snakes)

Common venomous and non-venomous snakes of Kerala: a] *Python molurus*

b] *Ptyas mucosus* c] *Gongylophis* (= *Eryx*) *conicus* d] *Indotyphlops braminus*

e] *Bungarus caeruleus* f] *Naja naja* g] *Daboia russellii* h] *Ophiophagus hannah*

Identification key for venomous and non-venomous snakes.

3. Order Crocodilia e.g. *Crocodylus*, *Gavialis*

[Mention the extinct subclasses **Euryapsida**, **Parapsida** and **Synapsida** (mammal-like reptiles) and mention the origin of mammals from synapsids].

Type: ***Calotes versicolor*** (Garden Lizard)

[Morphology, body wall, skeletal system (exclude skull bones), digestive system, respiratory system, circulatory system, excretory system, sense organs and reproductive system].

[Short answers/Paragraphs/Essays]

Topics for Assignments/Seminars

(*Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students*)

1. Migration of fishes.
2. Parental care in fishes.
3. Parental care in amphibians.
4. Snake venom: nature; composition; antivenin; poly antivenins; prophylaxis.
5. Accessory respiratory organs in fishes.
6. Economic importance of fishes.

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Semester IV

Course Code: SJZOL4B04T

Core Course IV: ANIMAL DIVERSITY: CHORDATA PART-II

54 hours (Credit - 3)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Describe the classification of class Aves down to orders, salient features of each order with suitable examples.	PO1,PO2,PO3 PSO1	U	F,C	11
CO2	Describe the external characters and functional systems of *Columba livia*.	PO1,PO2,PO3 PSO1	U	F	14
CO3	Enumerate the salient features and classification of class Mammalia down to orders with suitable examples.	PO1,PO2,PO3 PSO1	R	F,C	11
CO4	Elucidate the external characters and functional systems of *Oryctolagus cuniculus*.	PO1,PO2,PO3 PSO1	U	F	14
CO5	Compare the circulatory, excretory and nervous systems of vertebrates.	PO1,PO2,PO3 PSO1	U,Z	C	4

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

CLASS: AVES [25 hrs]

MODULE 1. Classification of Aves [11 hrs]

Classification of class Aves down to the orders specified; mention at least one example for each order.

Subclass **Archaeornithes** **[2 hrs]**

1. Order Archaeopterygiformes e.g. *Archaeopteryx lithographica* – a brief account on its discovery and evolutionary significance.

Subclass **Neornithes** **[2 hrs]**

Super order **Palaeognathae** [=Ratitae]

2. Order Casuariiformes e.g. *Casuarius* (Cassowary)
3. Order Dinornithiformes [=Apterygiformes] e.g. *Apteryx* (Kiwi)

4. Order Rheiformes e.g. *Rhea*
5. Order Struthioniformes e.g. *Struthio* (Ostrich)

Super order **Neognathae** [=Carinatae] **[7 hrs]**

6. Order Galliformes [pheasants, quail, turkeys, grouse] e.g. *Pavo cristatus*
7. Order Anseriformes [screamers, water fowls] e.g. *Anas poecilorhyncha*
8. Order Passeriformes [perching birds] e.g. *Passer domesticus*
9. Order Piciformes [woodpeckers, barbets, honeyguides] e.g. *Dinopium*
10. Order Coraciiformes [kingfishers & allies] e.g. *Alcedo atthis*
11. Order Apodiformes [swifts, humming birds] e.g. *Apus nipalensis*
12. Order Strigiformes [owls] e.g. *Bubo*
13. Order Cuculiformes [cuckoos, roadrunners, turacos] e.g. *Eudynamys*
14. Order Psittaciformes [parrots, lories, cockatoos] e.g. *Psittacula krameri*
15. Order Gruiformes [cranes, rails, coots, bustards] e.g. *Ardeotis nigriceps*
16. Order Charadriiformes [plovers, gulls, terns, auks, sand pipers] e.g. *Tringa*
17. Order Columbiformes [pigeons, doves, dodoes, sand grouse] e.g. *Columba*
18. Order Falconiformes [diurnal birds of prey – falcons, hawks] e.g. *Mylvus*
19. Order Ciconiiformes [herons, storks, ibis, spoon bills] e.g. *Ardeola grayii*
20. Order Pelecaniformes [pelicans, cormorants] e.g. *Pelecanus*
21. Order Sphenisciformes [Impennae] e.g. *Aptenodytes* (penguin)
22. Order Phoenicopteriformes [flamingos] e.g. *Phoenicopterus*

Recent Extinctions: Passenger Pigeon [*Ectopistes migratorius*), Dodo [*Raphuscucullatus*], Pink-headed Duck [*Rhodonessa caryophyllacea*], Elephant Bird[*Aepyornis*].

Migratory birds in Kerala (brief).
Rediscovery of Jerdon's Courser [*Cursorius bitorquatus*] & Forest Owlet [*Athenebleiwitti*].

[Short answers/Paragraphs/Essays]

MODULE 2. Type: ***Columba livia*** (Rock Pigeon) **[14 hrs]**
[External characters, integumentary system (structure of feather in detail – exclude development of feather), skeletal system (skull excluded), digestive system, respiratory system, circulatory system, excretory system, sense organs and reproductive system].

[Short answers/Paragraphs/Essays]

CLASS: MAMMALIA [25 hrs]

MODULE 3. Classification of Mammalia [11 hrs]
Classification of class Mammalia down to the orders cited with examples specified.

Subclass Prototheria **[2 hr]**

Infraclass **Ornithodelphia** [egg-laying mammals]

1. Order Monotremata e.g. *Ornithorhynchus* [Platypus],*Tachyglossus* [= *Echidna*]

Subclass Theria **[2 hr]**

Infraclass **Metatheria** [marsupials]

2. Order Marsupialia e.g. *Didelphis* [Opossum], *Macropus* [Kangaroo]

Infraclass **Eutheria** [true placental mammals] **[7 hrs]**

3. Order Edentata e.g. *Bradypus* (Sloth), *Dasypus* (Armadillo) *Myrmecophaga* (Spiny ant-eater)
4. Order Pholidota e.g. *Manis* (Pangolin/ Scaly ant-eater)
5. Order Lagomorpha [rabbits and hares] e.g. *Lepus nigricollis*(Indian Hare)
6. Order Rodentia e.g. *Funambulus, Ratufa*(Giant squirrel)
7. Order Soricimorpha [shrews, moles] e.g. *Suncusmurinus, Crocidura*
8. Order Erinaceomorpha e.g. *Paraechinus micropus* (Indian Hedgehog)
9. Order Chrysochloridea e.g. Golden mole of South Africa
10. Order Dermoptera [colugos] e.g.*Cynocephalusvolans* (flying lemur)
11. Order Chiroptera e.g. *Pteropus, Pipistrellus, Kerivoula picta (Painted bat)*
12. Order Primates e.g. *Loris, Macaca, Gorilla, Pongo, Hylobates, Homo*
13. Order Carnivora e.g. *Phoca* (Seal), *Odobenus* (Walrus), *Panthera sp.*, *Viverriculaindica* (Civet), *Lutrogale* (Otter), *Cuon alpinus* (Wild dog).
14. Order Cetacea e.g. *Physeter* (Sperm whale), *Delphinus* (Dolphins), *Phocaena* (Porpoise), *Balaenoptera* (Baleen whale]
15. Order Artiodactyla e.g. *Sus scrofa cristatus* (Wild Boar), *Bos gaurus* (Gaur), *Giraffa* (Giraffe), *Hemitragus* [Tahr], *Rusa* (=*Cervus) unicolor* (Sambar deer), *Axis axis* (Spotted deer), *Moschiola* (Mouse deer), *Antilope cervicapra* (Blackbuck).
16. Order Perissodactyla e.g. *Equus caballus* (Horse), *Rhinoceros*
17. Order Sirenia e.g. *Trichechus* (Manatee), *Dugong*
18. Order Proboscidea e.g. *Elephas maximus indicus* [Indian elephant], *Elephas maximus borneensis* [Borneo pigmy elephant], *Loxodonta africana* [African savanna elephant] and *Loxodonta cyclotis* [African forest elephant].
19. Order Hyracoidea e.g. Hyrax (Coney)
20. Order Tubulidentata e.g. *Aardvark*

[Short answers/Paragraphs/Essays]

MODULE 4. Type*: **Oryctolagus cuniculus*** (European Rabbit) **[14 hrs]**

[External features, integumentary system, skeletal system (dentition in detail – skull excluded), digestive system, respiratory system, circulatory system (exclude arterial and venous systems), excretory system, sense organs and reproductive system].

[Short answers/Paragraphs/Essays]

MODULE 5. Comparative Anatomy [4 hrs]

Compare the circulatory, excretory and nervous systems of vertebrates.

[Short answers/Paragraphs]

Topics for Assignments/ Seminars

(*Topics allotted for assignments/ seminars should be considered for internalassessments only, and can be subdivided among students*)

1. Aquatic mammals and their adaptations
2. Dentition in mammals [adaptations related to food)
3. Endangered mammals of Kerala
4. Flying mammals
5. Migration in birds
6. Flight adaptations in birds
7. Flightless birds

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Semester IV

Course Code: SJZOL4B05P

Core Course V: ZOOLOGY CORE PRACTICAL – I

144 hours (Credit - 4)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Identify and describe specified protists and acoelomate & pseudocoelomate non-chordates and perform the culture of selected protists; understand the histological features of coelenterate, platyhelminth and nematode.	PO1,PO2,PO3, PO6, PSO4	U, Z	P	36
CO2	Identify and describe specified coelomate non-chordates and the transverse sections of annelids; Perform mounting of the specified organs of selected non-chordates.	PO1,PO2,PO3,PO6, PSO4	U, Z	P	36
CO3	Identify and describe specified chordates and specified bones of chordates; Prepare key for identification of venomous snakes; Perform mounting and dissection of specified organ systems of chordates.	PO1,PO2,PO3, PO6, PSO4	U, Z	P	36
CO4	Identify and describe selected vertebrates and specified bones of vertebrates.	PO1,PO2, PO3,PO6, PSO4	U, Z	P	36

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

FIRST SEMESTER B. Sc. DEGREE PROGRAMME

CORE COURSE PRACTICAL- I*A

ANIMAL DIVERSITY: NONCHORDATA Part - I

[36 hours] [2 hrs per week]

[Students are expected to make sketches with notes, while they study the specimens in the laboratory/field itself. The record must carry sketches with notes of selected specimens, mountings and dissections. Emphasis must be on scientific accuracy and not on beauty of sketches.]

MODULE 1. [36 hrs]

Section A. Study of the following Non-chordate specimens:

(Choose useful and harmful forms from different habitats. All animals intended for type study are to be included. Slides / museum preparations are to be used; charts / models may be used in exceptional cases. Students are expected to identify the specimens by their generic names and assign them to the respective phyla and classes).

1. **Protists**:*Amoeba, Noctiluca, Ceratium, Entamoeba, Trichonympha, Paramecium*[any 4]
2. **Poriferans**:*Leucosolenia/Scypha*or*Spongilla,*Sponge gemmule, spicules
3. **Cnidarians**: Sedentary hydrozoans: *Hydra, Obelia, Obelia* medusa [any 2]
   Pelagic hydrozoans: *Physalia/Velella*
   Pelagic scyphozoan: *Aurelia/ Rhizostoma*
   Common anthozoans: *Adamsia, Edwardsia, Madrepora, Fungia, Tubipora Gorgonia* [any 3]
4. **Platyhelminths**: Free living flat worm:*Bipalium Dugesia*Parasitic flat worms: *Fasciola/Taenia solium*
5. **Aschelminths**: Parasitic round worms:*Ascaris*/*Ancylostoma*/*Wuchereria*
6. **Minor Phyla** :*Sipunculus/Bonellia*or any other specimen
7. **Local Biodiversity Record**: Observe water samples from the locality for live protists and make a field note.
8. Demonstration of culture methods of Protists [*Amoeba*/*Euglena*/*Paramecium*].

Section B. Histology

Transverse sections of a coelenterate [*Hydra*], a platyhelminth [*Dugesia*] and a nematode (*Ascaris* male & female).

SECOND SEMESTER B. Sc. DEGREE PROGRAMME

CORE COURSE PRACTICAL– I*B

ANIMAL DIVERSITY: NON-CHORDATA Part– II

[36 hours] [2 hrs per week]

MODULE 2. [36 hrs]

Section A. Study of the following Coelomate Non-chordate specimens:

1. **Annelids** : Polychaetes: *Aphrodite, Chaetopterus, Arenicola, Tomopteris* [any 2]

Common earthworm: *Megascolex / Pheretima*
Leech: *Hirudinaria, Heamadipsa, Branchellion* [any 2]

2. **Arthropods**: Items of evolutionary / taxonomic importance - *Limulus, Streptocephalus* [any 1]

Common fouling barnacle – *Lepas / Balanus*
Parasitic crustaceans– *Sacculina, Cymothoa, Argulus* [any 2]

Crustacean of the sandy shore– *Emerita / Albunea*
Symbiotic crustacean - *Eupagurus*
Economically important crustacean - *Penaeus, Scylla* [any 1]

Vectors – *Cyclops, Aedes, Musca, Xenopsylla* [any 2]

Insect pests – *Lepisma*, termite queen,
Pest of paddy, pest of coconut, pest of stored grains [any 5]

Aquatic insects – *Belostoma, Nepa, Ranatra* [any 2]

Predatory insect - Dragonfly, Ant-lion, *Mantis* [any 1]

Insect which camouflages - *Carausius* /*Phyllium* Common myriapods – *Scolopendra/Scutigera, Julus/ Spirostreptus/Jonespeltis* [any 2]

Common arachnids – *Palamnaeus/ Buthus*, Spider/ tick/mite [any 2]

3. **Molluscs**:Inter tidal mollusks – *Chiton, Patella, Haliotis, Onchidium,Aplysia* [any 2]

Ornamental gastropods –*Cypraea, Murex, Turbinella* [any 2]

Poisonous gastropod – *Conus*
Pelecypods of economic importance – *Perna, Pinctada, Teredo, Ostrea* [any 2]

Scaphopod - *Dentalium*
Cephalopods of economic/evolutionary importance - *Sepia, Loligo, Octopus, Nautilus* [any 3]

4. **Echinoderms**: *Antedon, Asterias, Ophiothrix, Cucumaria, Echinus*, cake urchin, hearturchin [any 3]

5. **Hemichordate:** *Balanoglossus*

6. **Onychophoran:** *Peripatus*(Evolutionary significance)
7. **Local Biodiversity Record**: Observation of butterflies/dragonflies or any otherNon-chordate group of the locality and prepare a field note.

Section B. Histology

Compare TS of any two annelids [*Neanthes*/ Earth worm/ Leech].

Section C. Mountings

1. Earthworm : Setae (a few loose setae) [Minor]
2. *Neanthes*: Parapodium [Minor]
3. *Penaeus* : Appendages [Minor]
4. Cockroach : Salivary apparatus [Major]
5. Honeybee/ plant bug: Mouth parts [Minor]

Section D. Dissections (Digital versions to be downloaded or procured as per UGC guidelines)

1. *Penaeus* : Nervous system [Major]
2. Cockroach : Nervous system [Major]

THIRD SEMESTER B. Sc. ZOOLOGY PROGRAMME CORE COURSE

PRACTICAL- I*C **ANIMAL DIVERSITY: CHORDATA Part - I**

[36 hours] [2 hrs per week]

[Students are expected to make sketches with notes, while they study the specimens in the laboratory and field. The record must carry notes of all specimens, mountings and dissections. Emphasis must be on scientific aspects. The record sheets related to part I and part II must be bound together to get a single Record.]

MODULE 3. [36 hrs]

Section A. Study of the following Chordate specimens:

(Students are expected to identify the specimens by their generic names and assign them to the respective phyla /classes/ orders)

1. **Urochordates** : *Ascidia*, ascidian tadpole, *Salpa, Doliolum* [any 2]
2. **Cephalochordates** :*Branchiostoma*
3. **Agnathans** : *Myxine, Petromyzon,* Ammocoetes larva [any 1]
4. **Fishes** :
   a. Common elasmobranchs - *Chiloscyllium, Stegostoma, Sphyrna, Pristis, Trygon, Narcine, Astrapes* [any 3]
   b. Common edible fishes (marine) - *Sardinella, Rastrelliger, Cynoglossus, Parastromateus, Trichiurus,Cybium, Thunnus* [any 3]
   c. Common edible fishes (Inland) - *Etroplus, Mugil, Wallagonia, Tilapia, Catla, Cirrhina, Labeo, Cyprinus [any 3]*

d. Fishes with special adaptive features - Hippocampus, Belone, Hemiramphus, Exocoetus, Tetraodon, Pterois, Ostracion, Heteropneustes, Clarias, Arius, Anabas, Channa, Echeneis, Antennarius, Amphisile, Anguilla. [any 5]

5. **Amphibians: Common amphibians** - *Duttaphrynus, Euphlyctis, Rhacophorus, Ambystoma, Axolotl larva, Ichthyophis/Uraeotyphlus [any 3]*

6.Reptiles :

a. Common lizard - *Hemidactylus, Calotes, Mabuya (Eutropis*) [any 1]

b. Lizards with special adaptations - *Draco, Chamaeleo, Phrynosoma* [any 2]

c. Non venomous snakes - *Ptyas, Gongylophis, Lycodon, Indotyphlops* [any 2]

d. Venomous snakes - *Naja, Daboia, Bungarus, Echis* [any 2]

e. Water snake – *Hydrophis / Enhydris / Xenochrophis*

f. Arboreal snake – *Dendrelaphis / Python / Ahaetulla*

6.**Reptiles :**

a. Common lizard - Hemidactylus, Calotes, Mabuya (Eutropis) [any 1]

b. Lizards with special adaptations - Draco, Chamaeleo, Phrynosoma [any 2]

c. Non venomous snakes - Ptyas, Gongylophis, Lycodon, Indotyphlops [any 2]

d. Venomous snakes - Naja, Daboia, Bungarus, Echis [any 2]

e. Water snake – Hydrophis / Enhydris / Xenochrophis

f. Arboreal snake – Dendrelaphis / Python / Ahaetulla

7. Key for identification of venomous and non-venomous snakes.

8**. Local Biodiversity Record**: Observe fishes/amphibians or any other vertebrate group (any one group) of the locality in their natural habitat and prepare a field note.

Section B. Histology

1. Branchiostoma - T. S. through pharyngeal region

Section C. Mountings

1. Sardine: Cycloid scale [Minor]
2. Shark: Placoid scale [Minor]
3. Shark/Frog/Calotes: Brain [Minor] - Demonstration only.

Section D. Dissections (Digital versions to be downloaded or procured as per UGC guidelines)

1. Mullet/ Sardine: Alimentary canal (Major)
2. Shark: IX and X cranial nerves on one side (Major) – Demonstration only.
3. Frog: V cranial nerve - branches, root and ganglion on one side (Major) Demonstration only
5. Frog/Calotes: Arterial system on one side (demonstration only).

Section E. Osteology

1. Frog: Typical, 8th, 9th Vertebrae,
2. Frog: Pectoral & Pelvic girdles
3. Snake Vertebra [show zygosphene and zygandrum]
4. Carapace and plastron of turtle/tortoise.

FOURTH SEMESTER B. Sc. ZOOLOGY PROGRAMME CORE COURSE

PRACTICAL- I*D **ANIMAL DIVERSITY: CHORDATA Part - II**

[36 hours] [2 hrs per week]

MODULE 4. [36 hrs]

Section A. Study of the following Vertebrate specimens:

1. Birds:

a. Fossil bird - *Archaeopteryx*
b. Flightless bird - *Rhea*, *Struthio* [any 1]
c. Wetland birds - Jacana, Duck, Egret, Heron, Ibis, Stork [any 2]
d. Shore birds – Gulls, Plovers, Terns [any 1]
e. Migratory birds - Pelican, Crane, Flamingo [any 1]
f. Birds of Prey – Falcon, Eagle, Kite, Shikra, Owl [any 2]
g. Features and adaptations of: duck, parrot, king fisher, owl, kite and wood pecker [draw sketches of the beaks and feet of 4 birds)

2. Mammals:

a. Common insectivore – *Suncus*, Hedgehog [any 1]
b. Common rodent – *Rattus*, *Bandicoota*, *Funambulus* [any 1]
c. Common bat of Kerala – *Pteropus*, *Megaderma*, *Pipistrellus* [any 1]
d. Small Carnivore – Jungle Cat, *Herpestes*, Civet [any 1]
e. Primate – *Loris* or any other species

3. Local Biodiversity Record: Observe birds/mammals (any one group) of thelocality in their natural habitat and prepare a field note.

Section B. Osteology

a. Pigeon/ Domestic Fowl: Cervical vertebra, Pectoral girdle and Sternum, Pelvic girdle with Synsacrum [mention the component bones].
b. Rabbit: Skull showing dentition, Atlas, axis, typical vertebra, scapula and pelvic girdle.

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Semester V

Course Code: SJZOL5B06T

Core Course VI: CELL BIOLOGY AND GENETICS

54 hours (Credit - 3)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Understand the principles and applications of various types of light microscopes, electron, Scanning-tunnelling and Atomic force microscope and illustrate the histological and histochemical processing of tissues.	PO1,PO2,PO3 PSO2	U	C,F	7
CO2	Explain the basic structure of a eukaryotic cell and the structure and functions of plasma membrane, mitochondria, lysosome, cytoskeletal elements and interphase nucleus.	PO1,PO2,PO3 PSO2	U	C	12
CO3	Illustrate the nucleosome organization of chromatin and higher order structures; structure of chromosomes and giant chromosomes.	PO1,PO2,PO3 PSO2	U	C	2
CO4	Enumerate eukaryotic cell cycle and cell division by amitosis, mitosis and meiosis.	PO1,PO2,PO3 PSO2	R	C	4
CO5	Explain the causes of transformation, characteristics of transformed cells and the role of protooncogenes and tumor suppressor genes in malignant transformation; mechanism and significance of apoptosis.	PO1,PO2,PO3 PSO2	U	C	2
CO6	Enumerate allelic and non-allelic gene interactions; supplementary, complementary, polymeric, duplicate and modifying	PO1,PO2,PO3 PSO2	R	C	5

	genes and polygenic inheritance.				
CO7	Illustrate multiple allelism and solve problems related to blood group inheritance.	PO1,PO2,PO3 PSO2	U	C,P	4
CO8	Explain characteristics of linkage groups and linkage map; crossing over and calculation of recombination frequency; sex-linked, sex-influenced and sex-limited characters; sex differentiation and disorders of sexual development.	PO1,PO2,PO3 PSO2	U	C	8
CO9	Describe the mechanisms of sex determination including chromosomal, genic, haploid-diploid mechanisms; the hormonal and environmental influence on sex determination and gynandromorphism.	PO1,PO2,PO3 PSO2	U	C	3
C010	Explain mutagenesis, mutagens and chromosomal and gene mutations.	PO1,PO2,PO3 PSO2	U	C	3
C011	Enumerate the classification and grouping of human chromosomes; numerical and mutational human autosomal and sex chromosomal anomalies; polygenic human traits and genetic counseling.	PO1,PO2,PO3 PSO2	R	C,F	4

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

Section A: CELL BIOLOGY (27 hrs)

MODULE 1. Techniques in Cell Biology (7 hrs)

Microscopy **(4 hrs)**

Light microscope: principles and uses; use of oil immersion objective. Types of light Microscopes: Bright-field, Phase contrast and Fluorescence microscope. Camera lucida: Principle and uses. Micrometry. Electron microscope: Principle, applications; advantages and disadvantages. Principles and applications of - Scanning Electron Microscope (SEM); Scanning-tunnelling microscope and Atomic force microscope.

Histological Techniques **(2 hrs)**

Preparation of materials for light microscopy (for temporary and permanent mounts): Fixation: common fixatives: buffered formalin, ethanol, Bouin's solution and Carnoy's fluid (mention composition). Processing of the fixed tissue: mention dehydration, infiltration, and embedding. Sectioning: Rotatory microtome (brief description), uses. Staining: Mention deparaffinization, hydration, staining, dehydration and mounting. Histological stains: Haematoxylin and Eosin. Vital stains: Neutral red and Janus green.

Histochemical Techniques **(1 hr)**

Mention the techniques for the demonstration of proteins (mercuric bromophenol blue method),carbohydrates (PAS) and lipids (Sudan)

[Short answers/Paragraphs]

MODULE 2. Structure of eukaryotic cell (12 hrs)

Plasma membrane **(6 hrs)**

Chemical composition and structure (unit membrane concept and fluid mosaic model), membrane lipids and membrane fluidity; significance of membrane fluidity; membrane proteins-integral proteins, peripheral proteins and lipid-anchored proteins; membrane carbohydrates.
Interactions between cells and their environment – extracellular space, glycocalyx, extracellular matrix - Mention basal lamina, collagen, fibronectin, proteoglycans and laminins.

Interaction of cells with other cells – cell adhesion molecules, selectins, immunoglobulins, integrins and cadherins. Modifications of the plasma membrane – microvilli, desmosomes, nexuses, tight junction and gap junction.

Functions: trans-membrane transport mechanisms – diffusion, osmosis, active transport, ion transport (channels), co-transport, bulk trans-membrane transport – exocytosis, endocytosis. Membrane receptors: Mention insulin receptor.

Mitochondria **(2 hrs)**

Ultra-structure; mitochondrial membranes; functions of mitochondria; Biogenesis of mitochondria.

Ribosomes & Lysosomes **(1 hr)**

Structure and types of ribosomes in prokaryotes, eukaryotes and mitochondria. Brief description of subunits and ribosome biogenesis.
Structure and function; polymorphism in lysosomes, lysosomal enzymes. Concept of GERL (Golgi body – Endoplasmic Reticulum – Lysosome complex).

Cytoskeleton **(1 hr)**

Location, ultrastructure, biochemical composition and functions of microfilaments, intermediate filaments and microtubules.

Interphase nucleus **(2 hrs)**

General structure and functions; nucleo-cytoplasmic index; ultrastructure of nuclear membrane and nuclear pore complex (NPC), functions of NPC; Nucleoplasm - Composition and function; Nucleolus - Structure, composition, nucleolar organizer, nucleolar cycle and functions of nucleolus. Chromatin: Euchromatin and heterochromatin.

[Short answers/Paragraphs/Essays]

MODULE 3. Structure of chromatin **(2 hrs)**

Nucleosome organization and higher order structures; Chromosome structure; Giant chromosomes - Polytene chromosomes: structure, puffs and bands; Endomitosis; significance. Lamp brush chromosomes: structure, loops and significance.

[Short answers/Paragraphs]

MODULE 4. Cell Cycle & Cell division **(4 hrs)**

Cell Cycle: G1, S, G2 and M phases – Check points; G_0 phase. Cell division:
Amitosis (brief account); Mitosis: description of all stages, cytokinesis and significance; Meiosis: description of all stages and significance. Role of centriole in animal cell division.

[Short answers/Paragraphs/Essays]

MODULE 5. Cancer and Apoptosis **(2 hrs)**

Characteristics of cancer cells; causes of transformation; protooncogenes and tumor suppressor genes and their role in transformation. Apoptosis, mechanism of apoptosis and its significance.

[Short answers/Paragraphs]

Section B: GENETICS (27 hrs)

MODULE 6. Interaction of genes (5 hrs)

Allelic interactions: incomplete dominance and co-dominance with examples. Non-allelic interactions: epistasis (inheritance of plumage colour in poultry), mention dominant and recessive epistasis. Supplementary genes (example: inheritance of comb pattern in poultry). Complementary genes, mention any one example. Polymeric genes, mention one example. Duplicate genes, mention one example. Modifying genes. Atavism, Penetrance and Expressivity. Polygenic (quantitative) inheritance (example: skin colour in man).

[Short answers/Paragraphs]

MODULE 7. Multiple alleles (4 hrs)

Definition and characteristics; example: coat colour in rabbits. Blood group genetics: ABO blood group system; MN blood group and Bombay phenotype. Inheritance of Rh factor; mention erythroblastosis foetalis. Problems related to blood group inheritance (5 problems). Isoalleles, mention any one example.

[Short answers/Paragraphs/Essays]

MODULE 8. Linkage and Recombination (8 hrs)

Definition and characteristics of linkage groups, Morgan's work on *Drosophila.*
Types of linkage: complete and incomplete - examples*;* Linkage groups.

Crossing over and recombination, Calculation of Recombination Frequency and Percentage; Linkage map, Map Distance; Mitotic Recombination (brief).

Sex-Linked Characteristics: Types of sex-linkage - X linked characters - Colour blindness and haemophilia in humans, holandric genes – hypertrichosis.

Dosage compensation – Barr body – Lyon hypothesis.

Sex-Influenced and Sex-Limited Characteristics.
Sex Differentiation: Testis-determining factor (TDF), Müllerian inhibition factor. Disorders of Sexual Development (short notes) - XX males and XY females, Point mutations in the *SRY* gene and testicular feminization.

[Short answers/Paragraphs/Essays]

MODULE 9. Sex determination (3 hrs)

Chromosomal mechanism of Sex-Determination: Male heterogametic and female heterogametic mechanism of sex determination. Genic Sex Determining Systems - Genic balance (ratio) theory of Bridges. Haploid-diploid mechanism of sex determination, honey bee as example.

Environmental Sex Determination: Example – *Bonellia,* Crocodile.

Hormonal influence on sex determination: Example - sex reversal in fowl and free martin in cattle; Gynandromorphism – types and causes. Intersex (brief).

[Short answers/Paragraphs/Essays]

MODULE 10. Mutations (3 hrs)

Chromosome mutations: numerical (euploidy and aneupoloidy) and structural changes (deletion, duplication, insertion, inversion, translocation).
Gene mutations: types- spontaneous, induced, somatic, gametic, forward and reverse. Types of point mutations- deletion, insertion, substitution, transversion and transition. Mutagenesis- Natural and artificial mutagenesis, Mutagenic agents:
a) UV radiation and ionising radiation b) Base analogues, alkylating and intercalating agents.

[Short answers/Paragraphs/Essays]

MODULE 11. Human Genetics and Genetic counselling (4 hrs)

Classification and grouping of human chromosomes (Patau's scheme). Chromosomal anomalies and disorders: Autosomal - (Down's, Patau's, Edward's and Cri du Chat syndromes). Sex chromosomal - (Turner's and Klinefelter's syndromes). Gene mutations: Autosomal mutation - albinism, PKU, alkaptonuria, galactosemia, Tay-Sach's syndrome, Gaucher's disease, Sickle cell anaemia, thalassemia and brachydactyly. Sex chromosomal mutations: haemophilia, Lesch– Nyhan syndrome, dermal hypoplasia. Polygenic traits: cleft palate / lip, club foot and hydrocephaly. Eugenics, Euthenics and Euphenics.

[Short answers/Paragraphs]

Topics for assignments/ seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Ribosomes: structure and functions
2. Golgi bodies: structure and functions
3. Cytoplasmic or extra nuclear inheritance:
   a) Shell coiling in *Limnaea*
   b) Endo-symbionts like kappa particle and sigma**.**
4. Mendel's experiments on pea plants
5. Mendel's laws of inheritance

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- Peter Snustad & Michael J. Simons (2011): *Principles of Genetics*;6th Edition, ISBN 1118129210, JW & S, 784 pages
- Read Andrew and Dian Donnai (2015): *New Clinical Genetics*, 3rd Edition, ISBN-10: 0073525308, McGraw Hill, 480 pages
- Ricki, L.(2011): *Human Genetics: Concepts and Applications*. 10th Edition, WCB MGH

- Robert H. Tamarin (1998): *Principles of Genetics*, 6th Edition, ISBN-10: 0697354628 William C Brown Pub, 680 pages
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Semester V

Course Code: SJZOL5B07T

Core Course VII: BIOTECHNOLOGY, MICROBIOLOGY AND IMMUNOLOGY

72 hours (Credit - 4)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Illustrate the steps in genetic engineering and animal cell culture.	PO1,PO2,PO3 PSO3	U	C	12
CO2	Explain transfection methods, transgenic animals and ethical issues of transgenic animals.	PO1,PO2,PO3,PO4, PSO3	U	C, P	5
CO3	Enumerate the applications of biotechnology.	PO1,PO2,PO3,PO8, PSO3	R	C, F	7
CO4	Understand the biological diversity of microbial forms and the various techniques for handling microbes in the laboratory.	PO1,PO2,PO3 PSO3	U	C, F	8
CO5	Enumerate the basic structure and life cycle of bacteria and virus.	PO1,PO2,PO3 PSO3	R	C	8
CO6	Understand the industrial and medical importance of microorganisms.	PO1,PO2,PO3 PSO3	U	F	8
CO7	Describe different types of immunity and the cells and organs of the immune system.	PO1,PO2,PO3 PSO3	U	C, F	6
CO8	Explain antigen, antibody, immunity and major histocompatibility complex.	PO1,PO2,PO3 PSO3	U	C	9
CO9	Enumerate autoimmune and immunodeficiency diseases and immunology of tumor and organ transplantation.	PO1,PO2,PO3 PSO3	R	C, F	9

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

Section A: BIOTECHNOLOGY (24 hrs)

MODULE 1: Genetic Engineering and Animal cell culture (12 Hrs)

Genetic Engineering **(10 hrs)**

Concept and scope of biotechnology – Mention branches of biotechnology. Introduction to the concept of Recombinant DNA Technology: Cloning vectors (Plasmid, pBR322, Phages, Cosmids, Virus vectors, YAC vector and Bac vector).

Enzymes: Type II Restriction endonucleases, polynucleotide kinase, exonuclease, terminal transferase, reverse transcriptase and DNA ligase.

Construction of Recombinant DNA: Preparation of vector and donor DNA, Joining of vector DNA with the donor DNA, Introduction of recombinant DNA into the host cell and selection of transformants (brief account).

Animal Cell Culture

(2 hrs)

Cell culture media (Natural and Defined), Preparation and Sterilization, Primary cell culture, Cell Lines, Pluripotent Stem Cells, Cryopreservation of cultures. Somatic cell fusion and HAT selection of hybrid clones – production of monoclonal antibodies.

[Short answers/Paragraphs/Essays]

MODULE 2: Transgenic Organisms (5 hrs)

Transfection Methods: (Chemical treatment, Electroporation, Lipofection, Microinjection, Retroviral vector method, Embryonic stem cell method and Shot Gun Method). Transgenic Animals: (Fish, Pig, Sheep, Rabbit, Mice, Goat and Insects), Knock Out Mice. Human Cloning and Ethical Issues of transgenic animals.

[Short answers/Paragraphs/Essays]

MODULE 3: Applications of Biotechnology (7hrs)

Molecular diagnosis of genetic diseases (Cystic Fibrosis, Huntington's Disease and Sickle Cell Anemia). Vaccines and Therapeutic agents, Recombinant DNA in Medicines (Recombinant Insulin and Human Growth Hormone).

Human gene therapy (gene therapy for severe combined immune deficiency).
Nanobiotechnology (Brief)

Enzymes in detergents and leather industries, Heterologous protein production, Biofiltration, Bioremediation & Types of Bioremediation (Brief account), Bioleaching, Molecular pharming and Bioreactors.

Molecular markers (brief account) RFLP, RAPD, VNTR, SNPs and their uses.

[Short answers/Paragraphs/Essays]

Section B: MICROBIOLOGY (24 hrs)

MODULE 4: Introduction and Methods in Microbiology (8 hrs)

Introduction **(1 hr)**

Microbial Diversity: Archaebacteria, Eubacteria, Prochlorophyta, Algae, Fungi, Protozoa, Viruses, Viroids, Prions, Mycoplasma and Rickettsias

Methods in Microbiology **(7 hrs)**

Sterilization: Physical and Chemical methods - Dry and Moist Heat, Pasteurization, Radiation, Ultrasonication. Disinfection, Sanitization, Antiseptics, Sterilants and Fumigation. Preparation of culture media: Selective, Enrichment and Differential media. Plating techniques and Isolation of pure colonies. Staining: Simple staining, Negative staining and Gram staining. Culture preservation techniques: Refrigeration, Deep freezing, Freezing under liquid Nitrogen and Lyophilisation.

[Short answers/Paragraphs]

MODULE 5: Basic Concepts in Bacteriology and Virology (8 hrs)

Bacteria: Structure of a typical Bacterium, Different types of bacterial culture (Batch, Synchronous, Arithmetic), Bacterial growth: Growth phases, Methods of growth determination.

Basic Concepts of Virology: General characteristics and classification of viruses. Bacteriophages: Diversity, lytic and lysogenic Phages (Lambda and P1 Phage), Applications of bacteriophages. Oncogenic Viruses. Prevention and control of Viral diseases: Antiviral compounds, Interferons and viral vaccines.

[Short answers/Paragraphs/Essays]

MODULE 6: Industrial and Medical Microbiology (8 hrs)

Industrial Microbiology

(4 hrs)

Bioengineering of microorganisms for industrial purposes: Microbial production of industrial products (micro-organisms involved, media, fermentation conditions, downstream processing and uses) - citric acid, ethanol, wine, penicillin, glutamic acid, riboflavin, enzymes (amylase, cellulase, protease, lipase, glucose isomerase, glucose oxidase). Bioinsecticides (Bt) and Steroid biotransformation.

Medical Microbiology (4 hrs)

Normal microflora of the human body: skin, throat, gastrointestinal tract and urogenital tract. Diseases caused by: (with reference to causative agent, symptoms and mode of transmission).

a) Bacteria: anthrax, tuberculosis, typhoid, whooping cough, pneumonia, cholera, gonorrhea, and syphilis.

b) Viruses: polio, chicken pox, herpes, hepatitis, rabies, dengue, AIDS and chikungunya.Emerging viral diseases in India (brief)

c) Protozoa: malaria, kala-azar and toxoplasmosis.

d) Fungi: dermatomycoses and opportunistic mycoses

Bacterial drug resistance.

[Short answers/Paragraphs/Essays]

Section C: IMMUNOLOGY (24 hrs)

MODULE 7: Cells and organs of immune system (6 hrs)

Introduction **(1 hr)**

Immunity: Natural and acquired, active and passive, immunization, vaccines, mechanisms of innate immunity - barriers, inflammation, phagocytosis.

Cells of the immune system **(3 hrs)**

B- cells, T – cells, NK cells, monocytes, macrophages, neutrophils, basophils, eosinophils, mast cells, and dendritic cells (APCs).

Organs of the immune system **(2 hrs)**

Lymphoid organs: Primary (thymus, bone marrow) and secondary (lymph nodes, spleen).

[Short answers/Paragraphs]

MODULE 8: Antigens, antibodies, immunity and MHC (9 hrs)

Antigens **(3 hrs)**

Types, factors for immunogenecity, exogenous antigens, endogenous antigens, adjuvant, haptens, epitopes, antigen-antibody reaction - precipitation reaction, agglutination reaction, agglutination inhibition reaction.

Immunoglobulins **(2 hrs)**

Structure, classification and biological functions. Mention immunoglobulin gene families – κ and λ light chain families and the heavy chain family.

Immunity **(2 hrs)**

Types of Immunity: humoral and cell mediated immunity, primary and secondary response, generation of cytotoxic T- cells (CTLs), NK cell mediated cytotoxicity, ADCC and cytokines (brief).

Major Histocompatability Complex **(2 hr)**

MHC, HLA, Class I MHC, Class II MHC molecules and structure. Mention Class III MHC.

[Short answers/Paragraphs/Essays]

MODULE 9: Autoimmune and Immunodeficiency diseases, Tumor and transplantation immunology (9 hrs)

Autoimmune diseases **(2 hrs)**

Auto immune diseases: Systemic (SLE, multiple sclerosis and rheumatoid arthritis). Organ specific-(Hashimoto's thyroiditis, Grave's disease, Myasthenia gravis)

Immunodeficiency disease **(3 hrs)**

Primary (Bruton's Disease, Di-George syndrome and SCID)

Secondary (AIDS) – Clinical course of HIV – acute infection, seroconversion, window period, chronic latent phase - lymph adenopathy and crisis phase. Mention anti-retroviral therapy (ART)

Tumor immunology **(2 hrs)**

Malignant transformation of cells, tumor antigens, immune response to tumor antigens.

Transplantation Immunology **(2 hrs)**

Transplantation Antigens, Various organ transplantation (liver, kidney, heart, skin), Xenotransplantation

[Short answers/Paragraphs/Essays]

Topics for assignments/seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Microbiological analysis of drinking water
2. Biogas plant
3. Social acceptance of biotechnology
4. Biofertilizers
5. DNA vaccines
6. Immunity and malnutrition

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Module 7-9 (Immunology)

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Semester V

Course Code: SJZOL5B08T

Core Course VIII: BIOCHEMISTRY AND MOLECULAR BIOLOGY

72 hours (Credit - 4)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Understand the elements of biological importance and the non-covalent interactions that stabilize biomolecules	PO1, PSO2	U	F	1
CO2	Describe the classification, types, structure, reactions and biological roles of carbohydrates, and diabetes Type I and II	PO1, PSO2	R	C	6
CO3	Enumerate the properties and classification of amino acids and their standard abbreviations; hierarchial levels of protein structure, classification, separation,purification and sequencing of proteins	PO2, PS02	R	F	7
CO4	Explain the classification and functions of lipids and fatty acids; chemistry and structure of nucleic acids and sequencing of DNA	PO2, PSO2	U	C	7
CO5	Understand the classification, nomenclature and properties of enzymes; enzyme action, co-enzymes, cofactors, isozymes, ribozymes and allosteric enzymes	PO1, PSO2	U	F	3
CO6	Explain glycolysis, Kreb's cycle, glycogenesis, glycogenolysis, gluconeogenesis, HMP pathway; amino acid and fatty acid oxidation and oxidative phosphorylation	PO1, PSO2	U	C	12
CO7	Describe the mechanism of DNA duplication and the role of enzymes	PO1, PSO2	R	C	4
CO8	Understand the concept of gene and gene expression; genetic code and wobble hypothesis	PO2, PSO2	U	C	6
CO9	Explain the mechanism of transcription and post-transcriptional modification of hnRNA	PO1, PSO2	U	C	7

CO10	Enumerate the processes of translation and post-translational modification and targeting of peptides	PO1, PSO2	U	C	7
CO11	Describe the regulation of trp operon, C-value, repetitive DNA, satellite DNA, selfish DNA, overlapping genes, pseudogenes, cryptic genes, transposons and retrotransposons	PO1, PSO2	R	F	8
CO12	Explain the structure and life cycle of bacteriophages and the gene transfer mechanisms in bacteria	PO1, PSO2	U	C	4

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

BIOCHEMISTRY (36 hrs)

MODULE 1. Introduction (1 hr)

Elements of biological importance; non-covalent bonds that stabilize biomolecules – Hydrogen bonds, hydrophobic interactions and Van der Waals Interactions.

[Short answer questions]

MODULE 2. Carbohydrates (6 hrs)

Monosaccharides: Aldoses and ketoses, trioses, tetroses, pentoses and hexoses; glyceraldehyde, dihydroxyacetone, ribose, deoxyribose, ribulose, glucose and fructose. Cyclization of pentoses and hexoses, optical activity and mutarotation, inversion and invert sugar, monosaccharides as reducing agents, Osazones.

Disaccharides: Glycosidic bond, reducing and non-reducing disaccharides, maltose and sucrose as examples.

Polysaccharides: Starch and glycogen, amylose and amylopectin, homo and heteropolysaccharides.

Biological functions of carbohydrates; Mention diabetes Type I and II.

[Short answers/Paragraphs]

MODULE 3. Amino acids, peptides and protein (7 hrs)

Proteinogenic amino acids, abbreviations (three letter and single letter) of the standard amino acids, structure and classification and general properties of amino acids, isoelectric point, peptide bonds, nonstandard amino acids.

Peptides and proteins: Classification of proteins - simple, conjugated and derived.

Structure of proteins: primary, secondary, tertiary and quaternary structure. Denaturation of proteins.

Separation and purification of proteins: Paper chromatography, column chromatography, ion exchange chromatography, size exclusion chromatography, affinity chromatography and high - performance liquid chromatography (Brief account only). Polyacrylamide Gel Electrophoresis.

Sequencing of peptides: Sanger's method, Edman degradation procedure and Mass spectrometry (Brief account only)

[Short answers/Paragraphs/Essays]

MODULE 4. Lipids and Nucleic acids (7 hrs)

Lipids **(2 hrs)**

Classification and functions (simple, compound, derived and miscellaneous lipids).

Fatty acids: saturated and unsaturated; triglycerides; mention phospholipids; lecithins; cephalins; phosphoinositides; prostaglandins and cholesterol. Mention the clinical significance of lipid profile estimation.

Nucleic acids **(5 hrs)**

Chemistry and structure of purines and pyrimidines, structure of nucleotides (ATP, dATP and cAMP), Watson – Crick model of DNA, Different forms of DNA, secondary and tertiary structure of tRNA. Sequencing of DNA by Sanger's method. Mention Maxam-Gilbert sequencing.

[Short answers/Paragraphs/Essays]

MODULE 5. Enzymes and co-enzymes (3 hrs)

Classification, nomenclature and properties of enzymes; Active centre, mechanism and theories of enzyme action, enzyme inhibition, co-enzymes (NAD, FAD) and cofactors. Mention isozymes, ribozymes and allosteric enzymes.

[Short answers/Paragraphs/Essays]

MODULE 6. Metabolism of carbohydrates, proteins and lipids (12 hrs)

Glycolysis, Kreb's cycle, glycogenesis, glycogenolysis, gluconeogenesis and HMP pathway. Amino acid oxidation and production of urea. β-oxidation of fatty acids.

Brief account on redox reactions, redox potentials, electrochemical gradients, electron transport chain, oxidative phosphorylation, proton gradient and chemiosmotic synthesis of ATP.

[Short answers/Paragraphs/Essays]

MOLECULAR BIOLOGY (36 hrs)

MODULE 7. DNA Replication (4 hrs)

Semi-conservative and semi-discontinuous, priming of Okazaki fragments, primer removal and joining of Okazaki fragments, Meselson and Stahl experiment.

[Short answers/Paragraphs/Essays]

MODULE 8. Gene and genetic code (6 hrs)

Gene concept **(2 hrs)**

Classical and modern concepts, housekeeping and luxury genes. Gene action: gene expression and gene products; one gene one enzyme hypothesis; one gene one polypeptide hypothesis. Central dogma of molecular biology, reverse transcription and modified central dogma.

Genetic code **(4 hrs)**

Deciphering of genetic code, experiments of Nirenberg and Khorana, codon assignments, properties of the genetic code and wobble hypothesis.

[Short answers/Paragraphs/Essays]

MODULE 9. Transcription (7 hrs)

RNA polymerases of eukaryotes and prokaryotes; promoters, terminators, enhancers and silencers.

Transcription unit, mono and polycistronic transcription units; coupling of transcription with translation in bacteria.

Initiation, elongation and termination of transcription (brief account).

Post transcriptional modification of the primary transcript – hnRNA, capping, poly (A) tailing and splicing (brief account), spliceosomes.

[Short answers/Paragraphs/Essays]

MODULE 10. Translation (7 hrs)

Activation of amino acids and aminoacyl tRNA synthetases; role of tRNA as adaptor molecules in translation. Role of ribosomes and active centres of ribosomes. Initiation, elongation and termination of translation.

Post translational modification of the peptide chain: cleavage, formation of disulfide-bridges, acetylation, glycosylation, myristoylation, sulphation, hydroxylation, prenylation, nitrosylation, ubiquitination and SUMOylation.

Protein folding and role of molecular chaperones; Protein targeting (brief account)

[Short answers/Paragraphs/Essays]

MODULE 11. Regulation of gene expression and organization of genome(8 hrs)

Regulation of gene expression **(4 hrs)**

Operon organization of bacterial transcription units; *trp* operon and its regulation.
Regulatory RNAs – ncRNAs, miRNAs, piRNAs, siRNAs and RNA interference.
Mention CRISPR–Cas9 and targeted genome editing.

Organization of genome **(4 hrs)**

Sequence components of eukaryotic genome – non-repetitive, moderately repetitive and highly repetitive DNA; satellite DNA. Mention selfish DNA. C-value and C-value paradox. Overlapping

genes, pseudogenes, cryptic genes, transposons andretrotransposons. Human genome and human genome project (brief account).

Mitochondrial and chloroplast genome (brief account).

[Short answers/Paragraphs/Essays]

MODULE 12. Genetics of bacteria and phages (4 hrs)

Conjugation in bacteria. Transduction – generalized and specialized; sexduction.

Structure and life cycle of a bacteriophage; temperate and virulent phages; lysogeny and lysis.

[Short answers/Paragraphs]

Topics for assignments/seminar

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. B-Complex vitamins as co-enzymes
2. Different types of eukaryotic RNAs
3. Biological functions of steroids
4. Lac operon and its regulation
5. Role of enzymes in DNA replication

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Semester V

Course Code: SJZOL5B09T

Core Course IX: METHODOLOGY IN SCIENCE, BIOSTATISTICS AND BIOINFORMATICS

54 hours (Credit - 4)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Session (appr.)
CO1	Explain science, its importance, disciplines and the major steps in formulating a hypothesis, various hypothesis models, theory, law and importance of animal models, simulations and virtual testing.	PO1,PO2, PO3 PSO2	U	C	6
CO2	Illustrate the principles and procedures in designing experiments and elaborate the requirements for carrying out experiments.	PO1,PO2, PO3 PSO2	U	C, P	4
CO3	Describe the ethical concerns in practicing science.	PO1,PO2, PO3,PO4 PSO2	U	C, F	5
CO4	Understand the Scope and role of statistics; methods and procedures of sampling; Construction of tables, charts and graphs.	PO1,PO2, PO3,PO6, PSO2	U	C, P	5
CO5	Calculate central tendency and measures of dispersion and application of its knowledge on hypothesis testing as well as in problem solving.	PO1,PO2, PO3,PO6, PSO2	U, Ap	P	10
CO6	Enumerate major biological databases and database search engines.	PO1,PO2, PO3 PSO2	U, Ap	C	8
CO7	Perform DNA and protein sequence analysis, including sequence alignment and sequence similarity search using BLAST, FASTA, CLUSTAL W and CLUSTAL X.	PO1,PO2, PO3,PO6, PSO2	U, Ap	C, P	4
CO8	Understand molecular phylogenetics and tools and methods for construction of	PO1,PO2, PO3,PO6, PSO2	U, Ap	C, P	3
CO9	Explain genome sequencing technologies, functional genomics, proteomic technologies and molecular docking and drug design.	PO1,PO2, PO3 PSO2	U	C	9

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

Section A: METHODOLOGY IN SCIENCE (15 hrs)

MODULE 1. Science, Scientific Studies and Methods (6 hrs)

Science and Scientific Studies

Science as a human activity; scientific attitude; Empiricism; Science disciplines; Interdisciplinary approach.

Scientific Methods

Major steps: Observation, Defining the problem, Collection of information, Formulation of a hypothesis, Experimentation, Analysis of the results and Conclusion based on interpretation of the results.

Methods in scientific enquiry: Inductive and deductive reasoning.

Hypothesis: Formulation of a hypothesis, different thought processes in developinghypothesis (analogy, induction, deduction and intuition), hypothetico-deductive model, testing hypothesis, auxiliary hypothesis, adhoc hypothesis.

Theories and laws in science; peer review; importance of models, simulations and virtual testing (brief account).

[Short answers/Paragraphs/Essays]

MODULE 2. Experimentation (4 hrs)

Types of experiments; design of an experiment: principles and procedures; necessity of units and dimensions; repeatability and replications; documentation of experiments; Planning of Experiments: design, selection of controls, observational and instrumental requirements; Test animals used in experiments.

[Short answers/Paragraphs/Essays]

MODULE 3. Ethics in Science and Animal Ethics (5 hrs)

Scientific information: Depositories of scientific information – primary, secondary and digital sources; Sharing of knowledge: transparency and honesty, Publications, Patents, Plagiarism.

Constitution of India Article 51A (g); Prevention of cruelty to animals Act of 1960 - Section 17.1(d), Committee for the purpose of control and supervision of experiments on animals (CPCSEA).

[Short answers/Paragraphs]

Section B: BIOSTATISTICS (15 Hrs)

MODULE 4. Introduction (5 hrs)

Definition; scope; role of statistics in life sciences; terminology and variables.

Sample and Sampling: Sample size, sampling errors, methods of sampling.

Collection/documentation of data of the experiments.

Classification of data; Presentation of data: Tabular, Graphical and Diagrammatic (histogram, frequency polygon and frequency curve; line diagram, bar diagram and pie diagram).

[Short answers/Paragraphs/Essays]

MODULE 5. Analysis and Interpretation of data (10 hrs)

Measures of central tendency: *(raw data, discrete series data, continuous seriesdata-problems are to be discussed)*

a) Mean, b) Median and c) Mode.

Measures of Dispersion: *(raw data, discrete series data, continuous series data -problems to be discussed)*

a) Range, b) Mean deviation, c) Standard deviation, d) Standard error. Hypothesis testing and Interpretation of results: *(problems to be discussed)* a)'t' test, b) F- test - ANOVA

Significance of statistical tools in data interpretation; Statistics-based acceptance or rejection of hypothesis. Statistical softwares for biological studies.

[Short answers/Paragraphs/Essays]

SECTION C: BIOINFORMATICS (24 hours)

MODULE 6. Introduction and Biological Databases (8 hrs) Overview of bioinformatics, Scope and application of Bioinformatics.

Major Databases in Bioinformatics: Biological databases, Features of a good database. Classification format of biological databases.
Primary databases: Nucleotide sequence databases–Mention EMBL, DDBJ,Genbank; Protein sequence databases – Mention Swiss Prot, PIR, MIPS.

Structure databases: PDB, NDB.

Special databases –PROSITE, Pfam, CATH, OWL, PubMed.

Secondary databases: Mention PROSITE, PRINTS. Databases of patterns, motifsand profiles, EST databases, SNP databases.

Metabolite databases –Mention KEGG, EcoCyc.

Database Search Engines:Entrez at NCBI of USA, SRS at EBI of England, STAG atDDBJ of Japan. Data retrieval with Entrez and SRS.

Sequence submission to NCBI.

[Short answers/Paragraphs/Essays]

MODULE 7. Sequence Analysis (4 hrs)

Web based and standalone tools for DNA and protein sequence analysis. Types of sequence alignment, methods of sequence alignment. Sequence similarity search – pair wise and multiple sequence alignments; BLAST, FASTA, CLUSTAL W, CLUSTAL X.

[Short answers/Paragraphs]

MODULE 8. Molecular Phylogenetics (3 hrs)

Basics of Phylogenetics; molecular evolution and molecular phylogenetics, cladistics and ontology. Gene Phylogeny versus species phylogeny. Phylogenetic tree construction methods and programmes. Forms of Tree representation.

[Short answer/Paragraphs]

MODULE 9. Genomics and Proteomics (9 hrs)

Genome sequencing technologies; Sanger capillary sequencing, Roche 454 (pyrosequencing), Illumina/Solexa, SOLiD System, Single molecule sequencing. Whole genome sequence assembly, annotation and analysis. Functional Genomics: Microarrays, SAGE, ESTs; Transcriptomics; Metabolomics. Metagenomics: Concept and applications.

Proteomics

Aims, strategies and challenges in proteomics. Brief account on proteomics technologies: 2D-electrophoresis, iso-electric focusing, LC/MS-MS, MALDI-TOF mass spectrometry, yeast 2-hybrid system. Protein-protein interactions: experimental and computational methods; structural proteomics. Deriving function from sequence databases.

Cheminformatics

Molecular docking and drug design; Structural Bioinformatics in drug discovery

[Short answers/Paragraphs/Essays]

Topics for seminar/assignment

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Findings that changed the course of science.
2. Prepare a table showing the height of 20 students in a class. Calculate the mean height.
3. What are the mathematical properties of SD? How is it a better measure of Dispersion than range? Calculate the arithmetic mean and the SD of the frequency distribution obtained from a sample of data.
4. Report an experimental data in tabular / graphical form.
5. Viral genome database (ICTVdb, VirGen).
6. Bacterial Genomes database (Genomes OnLine Database –GOLD, Microbial Genome Database-MBGD).

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Module 4-5 (Biostatistics)

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Module 6-9 (Bioinformatics)

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Semester V

Course Code: SJZOL5D01T

Open Course - I: REPRODUCTIVE HEALTH AND SEX EDUCATION

54 hours (Credit - 3)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Understand the reproductive health, and importance of sex education for teen and youth.	PO1,PO2,PO3 ,PO5,PO8, PSO3	U	F, C	2
CO2	Explain the chromosomal mechanism of sex determination and sex chromosomal anomalies	PO1,PO2,PO3 PSO3	U	C	3
CO3	Describe the structural and functional features of human reproductive system, fertilization, implantation, pregnancy, gestation, placenta, parturition and lactation.	PO1,PO2,PO3 ,PO8, PSO3	U	F, C	17
CO4	Explain the scope of reproductive technologies in infertility management and the assisted reproductive techniques.	PO1,PO2,PO3 ,PO7,PO8 PSO3	U	C	10
CO5	Understand the different methods of prenatal diagnosis and associated ethical issues.	PO1,PO2,PO3 ,PO4,PO8 PSO3	U	F	4
CO6	Describe the different methods of fertility control.	PO1,PO2,PO3 ,PO7,PO8, PSO3	U, R	C, F	4
CO7	Understand the symptoms, mode of transmission, diagnosis and treatment of different sexually transmitted diseases and their socio-economic dimensions	PO1,PO2,PO3 PSO3	U	C	7
CO8	Describe sexual orientation, sexual abuse and myths.	PO1,PO2,PO3 PSO3	U, R	F	5
CO9	Understand the ethical aspects of sex	PO1,PO2, PO4, PSO3	U	C	2

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

MODULE 1. Introduction (2 hrs)

Definition; Reproductive health - problems and strategies; reproductive rights; importance of sex education for teen and youth.

[Short answers/Paragraphs]

MODULE 2. Sex determination and Chromosomal anomalies (3 hrs)

Chromosomal mechanism of sex determination; Barr body; twin studies; sex reversal; Sex chromosomal anomalies: Turner's syndrome and Klinefilter's syndrome.

[Short answers/Paragraphs]

MODULE 3. Human Reproduction (17 hrs)

Male reproductive system: Structure of testis, male accessory organs; Semen production and composition; ejaculation. Spermatogenesis.

Female reproductive system: Structure of human ovary; development of primary follicle; structure of graafian follicle; fallopian tubes; uterus; external genitalia; mammary glands. Ogenesis.

Menstrual cycle and hormonal control; brief account of fertilization, implantation, pregnancy, gestation, placenta, parturition and lactation (Brief account on hormonal control of lactation).

[Short answers/Paragraphs/Essays]

MODULE 4. Infertility and Assisted reproductive technologies (10 hrs)

Infertility: Causes and problems in male and female. Infertility management: semen collection, preservation and storage, artificial insemination, surrogacy. Cryopreservation and embryo transfer: Collection, care and preservation of embryos. *In vitro* fertilization (IVF) and embryo transfer: Major steps; Test tube babies. Assisted Reproductive Techniques (ART): GIFT, ZIFT, ICSI, oocyte donation and embryo donation.

[Short answers/Paragraphs/Essays]

MODULE 5. Prenatal Diagnosis (4 hrs)

Different methods: Ultrasonography, amniocentesis, chorionic villus sampling and alpha-foetoprotein estimation; female foeticide: ethical issues and laws (Mention– PNDT Act).

[Short answers/Paragraphs]

MODULE 6. Fertility Control (4 hrs)

Natural methods; artificial methods; chemical methods; hormonal methods; contraceptive devices; surgical contraception; abortion, legal termination of pregnancy.

[Short answers/Paragraphs/Essays]

MODULE 7. Sexually transmitted infectious diseases (7 hrs)

Symptoms, mode of transmission, diagnosis, treatment and prophylaxis of AIDS, syphilis, gonorrhea, herpes (genital), human papilloma virus and genital warts, hepatitis, gonococcal vulvo vaginitis, Trichomonal vaginitis. Mention the term venereal disease. Socio economic dimensions of STD.

[Short answers/Paragraphs]

MODULE 8. Sexual orientation, sexual abuse and myths (5 hrs)

Homosexuality and bisexuality (mention LGBT), oral sex, animal sex, cyber sex, sexual abuse, premarital and extramarital sex, sexual perversions, paraphilia, child abuse, prostitution, sexual hygiene, protection of children from sexual offences (POCSO) Act, 2012 (brief account only), sexual myths.

[Short answers/Paragraphs]

MODULE 9. Ethical aspects of sex (2 hrs)

Healthy relationship with opposite sex, role of counseling, gender discrimination in family and society.

[Short answers/Paragraphs]

Topics for Assignments/Seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Sexual counseling
2. Marriage counseling
3. Population explosion and birth control
4. Functions of male and female hormones
5. Hormones of pregnancy

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Semester V

Course Code: SJZOL5D02T

Open Course - II: NUTRITION, HEALTH AND HYGIENE

54 hours (Credit - 3)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Describe the basic concepts in nutrition	PO1, PO2, PO4, PSO3	U	C	3 hrs
CO2	Demonstrate the understanding of nutrients and energetics	PO1, PO2, PO3, PO5, PSO3	A	P	19 hrs
CO3	Enumerate the vitamins and minerals and their roles in human nutrition	PO1, PO2, PO5, PSO3	R, U	F	5 hrs
CO4	Explain balanced diet, RDA and factors that affect it and meal planning for various categories of people	PO1, PO2, PO5, PO8, PSO3	U	F	4 hrs
CO5	Illustrate diet therapy and dietary management of various conditions	PO1, PO2, PO5, PO8, PSO3	A	P	3 hrs
CO6	Explain health, fitness and hygiene	PO1, PO2, PO5, PO8, PSO3	U	C	5 hrs
CO7	Describe the major communicable, non-communicable, congenital and sexually transmitted human diseases	PO1, PO2, PO4, PO5, PO8, PSO3	U	F	11 hrs
CO8	Perform first aid management in emergency situations	PO1, PO2, PO4, PO5, PO8, PSO3	A	P	4 hrs

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

Section A: NUTRITION (34 hours)

MODULE 1. Key concepts in Nutrition (3 hrs)

Basic Nutrition Concepts: Nutrition, Food energy - Kilocalories, Nutrients, Nutrient Density. Nutritional needs of body, classification of foods.

Factors Influencing Food Selection: Flavor, Demographics, Culture and Religion, Social and Emotional Influences, Health, Environmental Concerns, Food industry and media (short notes only).

Nutrients and non-nutrients: Six classes of nutrients: Carbohydrates, Fats, Protein, Vitamins, Minerals, Water; functions of these nutrients. Mention essential nutrients.

[Short answers/Paragraphs]

MODULE 2. Nutrition and Energetics (19 hrs)

Digestion, Absorption and Metabolism (14 hrs)

Classification, Sources and nutritional significance of carbohydrates, proteins and fats. Gastrointestinal tract, digestion and absorption of carbohydrates, proteins and fats. Mention dietary fibers, essential and non essential amino acids, saturated, unsaturated and essential fatty acids. Deficiency of Protein — Protein energy malnutrition (PEM), Kwashiorkor, Marasmus.

[Short answers/Paragraphs/Essays]

Energy Metabolism (5 hrs)

Energy value of macronutrients, factors affecting the caloric value of foods, PFV (Physiological Fuel Value) of foods, low calorie modifications, Bomb calorimeter, Basal metabolic rate (BMR), factors affecting BMR; Thermic effect of food and thermogenesis. Energy balance and Body mass index (BMI).

[Short answers/Paragraphs/Essays]

MODULE 3: Vitamins and Minerals (5 hrs)

Vitamins (4 hrs)

Fat soluble — A, D, E, K.; Water soluble vitamins — B Complex — Thiamine, Riboflavin, Niacin, Pantothenic Acid, Folic Acid, Vitamin B 12, Biotin and Pyridoxine, Vitamin C. Sources and effects of deficiency.

Macro and Micro Minerals (1 hr)

Physiological functions, sources and deficiency: Calcium, Phosphorous, Iron and Iodine.

[Short answers/Paragraphs/Essays]

MODULE 4. Meal Planning (4 hrs)

Characteristics of a nutritious Diet: Adequate, Balanced, Moderate and Varied diet. Nutrient requirement and meal planning for adults; changes in nutrient requirement according to sex, age & activity. RDA (recommended dietary allowance), Factors affecting RDA. Special nutritional requirements and conditions: Pregnancy, lactation and weaning.

[Short answers/Paragraphs]

MODULE 5. Clinical Dietetics (3 hrs)

Therapeutic modification of normal diet. Etiology, symptoms and dietary management in peptic ulcer, diarrhoea, obesity, hypertension, diabetes mellitus, nephritis, cirrhosis of liver and lactose intolerance.

[Short answers/Paragraphs]

Section B: HEALTH AND HYGIENE (20 hours)

MODULE 6. Health and Hygiene (5 hrs)

Relationship between Food, Nutrition & Health. Physical, psychological and sociological health. Body fitness: Principles of exercise programming, Exercise, Yoga, cycling & walking. Hygiene: Personal hygiene, Oral Hygiene and Sexual Hygiene. Tobacco Use: Smoking habits, Active and passive smoking, composition and effects of tobacco smoke. Alcohol Use: Alcoholism, Physiological effects of alcohol and abuse of alcohol.

[Short answers/Paragraphs]

MODULE 7. Human Diseases (11 hrs)

Communicable diseases: Bacterial (Cholera and Typhoid), Viral (Measles and Poliomyelitis), Fungal (Candidiasis), Protozoan (Amoebiasis and Malaria), Helminth (Ascariasis and Taeniasis).
Non-Communicable diseases: Blood pressure (Hypertension and Hypotension); Cerebral haemorrhage and stroke; Coronary thrombosis, Atherosclerosis and Arteriosclerosis; Diabetes: Type I and Type II; Cancer: Thyroid and Breast cancer; Congenital diseases: Autism, Dyslexia, Down and Foetal alcoholic Syndrome;
Sexually transmitted diseases (STD): Syphilis and Gonorrhea
Vectors and diseases: Anopheles, Aedes, Culex and Xenopsylla

[Short answers/Paragraphs/Essays]

MODULE 8. First Aid Management in Emergency Situation (4 hrs)

Dog bite; Insect sting: scorpion, Bee and wasp; Snake bite: venomous and Nonnenomous snakes; Haemotoxic Venom and Neurotoxic Venom; Antivenom and Polyvalent snake antivenom; First aid for Road accidents and drowning; Risks of self-medication practices.

[Short answers/Paragraphs]

Topics for Assignments/Seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Non-nutritive components of food: food additives and preservatives.
2. Tobacco abuse.
3. Drugs and narcotics abuse.
4. Hepatitis and sub types A, B & C.
5. Nutrition in outer space.
6. Integrated Child Development Services (ICDS).
7. Mid-Day Meal Scheme (MDMS).
8. Special Nutrition Programme.
9. Balwadi Nutrition Programme.
10. National Nutrition Policy of 1993.

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- Harvey Washington Wiley: Wiley's Health Series, Vol. 1: Nutrition Hygiene Physiology;
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- ISBN: 9781455770052, Paperback ISBN: 9781455770168, Elsevier, 1168 pages
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Semester V

Course Code: SJZOL5D03T

Open Course - III: APPLIED ZOOLOGY

54 hours (Credit - 3)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	List and describe the pests and vectors, their habits, damages and control measures and mechanisms of insect pest management.	PO1,PO2, PO3, PSO1	R	F	18 hrs
CO2	Develop personal, academic, employability and self-management skills in apiculture, lac-culture, sericulture and vermiculture.	PO1,PO2, PO3,PO6, PO8, PSO1	C	P	11 hrs
CO3	Demonstrate an understanding of the various strategies in pisciculture, prawn culture, mussel culture and pearl culture.	PO1,PO2, PO3,PO6, PO8, PSO1	A	P	4 hrs
CO4	Recognize the significance of poultry farming and its economic implications in rural India.	PO1,PO2, PO5,PO6, PO8, PSO1	R	F	6 hrs
CO5	Reviews Indian breeds of cattle and goats and the strategies in their breeding.	PO1,PO2, PO6,PO8, PSO1	U	F	6 hrs
CO6	Recognize the significance of parasitic mode of life and their implications in human health.	PO1,PO2, PO3,PO8, PSO1	R	F	9 hrs

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

MODULE 1. Vectors and Pests (18 hrs)

Insect Pests (8 hrs)

Definition of pest and Types of pests. Nature of damage caused and control measures of the following pests:
(a) Pests of paddy: Spodoptera mauritia (Rice swarming caterpillar), Leptocorisa acuta (Rice bug); (b). Pests of coconut: Oryctes rhinoceros (Rhinoceros beetle), Rhynchophorus ferrugineus (Red palm weevil); (c). Pests of stored products: Sitophilus oryzae (Rice weevil), Callasobruchus chinensis (Pulse beetle); Termites.

[Short answers/Paragraphs/Essays]

Insect Pest Management (5hrs) Principles of Cultural control, Mechanical controls, Biological control, Chemical control, Integrated pest management (IPM)

[Short answers/Paragraphs/Essays]

Vectors of Human Diseases (5 hrs)

Mention habits, disease caused and control measures of the following

Blackflies, Sandflies, Tsetse flies, Mosquitoes: Anopheles, Culex & Aedes, Soft ticks and Hard ticks, Ectoparasitic insects: human lice, rat flea.

[Short answers/Paragraphs]

MODULE 2. Animal Breeding and Animal Cultures (11 hrs)

(a) Apiculture: Brief description of adaptations of social bees used for honey harvesting – mention *Apis dorsata*, *Apis cerana, Apis florea,* and *Tetragonula iridipennis*; Bee keeping equipments and methods; Honey bee products: bee wax and its uses, chemical composition of honey and uses; Bee pollination, Economics of bee keeping.

(b). Sericulture: Brief description of Bombyx mori (Mulberry silk moth); Silkworm rearing and extraction of silk, Economics of sericulture; Types of silk: Tassar, Muga and Eri silk.

(c). Lac-culture: History, Morphology of lac insect, host plants, Natural infection, Artificial infection (inoculation), methods in lac-culture and economics of lac products.

(d). Vermiculture: Varieties of earthworms and their economic importance, Methods of vermicomposting: basic requirements, preparation of vermibed, collection of compost, vermiwash, Effect of vermiwash on yield and quality of crops.

[Short answers/Paragraphs/Essays]

MODULE 3: Aquaculture (4hrs)

Brief account on Pisciculture, Prawn culture, Mussel culture, Pearl culture and ornamental fish culture (with examples).

[Short answers/Paragraphs]

MODULE 4: Poultry Farming (6 hrs)

Introduction, Importance of egg production, Nutritive value of eggs, factors affecting egg size; Breeds of fowl: a) Exotic breeds: Rhode Island Red, Plymouth Rock, New Hampshire. b) Indigenous breeds: Chittagong, Gangus; Brief notes on Poultry Housing and Equipment.

[Short answers/Paragraphs]

MODULE 5: Animal Husbandry (6 hrs)

Introduction, Exotic and Indian breeds of Cattle and Goats, Artifical insemination, Storage of semen, Embryo transfer technology, Short notes of common diseases: Anthrax, Foot and mouth diseases, Rinderpest, Brucellosis, Peste des Petits Ruminants (PPR).

[Short answers/Paragraphs]

MODULE 6: Parasitology (9 hrs)

Introduction – Commensalism, Phoresis, Parasitism, Symbiosis, Host-parasite Relationship, Physiology, immunology and biochemistry of parasitism, Mention Definitive host, Intermediate host, Reservoir and Zoonosis. Human Parasites: Mention the habits, habitat, life cycle, mode of infection, control measures of the following parasites: Entamoeba hystolytica, Giardia lamblia, Leishmania donovani, Plasmodium vivax, Taenia solium and Wuchereria bancrofti.

[Short answers/Paragraphs]

Topics for Assignments /Seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students).

1. Genetic engineering applications in Animal Breeding
2. Mosquitoes and their Control
3. Fire Ants
4. National Project for Cattle and Buffalo Breeding
5. National Action Plan for Egg & Poultry-2022

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Semester VI

Course Code: SJZOL6B10T

Core Course X: PHYSIOLOGY AND ENDOCRINOLOGY

54 hours (Credit - 3)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Describe the regulation of digestion in man, nutrition in pregnancy and infancy, nutritional disorders, balanced diet, starvation, fasting and obesity.	PO1,PO2,PO3 PSO3	R	C	5
CO2	Understand the mechanism of transport and exchange of respiratory gases and its neurophysiological control and physiological problems in diving mammals, new-born and aged individuals.	PO1,PO2,PO3 PSO3	U	C	6
CO3	Describe functions, composition, coagulation, transfusion, agglutination and clinical analysis of blood, haemoglobinopathies, types of heart and common cardio-vascular problems.	PO1,PO2,PO3 PSO3	R	C, F	6
CO4	Understand the osmoregulatory mechanisms in hormonal control and common renal disorders in man.	PO1,PO2,PO3 PSO3	U	C, F	6
CO5	Explain the ultrastructure of skeletal energetics of muscle contraction.	PO1,PO2,PO3 PSO3	U	C	5
CO6	Understand the different types of nerve cells, glial cells and nerve fibres, and the mechanism of nerve impulse transmission	PO1,PO2,PO3 PSO3	U	C	6
CO7	Understand the types, physiology and significance of bioluminescence, and the structure and functions of electric organs.	PO1,PO2,PO3 PSO3	U	C	2
CO8	Describe invertebrate neuro-endocrine organs and hormones,	PO1,PO2,PO3 PSO3	U	C	12

	vertebrate endocrine glands, their hormones and functions.				
CO9	Understand the concept of neurosecretion and the mode of action of peptide and steroid hormones.	PO1,PO2,PO3 PSO3	U	C	6

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

Section A: PHYSIOLOGY (36 hours)

MODULE 1. Nutrition (5 hrs)

Regulation of digestive activity: Nervous and hormonal control; Ruminant digestion; Nutrition in pregnancy, infant nutrition, breast feeding, composition of breast milk; Importance of dietary fibres; Balanced diet; Nutritional disorders: anorexia, acidity, ulcer, flatulence; starvation, fasting and its significance; Obesity: causes and consequences, brief description on BMI, Waist to hip ratio, Waist – neck correlation

[Short answers/Paragraphs]

MODULE 2. Respiration (6 hrs)

Gaseous exchange and transport of respiratory gases (brief account), Oxygen-Haemoglobin dissociation curve; Respiratory pigments, structure and properties of Hb; Neurophysiological control of respiration; Physiological problems in diving mammals, new-born and aged individuals.

[Short answers/Paragraphs/Essays]

MODULE 3. Circulation (6 hrs)

Blood: functions and composition; Coagulation of blood (Enzyme cascade theory); Clinical analysis of blood, ESR; Haemodynamics; Haemostasis, haemolysis andjaundice, haemoglobinopathies; Blood transfusion and agglutination, aphaeresis.

Lymph – Composition and function (brief)

Types of heart; ECG; Common cardio-vascular problems: Abnormal variations in BP, Tachycardia, Bradycardia, Myocardial infarction, heart failure, cerebral hemorrhage and cerebro-vascular accident.

[Short answers/Paragraphs/Essays]

MODULE 4. Osmoregulation and Excretion (6 hrs)

Osmoconformers and osmoregulators; Water conservation in desert forms; Osmotic and ionic regulation in terrestrial, fresh water and marine animals; Types of excretion, urea cycle; Human kidney: Urine formation with counter-current mechanism and hormonal regulation; Common renal disorders: haematuria, uremia, proteinuria, renal hypertension, nephritis, renal calculi, oedema, acidosis and alkalosis; Dialysis.

[Short answers/Paragraphs/Essays]

MODULE 5. Muscle Physiology (5 hrs)

Structure of vertebrate skeletal muscle: EM structure of Myofibrils and Myofilaments, contractile proteins; Mechanism of muscle contraction: Ultra structural changes (sliding filament theory); physiology, biochemistry and energetics of muscle contraction; energy sources, role of creatine phosphate, cori cycle; Muscle twitch, fatigue, tetany and rigor mortis.

[Short answers/Paragraphs/Essays]

MODULE 6. Nerve Physiology (6 hrs)

Different types of nerve cells; glial cells, giant nerve fibre of crustaceans and cephalopods; regeneration of medullary fibres, neurotrophins; Nerve impulse transmission, synapses and neuromuscular junctions, synaptic transmission (electrical and chemical), neurotransmitters.

[Short answers/Paragraphs/Essays]

MODULE 7. Bioluminescence and Bioelectricity (2 hrs)

Classification of bioluminescence: symbiotic, extracellular and intracellular; Physiology and significance of light production; Structure and functions of electric organs.

[Short answers/Paragraphs/Essays]

Section B: ENDOCRINOLOGY (18 hrs)

MODULE 8. Invertebrate and Vertebrate endocrinology (12 hrs)

Neuro- endocrine organs and hormones in crustaceans and insects.

Classification of hormones: Amine, peptide and steroid hormones; Endocrine glands in man (hypothalamus, pituitary, thyroid, parathyroid, pancreas, adrenal, thymus, pineal and gastro-intestinal): their hormones and functions (brief account); Hormonal disorders.

Hormones of reproduction: Testes, ovaries and placenta, their hormones and physiological effects; role of hormones in female sexual cycle; hormone related female and male sexual dysfunctions.

[Short answers/Paragraphs]

MODULE 9. Concept of neurosecretion and hormonal action (6 hrs)

Hypothalamus-hypophysial interactions, hypothalamus releasing and inhibiting hormones and their roles, Neuro-hormonal integration, Neuro-endocrine pathways, Regulation of hormone secretion.

Hormonal action :Hormone receptors; Mechanism of action of peptide and steroid hormones; mode of action of insulin and thyroxine; positive and negative feedback regulation.

[Short answers/Paragraphs]

Topics for assignments/seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. History, aim, scope and branches of Physiology.
2. Absorption of carbohydrates, proteins, and lipids.
3. Conducting system of the heart.
4. Composition and functions of lymph.
5. Gross and micro structure of human kidney.
6. Endocrine disorders in man : Cushing's disease, Addison's disease, diabetes mellitus, diabetes insipidus, dwarfism, gigantism, cretinism, myxedema and goitre.

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Semester VI

Course Code: SJZOL6B11T

Core Course XI: REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY

54 hours (Credit - 3)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Explain the reproductive strategies in invertebrates and vertebrates and structural and functional features of human reproductive system.	PO1,PO2,PO3 PSO3	U	C	6
CO2	Describe process of fertilization, pregnancy, gestation, placentation, parturition and lactation in humans.	PO1,PO2,PO3 PSO3	U	C, F	3
CO3	Explain the scope of reproductive technologies in infertility management; prenatal diagnostic techniques and methods of fertility control.	PO1,PO2,PO3 PSO3	U	C, P	5
CO4	Understand the phases and theories of development, and classification of eggs	PO1,PO2,PO3 PSO3	U	C	3
CO5	Enumerate the types of cleavage, arrangement of blastomeres, germ layers and their derivatives, cell lineage in Planocera and different types of blastula	PO1,PO2,PO3 PSO3	U	C	3
CO6	Illustrate the early developmental process of egg in Amphioxus, frog, chick and man.	PO1,PO2,PO3 PSO3	U	C, F	22
CO7	Explain the basics of cell differentiation and its genetic control, stem cells and applications of stem cell technology.	PO1,PO2,PO3 PSO3	U	C	3
CO8	Describe parthenogenesis, types, and significance	PO1,PO2,PO3 PSO3	U	C	2

CO9	Explain fate map construction, Spemann's constriction experiments on amphibian embryos, organizers in development, embryonic induction, gradient experiments in sea urchin eggs, cloning experiments in sheep and teratogenesis.	PO1,PO2,PO3 PSO3	U	C	7

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

SECTION A: REPRODUCTIVE BIOLOGY (14 hrs)

MODULE 1. Introduction and Human Reproductive system (6 hrs)

Introduction to Reproductive Biology **(1 hr)**

Importance and scope. Reproductive strategies in invertebrates and vertebrates; semelparity and iteroparity. Sex patterns; Mention sex reversal with examples.

[Short answers/Paragraphs]

Human Reproductive system **(5 hrs)**

Male reproductive system: structure of testis, semen production and composition. Female reproductive system: structure of ovary and graffian follicle, ovulation, mention corpus haemorrhagicum, corpus luteum and corpus albicans. Accessory reproductive organs. Secondary sexual characteristics. Menstrual cycle and its hormonal control (brief account of oestrous cycle in mammals). Gametogenesis: spermatogenesis and oogenesis.

[Short answers/Paragraphs]

MODULE 2. Fertilization, Pregnancy, Gestation, Placentation, parturition and lactation (3 hrs)

Fertilization: Fertilizin and anti-fertilizin, capacitation, agglutination, sperm penetration, activation of egg and amphimixis. Physiological and biochemicalchanges during and after fertilization. Pregnancy, Gestation, Placentation, parturition and lactation.

[Short answers/Paragraphs]

MODULE 3. Reproductive technologies (5 hrs)

Reproductive technologies **(3 hrs)**

Infertility and its management: Brief account of semen collection, preservation, storage, artificial insemination, surrogacy. Cryopreservation and embryo transfer: Collection, care and preservation of embryos; *in vitro* fertilization and embryo transfer: major steps; Test tube babies.

Assisted Reproductive Techniques (ART): GIFT, ZIFT, ICSI, oocyte donation and embryo donation.

Prenatal Diagnosis **(1 hr)**

Different Prenatal Diagnostic techniques (invasive and non-invasive); Prevention of Female foeticide - ethical issues and laws (Mention–PNDT Act).

Fertility control **(1 hr)**

Natural methods, artificial methods, chemical methods, hormonal methods, surgical contraception, removal of gonads and uterus; abortion.

[Short answers/Paragraphs]

SECTION B: DEVELOPMENTAL BIOLOGY (40 hrs)

MODULE 4. Introduction and Types of eggs (3 hrs)

Introduction to Embryology **(1 hr)**

Historical Perspective (brief account): Mention phases in development. Theories: preformation, epigenesis, recapitulation and germplasm theory.

Types of eggs **(2 hrs)**

Classification of eggs with examples based on: Amount of yolk (micro, meso & macrolecithal); Distribution of yolk (iso, centro and telolecithal); Presence or absence of shell (cleidoic & non cleidoic); Types of development (determinate and indeterminate).

Egg membranes: primary, secondary and tertiary; functions of egg envelopes.

Types of placenta in mammals. (brief)

[Short answers/Paragraphs/Essays]

MODULE 5. Cleavage and cell lineage (3 hrs)

Types of cleavage with examples based on: Plane of cleavage (Meridional, Vertical, Equatorial and Latitudinal); Amount of yolk (Holoblastic and Meroblastic); Types of development (Determinate and Indeterminate); Pattern of arrangement of blastomeres (Radial and Spiral).

Germ layers and derivatives. Cell lineage studies in Planocera (brief account only).

Different types of blastula.

[Short answers/Paragraphs]

MODULE 6. Development of Amphioxus, frog, chick and man (22 hrs)

Early development of Amphioxus **(3 hrs)**

Brief account of fertilization. Cleavage, Blastulation, Gastrulation and Neurulation.

Development of Frog **(8 hrs)**

Fertilization, Cleavage, Blastulation and fate map, Gastrulation (Morphogenetic movements) and formation of germ layers, neurulation and notochord formation, mesoderm and coelom formation; organogeny of brain and eye. Hormonal control of amphibian metamorphosis.

Development of Chick **(7 hrs)**

Structure of egg; fertilization, cleavage, blastulation, gastrulation and formation of germ layers. Salient features of chick embryo at primitive streak stage, 24, 33 and 48 hours stages. Development and functions of extra embryonic membranes.

Development of Man **(4 hrs)**

Cleavage and formation of morula, development of blastocyst, implantation, gastrulation up to the formation of germ layers. Human placenta; functions of placenta.

[Short answers/Paragraph/Essays]

MODULE 7. Cell Differentiation and Gene action during development **(3 hrs)**

Cell differentiation, totipotency, pluripotency, dedifferentiaton and redifferentiation. Controlled gene expression during development; Homeotic genes, Mention Hox-genes. Stem cells – embryonic and adult stem cells; their significance and applications.

[Short answers/Paragraphs]

MODULE *8.* Parthenogenesis (2 hrs)

Definition and types. Natural parthenogenesis: Arrhenotoky, Thelytoky, Obligatory and Facultative. Artificial parthenogenesis. Significance of parthenogenesis.

[Short answers/Paragraphs]

MODULE *9.* Experimental Embryology & Teratology (7 Hrs)

Experimental Embryology (5 hrs)

Construction of fate map, vital staining, marking with carbon particles and radioactive tracing. Spemann's constriction experiments on amphibian embryos, potency of nuclei and importance of Grey crescent. Organizers in amphibian development (primary, secondary & tertiary organizers). Embryonic induction. Gradient experiments in sea urchin eggs. Cloning experiments in sheep.

Teratology (2 hrs)

Environmental disruption in animal development: Teratogenic agents and their effects (alcohol, drugs, nicotine and other chemicals), infections (Herpes virus, Cytomegalovirus and Rubella virus), metabolic imbalance (malnutrition and autoimmunization) (brief account).

[Short answer/Paragraphs]

Topics for assignments/seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Development of foetal membranes in man.
2. Regeneration in animals.
3. Factors affecting regeneration.
4. Factors inducing parthenogenesis.
5. Structure of different types of eggs (Amphioxus, frog, insect)

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Semester VI

Course Code: SJZOL6B12T

Core Course XII: ENVIRONMENTAL AND CONSERVATION BIOLOGY

54 hours (Credit - 3)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Explain the structure of ecosystem and its functioning through energy flow and nutrient cycling.	PO1,PO2,PO3,PO5, PSO1	U	C	6
CO2	Enumerate biogeochemical cycles and understand the concept of limiting factors	PO1,PO2,PO3,PO5, PSO1	R	C	5
CO3	Describe the ecology of population, community and habitat as a self-regulating system.	PO1,PO2,PO3,PO5, PSO1	U	C	14
CO4	Understand various types of population interactions and appraise the co-evolution	PO1,PO2,PO3,PO5, PSO1	U	C, F	3
CO5	Comprehend the diverse environmental and sustainability challenges ranging from local to global and the establishment of perfect harmony between economic development, social issues and environmental conservation.	PO1,PO2,PO3,PO4,PO5,PO8 PSO1	U	C, F	4
CO6	Enumerate the several tools and techniques employed for studies on populations, communities and ecosystems.	PO1,PO2,PO3,PO5, PSO1	R	P	4
CO7	Understand the threats to biodiversity, and strategies adapted for the	PO1,PO2,PO3,PO5,PO8 PSO1	U	F	10

	conservation of diversity of organisms.				
CO8	Describe the various international strategies for conserving biodiversity	PO1,PO2,PO3,PO5,PO8, PSO1	U	F	4
CO9	Describe the toxic chemicals, their toxicity levels and the health hazards caused by them	PO1,PO2,PO3,PO5, PSO1	U	C, F	4

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

Section A: ENVIRONMENTAL BIOLOGY (36 hrs)

MODULE 1. Introduction, Ecosystem and Energetics (6 hrs)

Introduction to Environmental biology: Definition, divisions of ecology, modern branches and scope.

Ecosystem-Structure and functions: Concept of ecosystem, characteristics; Structure (components) of ecosystem (pond as an example); Mention kinds of ecosystems.

Ecosystem Energetics: Photosynthetic production and energy fixation; Energy flow in the ecosystem, Energy flow and laws of thermodynamics, Energy transfer and energy transformations [Trophic dynamics or community dynamics (Lindeman's model of energy flow)]; Ecological efficiency.

Productivity of ecosystem: Concept of productivity- standing crops, material removed and production rate; Kinds of productivity: a) Primary productivity (GPP, NPP, NCP) b) Secondary productivity).

[Short answer/Paragraph/Essays]

MODULE 2. Biogeochemical Cycles and Limiting factors (5 hrs)

Biogeochemical Cycles: Basic types of biogeochemical cycles: Gaseous cycles (Carbon and nitrogen cycles) Sedimentary cycle (Phosphorous cycle).

Limiting factors: Basic concepts. Leibig's law of minimum; Shelford's law of tolerance and combined concept of limiting factors. Ecological indicators.

[Short answer/Paragraph/Essays]

MODULE 3. Population, Community and Habitat Ecology (14 hrs)

Population Ecology

Properties of population: density, natality, mortality, age distribution, biotic potential, environmental resistance, migration, emigration, immigration and carrying capacity. Population growth forms, J and S shaped curves.

Community Ecology

Biotic community: Definition and kinds of communities.

Characteristics: Species diversity, abundance, dominance, stratification, succession, growth forms, trophic structure, co-existence, interdependence and key stone species; Concept of ecotype, ecotone and edge effect.

Habitat ecology

a) Marine ecology: Biotic divisions of the marine habitat, their characteristics. Pelagic realm- planktonic and nektonic adaptations. Benthic realm – littoral and abyssal adaptations. Adaptations of animals of rocky, sandy and muddy sea shores.
b) Fresh water ecology: Lentic and lotic habitats, their characteristics, faunal characteristics and adaptations.
c) Terrestrial ecology: Tropical wet evergreen forests and Tropical dry deciduous forests, their characteristics, adaptations of animals of forests.

[Short answer/Paragraph/Essays]

MODULE 4. Population Interactions (3 hrs)

a) Intraspecific interactions b) Inter specific interactions: Positive interactions-Mutualism, Commensalism and Proto-cooperation (with examples). Negative interactions-Competition, Predation and Parasitism (with examples).

[Short answer/Paragraph/Essays]

MODULE 5. Social issues and Environment (4 hrs)

Sustainable development; Joint Forest Management; Goals of United Nations; Environmental ethics: Issues and possible solutions, Habitat destruction and its

consequences- socio-ecological concern: wetland, paddy fields, mangrove, river encroachment, sand and clay mining; Ecological impacts of tourism.

Disaster management: Natural & Artificial - floods, drought, earthquake, cyclone and landslides.

Environmental movements – in global and Indian scenario (brief)

Gadgil Report and Kasturirangan Report on Western Ghats (brief)

Ecological footprint and Carbon footprint (brief)

[Short answer/Paragraphs]

MODULE 6. Ecological tools and Techniques (4 hrs)

Commonly used techniques for study of animal populations: a) Sampling of animal populations b) Trapping and collecting various groups of organisms [insects, aquatic organisms, soil organisms, birds and mammals] c) Marking of animals d) Determination of age in animal groups d) Determination of home range and territory e) Estimation of number of animals in a population f) Indirect method of estimating wild animal populations g) Recent trends- Camera trapping, Radio collaring and Remote sensing

[Short answer/Paragraphs]

Section B: CONSERVATION BIOLOGY (14 hrs)

MODULE 7. Biodiversity (10 hrs)

Introduction, Components of biodiversity: Genetic diversity, species diversity (mention Shannon diversity index and Simpson's dominance index), community diversity and ecosystem diversity, landscape diversity; Levels of diversity in community and ecosystem diversity: Alpha, beta and gamma diversities.

Hot spots of biodiversity. Mention hotspots in Indian region (Western Ghats and Sri Lanka, Himalayas, Indo Burma and Sundaland).

Threats to biodiversity; Loss of biodiversity and its causes.

Threatened species, Extinction of species, Red data book and IUCN Red list categories.

Conservation of biodiversity and wildlife: conservation measures; Wild life (protection Act) 1972, Conservation projects: Project Tiger, Elephant, Lion, Crocodile, Gangetic Dolphins, Kashmir Red Deer and Brow-antlered Deer (Sangai).

Biodiversity conservation strategies: Protection of endangered species- *Ex situ conservation* (conservation in Seed banks, Gene banks, Germ plasm banks, Zoo, Botanical gardens etc.).

In situ conservation: Wildlife Sanctuaries -Thattekkad bird sanctuary, ParambikulamWLS, PeriyarWLS, Malabar WLS); National Parks- Eravikulam NP & Silent Valley NP; Biosphere Reserves - Nilgiri BR & Agasthyamalai BR; Community reserve- Kadalundy.

[Short answer/Paragraph/Essays]

MODULE 8. Global strategy for conservation (4 hrs)

Brief notes on i) Stockholm conference/Declaration (1972), ii) IUCN, iii) WWF, iv) UNEP, v) CITES, vi) Rio Declaration vii) Rio convention on Biodiversity, 1992 (Rio Earth Summit, 1992), Rio (2012). viii) Kyoto Agreement (1997), Paris Agreement (2016) and Conference of the Parties (COP) on climate change (2018), ix) Ramsar convention (2018).

[Short answer/Paragraphs]

Section C: TOXICOLOGY (4 hrs)

MODULE 9. Toxicants and public health hazards (4 hrs)

a. Toxic chemicals (biocides, automobile emissions, heavy metals, fertilizers, food additives, xenobiotics, radioactive wastes, e-waste).

b. Classification of poisons; Physico-chemical characteristics and mode of action of poisons; Accidental, suicidal and homicidal poisonings; Signs and symptoms of common poisoning and their antidotes.

c. Levels of toxicity: Acute, sub acute, chronic, Dose-response relationship. Measures of toxicity: LD_{50} and LC_{50}.

[Short answer/Paragraps]

Topics for Assignments/Seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Environmental factors (Temperature, water, light, soil) and their influence on organisms.
2. Concept of habitat and niche.
3. Food chains and food web.

4. Major biomes of the world.
5. Ecological pyramids.
6. Ecological succession, basic types and processes in succession.
7. Environmental pollution-Land, water, air, sound and radiation.
8. Global warming and Ozone depletion.
9. Individual responsibilities – Role of Governmental and Non-Governmental Organizations in biodiversity conservation – Chipko, Green peace WWF
10. Food additives.

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Semester VI

Course Code: SJZOL6B13T

Core Course XIII: ETHOLOGY, EVOLUTION AND ZOOGEOGRAPHY

54 hours (Credit - 3)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Describe the patterns and mechanisms of animal behaviour	PO1/ PSO1	R	F	5
CO2	Illustrate biological rhythms and the chemical basis of communication	PO1/ PSO3	U	C	7
CO3	Identify major evolutionary transitions over time, and explain the tools and evidences that support current hypotheses of the history of life on earth	PO2/ PSO1	U	F	8
CO4	Describe the evidences for evolution and its required corollaries	PO1/ PSO1	R	F	5
CO5	Explain the various theories of evolution	PO1/ PSO1	R	F	6
CO6	Describe the mechanisms by which evolution occurs	PO1/ PSO1	R	C	5
CO7	Recognize the significance of reproductive isolation in reducing gene flow between populations, biological and morphological species concepts and distinguish between prezygotic and postzygotic barriers to reproduction	PO1/ PSO1	U	C	7
CO8	Review the events in human evolution	PO1/ PSO1	A	C	3
CO9	Explain ecological and historical foundations for understanding the distribution and abundance of species, and their changes over time and comprehend the basic principles of biogeography as a discipline	PO1/ PSO1	U	C	8

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

Section A: ETHOLOGY (12 hrs)

MODULE 1. Patterns and Mechanisms in Animal Behaviour (5 hrs)

Introduction and Patterns of behavior **(4 hrs)**

History (brief), scope of ethology. (a) Innate behaviour: Orientation-taxes/kinesis, simple reflexes, instincts, motivation. (b) Learned behaviour: Habituation, conditioned reflex, trial and error learning; latent learning, imprinting, insight learning, memory and learning.

Neural mechanism in behavior **(1 hr)**

Role of hypothalamus in thirst and feeding; role of cerebral cortex in emotional behavior; mammalian limbic system and control of behavior (brief account).

[Short answers/Paragraphs]

MODULE 2. Biological rhythm and Sociobiology (7 hrs)

Biological clocks/rhythms **(4 hrs)**

Photoperiodism, circadian rhythm; migration, orientation, navigation and homing; diapause, hibernation and aestivation (brief account); Chronobiology (brief)

Sociobiology **(3 hrs)**

Social groups in termites and elephants; Chemical communication: classification and significance of pheromones (mention human pheromones also).

[Short answers/paragraphs]

Section B: EVOLUTION (34 hrs)

MODULE 3. Course of Evolution (8 hrs)

History of Evolutionary thought **(2 hrs)**

History of evolutionary thought: Ideas of evolution during Pre-Darwinian, Darwinian and Post- Darwinian periods (brief account).

Origin of life **(5 hrs)**

Biochemical origin of life (Modern hypothesis–Oparin-Haldane Theory). Major steps in the biochemical evolution of life (brief account): Origin of Earth and the primordial atmosphere, formation of simple organic molecules, formation of macromolecules or

polymers, and formation of coacervates, microspheres, protocells and full-fledged living cells; origin of mitochondria and chloroplast. Experimental evidence for biochemical origin of life: Urey-Miller experiment; Other experiments; Modern ideas on the origin of life. Mention origin of prokaryotes and eukaryotes.

History of Life on Earth **(1 hrs)**

Geological time scale (simple chart), mention Cambrian explosion. Fossils, Fossilization and Dating of fossils (brief account). Living fossils: *Peripatus*, *Limulus* and *Sphenodon* as examples.

[Short answers/Paragraphs/Essays]

MODULE 4. Evidences of Organic Evolution (5 hrs)

i) Morphological and anatomical, ii) physiological and biochemical, iii) embryological, iv) palaeontological, v) molecular, vi) taxonomical evidences and vii) biogeographical evidences

[Short answers/Paragraphs/Essays]

MODULE 5. Theories of Evolution (6 hrs)

Lamarck's theory: Explanation of the major postulates of the Lamarck's theory with examples, Criticism against Lamarckism, Neo-Lamarckism, Present status of Lamarckism.

Darwin's theory: Explanation of important postulates of Darwin's theory, Examples for natural selection, Criticism against Darwinism, Neo-Darwinism (Synthetic theory of evolution).

Weismann's germplasm theory; Mutation theory of De Vries. Mention the contributions of Wallace. ***[Short answers/Paragraphs/Essays]***

MODULE 6. Concepts of Evolutionary Process (5 hrs)

Genetic basis of evolution: i) Mutations (brief account of gene and chromosomal mutations),

ii) Variations: somatic (environmental) variations and genetic (hereditary) variations, iii) Hardy-Weinberg Principle: Hardy-Weinberg Equilibrium, Factors that upset Hardy-Weinberg Equilibrium, iv) Genetic drift: effects on population, Evolutionary bottleneck and Founder effect, genetic drift and natural selection, importance of genetic drift in evolution; theory of punctuated equilibrium and its relevance.

[Short answers/Paragraphs/Essays]

MODULE 7: Nature of Evolution (7 hrs)

Species and Speciation: Species concept: phylogenetic and biological species concepts; General characteristics and subdivisions of species: subspecies, semi species, sibling species, cline and deme.

Speciation: Types of speciation i) Phyletic speciation ii) Quantum speciation iii) Gradual speciation; Major methods of natural speciation: Allopatric, parapatric and sympatric speciation.

Isolation and Isolating mechanisms: Types of isolating mechanisms i) Geographic isolation: mention examples, ii) Reproductive isolation (a) Prezygotic isolation (habitat, seasonal, ethological, morphological, physiological and cytological isolation with examples), (b) Postzygotic isolation (hybrid inviability, hybrid sterility and F2 breakdown isolation with examples).

Adaptive Radiation (Divergent Evolution): cause and significance, adaptive radiation in Darwin's finches; Convergent Evolution; Pre-adaptation; Co-evolution (mention examples also).

[Short answers/paragraphs/Essays]

MODULE 8: Evolution of Modern Man (3 hrs)

Evolutionary trends in humans; Fore-runners of anthropoids-*Parapithecus*; Fore-runners of apes-*Dryopithecus*; Fore-runners of modern man-*Ramapithecus* (Kenyapithecus), *Australopithecus* (The ape-man), *Homo habilis* (The handy man), *H.erectus* (Pithecanthropines), *H.sapiens neanderthalensis* (Neanderthal man), *Homo sapiens fossilis* (The Cro-magnon), *Homo sapiens sapiens* (Modern man), mention Denizoans and Malapan man.

[Short answers/paragraphs/Essays]

Section C: ZOOGEOGRAPHY (8 hrs)

MODULE 9: Zoogeographical realms and Biogeography of India (8 hrs)

Geographical Distribution (4 hrs)

(a) Geographical distribution of animals: Cosmopolitan, discontinuous, bipolar and isolated distribution. (b) Barriers in animal distribution: Physical, climatic and biological barriers.

Zoogeographical realms **(2 hrs)**

Zoogeographical regions with specific fauna (faunal regions): Palaeartic region, Nearctic region, Neotropical region, Ethiopean region, Oriental region and Australian region; brief description on Wallace line, Weber line and Wallacea.

Insular fauna **(1 hr)**

Faunal characteristics of continental (Madagaskar and Sri Lanka) and oceanic islands (Galapagos and New Zealand).

Biogeography of India **(1 hr)**

Biogeographical zones of India: Himalayan, Desert zone, Semi-arid zone, Western Ghats, Deccan plateau, Gangetic plain, North east Indian zone, Island zone and Coastal zone (brief account).

[Short answer/Paragraphs]

Topics for Assignments / Seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Old theories on origin of life: i) Theory of abiogenesis ii) Theory of biogenesis iii) Theory of special creation iv) Theory of Panspermia.
2. Evolution of Vertebrate Groups: Evolution of agnathans, fishes, amphibians, reptiles, birds and mammals (brief account).
3. Evolution of horse
4. Polypliody and Evolution
5. Ancestry of human population of India

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Module 3-8 (Evolution)

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Module 9 (Zoogeography)

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Semester VI

Course Code: SJZOL6B14 (E) 01T

CORE COURSE- XIV:
Elective Course - I: HUMAN GENETICS AND GENDER STUDIES

54 hours (Credit - 3)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Explain the characteristics, nomenclature and classification of human chromosomes; non-disjunction of chromosomes and the phenotypic effects of chromosome structural modifications.	PO1,PO2,PO3 PSO2	U	C	16
CO2	Understand the construction of pedigrees of Sex-linked and Autosomal dominant and recessive gene mutation disorders and presentation of molecular genetic data in pedigrees.	PO1,PO2,PO3 PSO2	U	C	4
CO3	Enumerate the major autosomal and X-linked dominant and recessive human genetic disorders.	PO1,PO2,PO3 PSO2	R	C, F	4
CO4	Explain multifactorial inheritance.	PO1,PO2,PO3 PSO2	U	C	4
CO5	Understand the basic genetics of reproduction and development.	PO1,PO2,PO3 PSO2	U	C	9
CO6	Explain the major genetic services and genetic counselling.	PO1,PO2,PO3 PSO2	U	C, P	4
CO7	Describe human genetic variations, archaeogenetics of South Asia and genetic origin of Indian populations.	PO1,PO2,PO3 PSO2	U	C	4
CO8	Understand the basics of sex, gender, queer perspective and eco-feminism.	PO1,PO2,PO3, PO7,PO8 PSO2	U	C	5

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

MODULE 1. Human chromosomes (16 hrs)

Classification and nomenclature (9 hrs)

History of classification and nomenclature of human chromosomes – various conferences and their contributions: Denver, Chicago, Paris and Stockholm Conferences. Characteristics of A to G groups of chromosomes. Various banding techniques - G-banding, Q-banding, R-banding, C-banding, Y-banding, NOR banding. Fluorescence in-situ hybridization (FISH)

Non-disjunction of Chromosomes (2 hrs)

Meiotic non-disjunction, mitotic non-disjunction, non-disjunction of autosomes, non-disjunction of sex chromosomes and mosaicism

Chromosome structural modification and the human phenotype (5 hrs)

Ring chromosome, Iso chromosomes, Philadelphia chromosome, Cri-du-chat syndrome (5p-syndrome) Prader willi syndrome, Fragile X- Syndrome (Martin Bell syndrome), Burkitt's lymphoma (14q+ syndrome)

[Short answers/Paragraphs/Essays]

MODULE 2. Human Pedigrees (4 hrs)

Gathering family history, Symbols of Pedigree, construction of pedigrees, Pedigrees of Sex-linked and Autosomal (dominant and recessive), X-linked dominant and recessive gene mutation disorders. Presentation of molecular genetic data in pedigrees.

[Short answers/Paragraphs]

MODULE 3. Chromosomal Disorders (8 hrs)

Autosomal dominant disorders (4 hrs)

Familial hyper cholesterolemia, metabolic and genetic control of cholesterol, Huntington's disease. Marfan's syndrome (Arachnodactyly). Ehlers-Danlos Syndrome (Rubber man or the Elastic Woman).

Autosomal recessive disorders (2 hrs)

Cystic fibrosis - CF gene and protein, Detection of CF homozygotes and carriers, hereditary microcephaly.

X-linked dominant and recessive disorders (2 hrs)

Duchenne muscular dystrophy, identification of the DMD gene, carriers and hemizygotes, X–SCID.

[Short answers/Paragraphs/Essays]

MODULE 4. Multifactorial Inheritance (4 hrs)

Congenital heart diseases (ASD and VSD), Alzheimer's disease, Schizophrenia, Intelligence

[Short questions]

MODULE 5. Genetics of Reproduction and Development (9 hrs)

Prenatal development: genes and hormones. Errors in sexual development: Defects of androgen target cells-deficiency of 5-alpha reductase, congenital adrenal hyperplasia (CAH) and sex reversal.

Maternal effect genes, Segmentation and pattern formation genes, Adhesion molecules and genes, Genomic imprinting, Inbreeding in isolates. Consanguinous marriages, twin studies, biology of twinning, analysis of twin data.

[Short answers/Paragraphs/Essays]

MODULE 6. Genetic counseling (4 hrs)

Procedures and ethical concerns; History of counseling; Methods of genetic counselling - marriage counselling, directive and non- directive reason for seeking counseling; Psychodynamics of genetic counselling.

[Short answers/Essays]

MODULE 7. Evolutionary Genetics (4 hrs)

Human genetic variation - haplogroups; Human races, human variability messages from mitochondrial DNA. Archaeogenetics: Genetics and archaeogenetics of South Asia - out of Africa theory. Genetic origin of Indian populations - Indian Genome Variation initiative. Pharmacogenetics and Ecogenetics (Brief account), Mention phenocopy.

[Short answers]

MODULE 8. Gender Studies (5 hrs)

Sex, Gender, Queer perspective – Basic concepts, Gender shaping Institutions, Theories of Gender construction, Understanding Sexism and Androcentrism, Queer Movement, LGBTQA, Transgenders, Third generation activism (3 hrs).

Gender and Environment - Nature and women's dependency on ecosystem. Rise of eco-feminism in India and women's resistance to environmentaldestruction (Chipko Movement and Narmada Bachao Andolan).India's Environmental Policies and its impact on women (2hrs).

Topics for assignments/seminar *(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)*

1. Mitochondrial DNA mutations in human disease.
2. Sequence components of the human genome.
3. Organization of the human genome.
4. Sex linked disorders.
5. Autism spectrum disorder.

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Semester VI

Course Code: SJZOL6B14 (E) 02T

CORE COURSE- XIV: Elective Course - II: AQUACULTURE, ANIMAL HUSBANDRY AND POULTRY SCIENCE

54 hours (Credit - 3)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Explain aquaculture and the process of prawn, mussel and pearl culture.	PO1, PO6/ PSO1	U	F	10
CO2	Illustrate the methodology of pisciculture and understand common culture fishes and ornamental fishes.	PO1, PO6/ PSO1	U, A	F	13
CO3	Identify major fishing crafts and gear and enumerate fish utilization and preservation	PO1, PO6/ PSO1	U	F, P	13
CO4	Enumerate the poultry rearing techniques and understand major breeds of fowl.	PO1, PO6/ PSO1	U, R	F, P	7
CO5	Understand the major breeds of cattle, cattle feeds and diseases of cattle.	PO1, PO6/ PSO1	U	F	6
CO6	Illustrate the steps in dairy processing and identify the role of dairy development in rural economy.	PO1, PO6/ PSO1	U, A	F, P	5

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

MODULE 1. Aquaculture (10 hrs)

Types of aquaculture **(3 hrs)**

Brief account of classification of aquaculture based on:

Environment – Freshwater, brackish water and mariculture.
Temperature – Warm water/cold water culture.
Culture techniques – pond aquaculture, cage culture, pen culture, raft culture, pole culture, rack culture and long line culture. Number of species – Mono culture and poly culture.

Type of organism – prawn culture, shrimp culture, edible oyster culture, lobster culture etc.

Mariculture **(7 hrs)**

Prawn culture: Important cultivable species in India, seed collection, spawning and larval rearing, induced breeding, types of culture systems - Pokkali culture, culture in bheries/ponds, culture and harvesting.

Mussel culture: *Perna indica*, *Perna viridis*, Seed collection, artificial seed production, induced spawning, culture techniques and harvesting.

Pearl culture: Method of pearl formation, selection and preparation of host, preparation of nucleus and implantation, post-operation care, post-operation culture and collection of pearls.

[Short answers/Paragraphs/Essays]

MODULE 2. Pisciculture (13 hrs)

i. Egg collection; induced spawning; construction, preparation and maintenance of ponds; manuring; feeding and harvesting. Cryopreservation of fish germplasm, semen bank and preservation media.
ii. Biology and culture of following Indian major carps: *Catla catla*, *Labeo rohita*, *Cirrhinus mrigala*.
iii. Biology and culture of Exotic carps: *Cyprinus carpio* (common carp), *Hypophthalmichthys molitrix* (Silver carp).
iv. Inland fishes and Fisheries (Brief account): *Channa*, *Clarias* and *Etroplus suratensis*
v. General account and fishery aspect of Sardine, Shark and Tuna. Mention GIFT Tilapia and Nutter (*Pygocentrus nutterei*)
vi. Ornamental fisheries: Common aquarium fishes: e.g: *Carassius auratus* (Gold fish), *Pterophyllum* spp. (Angel fish), *Astronotus ocellatus* (Oscar cichlid), *Poecilia reticulata* (Guppy), *Poecilia sphenops* (Black molly), aquarium management.
vii. Plankton and Fishery production: Zoo and Phytoplankton – Vertical migration – Plankton and Productivity.

[Short answers/Paragraphs/Essays]

MODULE 3. Fishing Crafts and Gear, fish preservation and utilization (13 hrs)

i. Fishing crafts – Mention Catamaran, Canoes and dug-out-canoes.

ii. Fishing gears – Gillnet/drift gillnet, purse-seines, harpoon, Chinese dipnets, echo sounders, sonar, remote sensing.
iii. Fish Spoilage and Preservation: Biochemical changes, spoilage, use of ice, freezing, canning, dehydration, salting and smoking.
iv. Fish utilisation: Nutritive value, bye products, liver oil, body oil, fish meal, fish flour, Isinglass, glue, skin, fin soup, lime, chitin and chitosan.
v. Diseases and parasites of Fish: Fungal infection – Epizootic Ulcerative Syndrome (EUS), Saprolegnia, Fin and tail rot disease, Dropsy.
vi. Mud banks of Kerala coast.

[Short answers/Paragraphs/Essays]

MODULE 4. Poultry science (7 hrs)

i. Egg production, cable bird production, nutritive value and bye products.
ii. Breeds of fowl – Exotic –Rhode Island Reds, Plymouth Rock, Naked Neck and Leghorn; Indigenous – Gramapriya, Giriraja and Kalinga Brown.
iii. Poultry rearing: Selection of eggs, hatching, incubation, brooding, sexing and vaccination.
iv. Poultry housing: Free range system, Semi-intensive system (deep litter system and individual cage system).
v. Equipments for feeding: Nutrients for starting, growing, laying hen.
vi. Common poultry feeds, food rations and feed formulation.
vii. Common diseases of poultry (Ranikket, Pullorum and Fowl pox)

[Short answers/Paragraphs]

MODULE 5. Animal husbandry (6 hrs)

Introduction: History, origin, domestication.
Breeds of cattle:
Dairy breeds: Sindhi, Gir
Draught breeds of cattle: Nagori, Kangayam
Dual purpose breeds: Ongole, Hariana
Exotic breeds: Jersey, Holstein – Friesian
Native breeds: Conservation programmes, Vechur cow and Kasargod Dwarf
Feeding: Common cattle feeds, fodder
Common diseases: Anthrax, Foot & Mouth disease.
Parasites of cattle
Meat hygiene: Slaughter and clean meat production – Zoonotic diseases.

[Short answers/Paragraghs]

MODULE 6. Dairy science (5 hrs)

i. Role of dairy development in rural economy, employment opportunities, white revolution.
ii. Dairy processes: Straining, Filtration, Cooling, Chilling, Clarification, Pasteurisation, Freezing, Recombined milk, Soft curd milk, Skimmed and toned milk.
iii. Artificial milk, Milk adulteration.

[Short answers/Paragraphs]

Topics for Assignments/Seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Role of physical and chemical factors in aquaculture.
2. Sea weed culture: e.g: Grassilaria, Sargassum.
3. Dairy products, manufacture and nutritive value.
4. Milk and milk spoilage.
5. Crab and lobster culture.

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Semester VI

Course Code: SJZOL6B14 (E) 03T

CORE COURSE XIV: Elective Course - III: APPLIED ENTOMOLOGY

54 hours (Credit - 3)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Describe the branches of entomology and insect services.	PO1, PO6/ PSO1	U, R	F, C	6
CO2	Identify and explain the life-cycle, damages and control of insect pests of crop plants and domestic animals.	PO1, PO6/ PSO1	U, R	F	26
CO3	Review the insect control strategies.	PO1, PO6/ PSO1	U, Z	F, P	11
CO4	List and describe the useful insects and the products derived from bees, silkworms and lac insects.	PO1, PO6/ PSO1	R, U	F	11

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

Section A: AGRICULTURAL ENTOMOLOGY

MODULE 1. General Introduction and Insect services (6 hrs)

Introduction to Entomology **(4 hrs)**

Branches of Entomology: Agricultural, Forest, Veterinary, Medical, Forensic, Industrial, Nutritional and Cultural Entomology. Classification of Class Insecta to Orders. Generalized morphological organization of an insect.

Insects in service of man **(2 hrs)**

Insects as pollinators, parasitoids, scavengers (enhancing soil fertility), pollution indicators, model organisms for scientific research; herbivory for weed control; insects in medicine and forensic science; insects of aesthetic value; use of insect pheromones and hormones.

[Short answers/Paragraphs]

MODULE 2. Harmful Insects: pests of crops and domestic animals (26 hrs)

Insects as enemies of man

Definition of pests, kinds of insect pests, causes of pest outbreak, pests injurious to plants and animals, vectors of diseases.

a) Pests of paddy (Life cycle, damage and control measures)

1. *Nilaparvata lugens* (Brown plant leafhopper)
2. *Leptocorisa acuta* (Rice bug)
3. *Cnaphalocrocis medinalis* (Rice leaf folder)

b) Pests of coconut (Life cycle, damage and control measures)

1. *Oryctes rhinoceros* (Rhinoceros beetle)
2. *Opisina arenosella* (Black headed caterpillar)
3. *Rhynchophorus ferrugineus* (Red palm weevil)

c) Pests of Sugarcane (damage and control measures)

1. *Chilo infuscatellus* (Sugar cane shoot borer)
2. *Scirpophaga nivella* (Sugar cane top borer)
3. *Saccharicoccus sacchari* (Cane mealy bug)

d) Pests of plantation crops: Two examples for each, damage and control measures.

Coffee	1. *Xylotrechus quadripes* (Coffee white stem borer)
	2. *Coccus viridis* (Coffee green bug)
Tea	1. *Helopeltis antonii* (Tea mosquito bug)
	2. *Toxoptera aurantii* (Tea aphid)
Rubber	1. *Saissetia nigra* (Scale insect)
	2. *Aetherastis circulata* (Bark feeding caterpillar)
Pepper	1. *Longitarsus nigripennis* (Pollu beetle)
	2. *Laspeyresia hemidoxa* (Top shoot borer)
Cardamom	1. *Sciothrips cardamomi* (Cardamom thrips)
	2. *Eupterote canarica* (Cardamom hairy caterpillar)

e) Pests of fruit plants: Two examples for each, damage and control measures.

Banana	1. *Odoiporus longicollis* (Pseudostem borer)
	2. *Pentalonia nigronervosa* (Banana aphid)

Mango 1. *Batocera rufomaculata* (Mango stem borer)
2. *Orthaga exvinacea* (Mango leaf webber)
Cashew 1. *Neoplocaederus ferrugineus* (Cashew stem borer)
2. *Lamida moncusalis* (shoot and blossom webber)

f) Pests of vegetables: Two examples for each, damage and control measures.

Lady's finger 1. *Helicoverpa armigera* (fruit borer)
2. *Earias vitella* (Spotted bollworm)
Brinjal 1. *Leucinodes orbonalis* (Shoot and fruit borer)
2. *Henosepilachna vigintioctopunctata*
Cucurbits 1. *Bactrocera cucurbitae* (Melon fly)
2. *Raphidopala foveicollis* (Pumpkin beetle)

g) Pests of stored products: damage and control measures

1. *Tribolium castaneum* (Rust red flour beetle)
2. *Callasobruchus chinensis* (Pulse beetle)

h) Pests of domestic animals

1. Domestic fowl *Menopon gallinae* (Shaft louse)
2. Goat *Oestrus ovis*
3. Cattle *Tabanus striatus*

[Short answers/Paragraphs/Essays]

MODULE 3. Control of Insect Pests (11 hrs)

a) Natural control b) Applied control or artificial control

Prophylactic and curative methods: cultural, mechanical, legal methods; biological and chemical methods.

Biological control: Ecological, biological and economic dimensions of biological control. Mention any three important biological control projects undertaken in India. Merits and demerits.

Chemical control: Classification of insecticides- mode of entry, mode of action, chemical nature; botanical insecticides; insecticide residue, resistance and resurgence of insect pests; pesticide appliances (hand compression sprayer, knapsack sprayer and rocker sprayer); environmental degradation of pesticides (brief account).

Autocidal and Pheromonal control (brief accounts)

Integrated pest management (IPM) – Features and advantages

[Short answers/Paragraphs/Essays]

Section B: INDUSTRIAL ENTOMOLOGY

MODULE 4: Industrial Entomology (11 hrs)

Productive insects:

a) Honey bee: Apiculture in India: Scope, Diversity, Castes, Morphological and communicative adaptations. Bee products – Honey and bee wax, composition and uses,

b) Silk moth: Types of silk worms (mulberry, eri, muga, tassar), life cycle of mulberry silkworm; sericulture and moriculture: processing and extraction of silk; composition and uses of silk.

c) Lac insect: lac host plants, different strains of lac insects, cultivation, inoculation, harvesting and propagation of lac, composition and uses of lac.

[Short answers/Paragraphs/Essays]

Topics for Assignments/Seminars

1. Biology of major insect vectors of human diseases, *Anopheles, Culex, Aedes, Xenopsylla, Pediculus, Cimex and Phthirus.*
2. Diseases and its control measures: Filariasis, Yellow fever, Dengue, Typhus fever and Kala-azar.
3. Insects as source of protein for human
4. Causes of success of insects
5. Bee diseases and enemies.
6. Diseases of silkworms.
7. Enemies of lac insects.

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Semester VI

Course Code: SJZOL6B15P

Core Course XV: ZOOLOGY CORE PRACTICAL – II

144 hours (Credit - 4)

COs	Course Outcome	POs/ PSOs	CL	KC
CO1	Perform experiments in cell biology and genetics including demonstration of Barr body in buccal epithelial cells of man, polytene chromosome in the salivary glands of *D. melanogaster* larva, mitotic division in onion root tip cells, micrometry of microscopic objects, prepare whole mounts of microscopic objects, and calculate mitotic and metaphase index from slides.	PO1,PO2,PO3, PO6, PSO4	U, A	P
CO2	Enumerate the inheritance of major human genetic traits, pedigree chart, normal and abnormal human karyotypes, phenotypic differences of male and female *Drosophila* and solve problems on Monohybrid, dihybrid crosses, blood groups and sex-linked inheritance.	PO1,PO2,PO3, PO6, PSO4	U, A	P
CO3	Understand electrophoresis, PCR, Northern blotting, Southern blotting and Western blotting, DNA sequencing and fingerprinting and isolation of genomic DNA.	PO1,PO2,PO3, PO6, PSO4	U	P
CO4	Perform gram staining and preparation of culture media for bacteria and demonstrate bacterial motility by standard laboratory protocols.	PO1,PO2,PO3, PO6, PSO4	U, A	P
CO5	Understand the detection of human blood groups and organs of immune system.	PO1,PO2,PO3, PO6, PSO4	U	P
CO6	Perform standard biochemical tests for the detection of reducing and non-reducing sugars, polysaccharides, proteins and lipids.	PO1,PO2,PO3, PO6, PSO4	U, A	P
CO7	Understand the staining of mitochondria, tissue homogenization	PO1,PO2,PO3, PO6, PSO4	U, A	P

	and isolation of nuclei, effect of colchicines on cell division, extraction of DNA and polyacrylamide and agarose gel electrophoresis.			
CO8	Solve basic problems in biostatistics and bioinformatics.	PO1,PO2,PO3, PO6, PSO4	A	P

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

FIFTH SEMESTER B. Sc. ZOOLOGY PROGRAMME

PRACTICAL II*A

CELL BIOLOGY, GENETICS, BIOTECHNOLOGY, MICROBIOLOGY & IMMUNOLOGY [72 hrs] [4 hrs/week]

Section A: Cell Biology

1. Study of diversity of eukaryotic cells – methylene blue staining of buccal epithelium and striated muscle cells (Minor).
2. Temporary mount of buccal epithelial cells to observe Barr body (Major).
3. Mitosis: stages in onion (*Allium cepa*) root meristem by squash preparation (major).
4. Calculation of mitotic index and metaphase index in root meristem of *Alliumcepa* (Major).
5. Study of the polytene chromosome of *Drosophila melanogaster* using salivary gland cells of 3rd instar larva (Demonstration only).
6. Measurement of size of microscopic objects using ocular and stage micrometres (Major).
7. Tissues (permanent slides of epithelial tissues, smooth muscle, cartilage, bone).
8. Preparation of permanent whole mount (Demonstration).
9. Study of different stages of meiosis in grass hopper testes (Demonstration).
10. Vital staining of mitochondria using insect flight muscle/cheek epithelium/yeast (Minor)

Section B: Genetics

1. Scheme of Pedigree chart.
2. Study of inheritance of human traits: (use Pedigree charts). Blood groups, Eye colour.
3. Genetic problems on Monohybrid, dihybrid crosses; blood groups; sex-linked inheritance (minimum ten problems to be worked out).

4. Frequency of the following genetic traits in human: widow's peak, attached ear lobe, dimple in chin, hypertrichosis, colour blindness, PTC tasting.
5. Study through photographs of the Karyotype: Down's, Klinefelter's, Turner's and Edward's Syndrome.
6. Study of phenotypic characters in male and female *Drosophila*

Section C: Biotechnology

1. Study of the principle and applications of Electrophoretic apparatus.
2. PCR-Principle and applications.
3. Study of transgenic animals.
4. Southern blotting (Principle and methodology - using flowcharts/diagrams/by visiting a diagnostic Lab)

Section D: Microbiology

1. Gram staining for the identification of Gram positive and Gram negative bacteria (*Lactobacilius* and *Rhizobium)* (Major).
2. Bacterial motility by hanging-drop method (Demonstration).
3. Preparation of culture media for bacteria (Synthetic Media, Natural Media, Simple Media, Differential Media and Selective Media).
4. Methylene blue reduction test for assessing the quality of raw milk (Demonstration).
5. Preparation of a fungal smear – Lactophenol cotton blue staining & mounting (Minor)

Section E: Immunology

1. Identification of human blood groups (A B O and Rh).
2. Histological study of spleen, thymus and lymph nodes through slides/photographs.
3. ELISA (methodology of detection of biomolecules using flowcharts/diagrams/by visiting a diagnostic Lab)
4. Western blotting (methodology of detection of specific proteins using flowcharts/diagrams/by visiting a diagnostic Lab)

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- Susan Mahler Zneimer (2016) *Cytogenetic Laboratory Management: Chromosomal, FISH and Microarray-Based Best Practices and Procedures*;1stEdition, ISBN-10: 9781119069744, Wiley-Blackwell, 840 pages

PRACTICAL II*B

BIOCHEMISTRY, MOLECULAR BIOLOGY,
METHODOLOGY IN SCIENCE, BIOSTASTICS & BIOINFORMATICS **[(72 hrs) (4 hrs/week)]**

Section A: Biochemistry

1. Detection of organic constituents (carbohydrates, proteins and lipids only) from sample solutions (Major)
   a) Detection of reducing sugar: Glucose/Fructose/Maltose [Fehling's test, Benedict's test, Moore's test, cupric sulphate test, rapid furfural test (any three) (Major).
   b) Detection of monosaccharides [Barfoed's test]
   c) Detection of non-reducing sugars: Sucrose [Hydrolysis test].
   d) Identification of functional groups of carbohydrates [Selivanoff's test]
   e) Detection of polysaccharides: Starch [Lugol's iodine test, confirmatory heating & cooling test].
   f) Detection of proteins: [Biuret test, Nitric acid test, Xanthoproteic test].
   g) Detection of lipids: [Sudan III or IV test, Spot test].
2. Preparation of Normal, molar and standard solutions and serial dilutions.
3. Separation of amino acids (or any other compounds) from a mixture by using paper chromatography (Demonstration).

a) Determination of concentration of unknown solutions using Photo electric colorimeter (Demonstration).

Section B: Molecular Biology (Any*four*items)

1. Cell fractionation and isolation of nucleus (demonstration).
2. Study of the effects of Colchicine on mitosis in the root meristem of *Allium cepa.*
3. Differential staining for DNA and RNA in human cheek epithelial cells (demonstration).

4. Poly acrylamide gel electrophoresis (Demonstration).
5. Agarose gel electrophoresis (Demonstration).
6. Isolation of DNA from animal tissues (Demonstration)
7. Isolation of RNA from animal tissues (Demonstration)

Section C: Methodology in Science, Biostatistics and Bionformatics

(Any 10 items of the following)

1. Design an experiment to prove a hypothesis by testing the specificity of the enzyme salivary amylase on starch.
2. Measure the size of given leaves / any sample of data and calculate the mean, median and mode (raw data, discrete series & continuous series).
3. Measure the size of given shells / any sample of data and represent it in a graphical form and interpret it.
4. Calculate the standard deviation of the given set of data (raw data, discrete series & continuous series). Enter the data in Excel, calculate SD and record the screen shots of steps and results.
5. Census the avian fauna / any fauna of two different areas and present the data in a suitable graphical form. Compare by t-test.
6. Construct a frequency curve with mean ± SD using suitable data. Draw the same in Excel or using any free software and record it.
7. Prepare a frequency polygon with mean ± SD utilizing appropriate data.
8. Draw a bar diagram with mean ± SD employing suitable data.
9. Construct a histogram with mean ± SD utilizing suitable data. Do the same with software
10. Draw a pie diagram using suitable data. Draw the same in Excel or using any free software.
11. Formulate a hypothesis of any scientific observation made by you.
12. Sequence retrieval from databases (demonstration).
13. Sequence similarity search using BLAST.
14. Multiple sequence alignment.
15. Construction of phylogenetic tree (Demonstration).
16. Docking studies (Demonstration).

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Semester VI

Course Code: SJZOL6B16P

Core Course XV: ZOOLOGY CORE PRACTICAL – III

144 hours (Credit - 4)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Perform standard laboratory experiments for the estimation of Hb, presence of hCG/abnormal constituents in urine, detection of blood pressure, bleeding and clotting time and identification of formed elements in blood	PO1,PO2,PO3, PO6, PSO4	U, A	P	46
CO2	Identify selected stages in the development of frog and chick and chosen larval forms of invertebrates and vertebrates.	PO1,PO2,PO3, PO6, PSO4	U, Z	P	26
CO3	Carry out experiments of laboratory standards to estimate water quality parameters including, dissolved Oxygen, Carbon dioxide, hardness and pH; determination of adulteration of selected food items and identify marine planktons and soil organisms.	PO1,PO2,PO3, PO6, PSO4	U, A	P	28
CO4	Demonstrate the behavioural response of earthworm/dipteran larva to selected stimuli.	PO1,PO2,PO3, PO6, PSO4	U, A	P	11
CO5	Describe homologous, analogous and vestigial organs, connecting links, adaptive radiation and evolution of man.	PO1,PO2,PO3, PO6, PSO4	U	P	11
CO6	Illustrate zoogeographical realms, Wallace line, Weber line, Wallacea and the distribution of *Peripatus*, lung fishes, *Sphenodon*, monotremes and marsupials.	PO1,PO2,PO3, PO6, PSO4	U, A	P	11
CO7	Identify the normal and selected abnormal human	PO1,PO2,PO3, PO6, PSO4	U, Z	P	11

	karyotypes and inheritance of chosen traits from pedigree charts/describe ornamental and other culture fishes/ describe chosen beneficial and harmful insects.				

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

SIXTH SEMESTER B. Sc. ZOOLOGY PROGRAMME

PRACTICAL III*A:

PHYSIOLOGY, ENDOCRINOLOGY, REPRODUCTIVE AND DEVELPOMENTAL BIOLOGY

[72 hours] [4 hrs/week]

Section A. PHYSIOLOGY AND ENDOCRINOLOGY (46 hrs)

1. Detection of Abnormal constituents of urine [glucose, ketone bodies and albumin] (Major).
2. Preparation human blood smear to study the formed elements (Major).
3. Osmotic response of RBC to saline solutions of different concentrations (Minor).
4. Determination of Hb content in man using Haemoglobinometer (Minor)
5. Determination blood clotting time (Demonstration).
6. Determination of blood pressure (Demonstration).
7. Determination of Body mass index.
8. Study of the histology of the following endocrine glands - pituitary, thyroid, adrenal an endocrine pancreas using slides/photographs.
9. Detection of pregnancy using standard kits (Demonstration).

Section B. REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY (26 hrs)

1. Demonstration of chick blastoderm.
2. Induced ovulation in fish.
3. Study of life cycle in *Drosophila.*
4. Spotters:
   Types of eggs (Insect, Amphioxus, frog, chick, and human).
   Cleavage in frog (use slides / diagrams/models).
   Shark: Yolk sac placenta.
   Development of Frog: Blastula, gastrula, neurula.
   Development of Chick: 18, 24, 32, 48 hours of incubation.
   Mammal: Any two mammalian embryos.
   Larval forms of invertebrates (any five) and vertebrates (any two).

REFERENCES

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- George Van Ness Dearborn (2016): A Text-Book of Human Physiology, Theoretic and Practical, ISBN-10: 1373146265, Wentworth Press, 572 pages
- G.K. Pal and Parvathy Pal (2016): Text book of practical physiology, 4th Edition, ISBN-10: 8173719969, Orient blackswan
- V.P. Varshney , Mona Bedi (2018): Ghai's Textbook of Practical Physiology, 9th Edition, ISBN-10: 9352705327, Jaypee Brothers, 376 pages

PRACTICAL III*B

ENVIRONMENTAL AND CONSERVATION BIOLOGY, ETHOLOGY, EVOLUTION, ZOOGEOGRAPHY & ELECTIVE [HUMAN GENETICS AND GENDER STUDIES]

[72 hrs] [4hrs/week]

Section A: ENVIRONMENTAL AND CONSERVATION BIOLOGY (28 hrs)

1. Estimation of dissolved O_2 in water sample using Winkler's method (Major).
2. Estimation of dissolved CO_2 in pond and tap water (Major).
3. Estimation of total hardness of water (Major).
4. Determination of pH using pH paper / digital pH meter (Minor).
5. Extraction of soil organism by hand picking, floatation and Berlese funnel method (Minor).
6. Study of marine planktons (any five items up to genus level) (Minor).
7. Study of a pond ecosystem and preparation of food chains and food web (Minor).
8. Detection of food adulteration in selected food items (Minor).

i) Detection of starch and urea in milk.
ii) Detection of tea adulterated by colouring.
iii) Detection of maida and chalk powder in wheat flour.

Section B: ETHOLOGY, EVOLUTION & ZOOGEOGRAPHY (33 hrs)

Ethology (Any three) **(11 hrs)**

1. Demonstration of the effect of alarm pheromones in ants.
2. Demonstration of phototaxis using Earth worm.
3. Study of Chaemotaxis in third instar larvae of *Drosophila melanogaster* to odours [Fructose, Yeast and Ethyl acetate].
4. Locomotory behaviour of dipteran larvae (Housefly/blowfly/fruitfly): on different types of substrata (writing paper, plastic sheet and sand paper].
5. Effects of light intensity and light quality on the rate of locomotion of dipteran

larva.

Evolution **(11 hrs)**

Study of models, charts and specimens related to comparative study of:

1. Study of homologous organs (limbs of 5 different groups of vertebrates).
2. Study of analogous organs (wings of bird, insect and bat).
3. Study of any four vestigial organs in humans.
4. Study of evolution of man based on three hominid fossils.
5. Study of connecting links (*Peripatus* and *Archeopteryx*).
6. Study of adaptive radiation in feet of birds / mouth parts of insects.

Zoogeography **(11hrs)**

1. Preparation of world map to show six zoogeographical realms.
2. Preparation of world map to show islands of zoogeographical significance.
3. Preparation of world map to show Wallace line, Weber line and Wallacea.
4. Locate the distribution of following animals in the world map: *Peripatus*, lung fishes, *Sphenodon*, monotremes, marsupials.

Section C: ELECTIVE COURSE [11 hrs]

[Human Genetics& Gender Studies]

HUMAN GENETICS& GENDER STUDIES

1. Problems on (a) autosomal dominant and recessive (b) polygenic traits (skincolour), (c) Sex linkage (X-linked genes and Y-linked genes).
2. Study of identical and fraternal twins.
3. Dermatoglyphics: Identification of arch, loop and whorl patterns; total ridge count in male and female; Tri- radii, importance of atd angle, simian line.
4. Ischiara chart (to detect red-green colour blindness).
5. Seminars on genetics in cardiology, oncology and genetic counselling, Pre-natal sexing, amniocentesis, importance of genetic screening.
6. Pedigree studies and identification of the nature of inheritance from pedigree chart (any one trait).
7. Identification of human karyotypes (Edwards and Patau's) from ideogram.

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- M.M. Trigunayat (2016): *A manual of Practical Entomology* (Field and laboratory guide); 3rd Edition, ISBN: 9788172339838, Scientific Publisher, 358 pages

B.Sc. ZOOLOGY

COMPLEMENTARY COURSE SYLLABUS

Semester I

Course Code: SJZOL1C01T

Complementary Course I: ANIMAL DIVERSITY AND WILDLIFE CONSERVATION

36 hours (Credit - 2)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Describe the general characters of protists and salient features of phylum – Rhizopoda, Ciliophora, Dinoflagellata and Apicomplexa.	PO1,PO2,PO3 PSO1	U	C, F	2
CO2	Enumerate the salient features and examples of Phylum – Porifera, Coelenterata, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Onychophora, Mollusca and Echinodermata, and the structural organization of *Peneaus* sp.	PO1,PO2,PO3 PSO1	R	C, F	14
CO3	Describe the characteristic features and classification of phylum Chordata with examples and, structural organization of *Oryctolagus cuniculus*.	PO1,PO2,PO3 PSO1	U	C, F	14
CO4	Explain levels of biodiversity, threats to biodiversity, biodiversity hotspots, importance and strategies for conservation of wildlife and sustainable development.	PO1,PO2,PO3 PSO1	U	C, F	6

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

Section A: PROTISTA

MODULE 1. Kingdom Protista (2 hrs)

General characters.

Salient features of protozoans.

Phylum Dinoflagellata: e.g. Noctiluca

Phylum Ciliophora: e.g. Vorticella

Phylum Rhizopoda: e. g. Amoeba

Phylum Apicomplexa: e.g. Plasmodium (exclude life cycle)

[Short answers]

Section B: Animal Diversity

MODULE 2: Animal diversity-Part I Nonchordata (14 hrs)

Salient features of phyla, classification down to classes**(8 hrs)** Phylum Porifera: e.g. *Leucosolenia*

Phylum Coelenterata: e.g. *Obelia, Aurelia, Sea anemone*

Phylum Platyhelminthes: e.g: *Fasciola, Schistosoma*

Phylum Aschelminthes: e.g. *Ascaris, Enterobius*

Phylum Annelida: e.g: *Arenicola, Hirudinaria, Megascolex*

Phylum Arthropoda: e.g: *Limulus, Sacculina, Eupagurus,*

Phylum Onycophora: e.g: *Peripatus*

Phylum Mollusca: e.g. *Perna, Teredo, Sepia, Pinctada*

Phylum Echinodermata: e.g. *Asterias, Holothuria, Sea urchin*

Type: *Penaeus* sp. (Exclude details of larval stages) **(6 hrs)**

[Short answers/Paragraphs/Essays]

MODULE 3. Animal diversity-Part II Chordata (14 hrs)

Phylum Chordata: Salient features, Mention classes **(6 hrs)**

Sub phylum Urochordata e.g. *Ascidia*

Subphylum Cephalochordata e.g. *Branchiostoma*

Subphylum Vertebrata:

Div I. Agnatha e.g. *Petromyzon, Myxine*

Div II: Gnathostomata

Super class: Pisces

Class: Chondrichthyes: e.g. *Narcine*

Class: Osteichthyes: e.g. *Echeneis, Hippocampus, Heteropneustes, Scomberomorus,* Pomfret

Super class: Tetrapoda

Class Amphibia: e.g. *Ichthyophis, Salamandra, Rhacophorus,Duttaphrynus,* Mention- *Nasikabatrachus sahyadrensis*

Class Reptilia: e.g. *Chamaeleo, Chelone*, *Naja*, *Bungarus*, *Daboia*

Class Aves e.g. *Columba*

Class Mammalia e.g. *Pteropus*

Type: *Oryctolagus cuniculus* **(8 hrs)**

External features, skeletal system, digestive system, respiratory system, circulatory system, sense organs and nervous system. [Exclude skin, skull bones, arterial system, venous system, lymphatic system, autonomous nervous system and endocrine system].

[Short answers/Paragraphs/Essays]

Section C: Conservation Biology

MODULE 4. Conservation Biology **(6 hrs)**

I. Biodiversity, Levels of biodiversity (brief), significance and uses of biodiversity, threats to biodiversity- (fragmentation, invasive species, over exploitation, poaching, climate change), extinction of species, concept of threatened species.

II Biodiversity hot spots, brief notes on hot spots that include Indian region (Western Ghats and Sri Lanka, Indo Burma, Himalayas and Sundaland); endemism.

III Wild life management and conservation- Importance of wild life, strategies of conservation (*Ex situ* and *In situ*), mention Protection Acts- The Wildlife Protection Act, 1972.

IVSustainable development (concept)

V. Red Data Book, IUCN, WWF (Brief account)

[Short answers/Paragraphs]

Topics for Assignments/Seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Project Tiger
2. Project Elephant
3. Operation Rhino
4. Ramsar sites

REFERENCES

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Semester II

Course Code: SJZOL2C02T

Complementary Course II: ECONOMIC ZOOLOGY

36 hours (Credit - 2)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Explain parasitism and the major protist, cestode, trematode and nematode parasites of man and major insect vectors of human diseases and their control.	PO1,PO2,PO3 PSO2	U	C, F	11
CO2	Understand major beneficial and harmful insects, damages caused to host plants and their control measures.	PO1,PO2,PO3 PSO2	U	F	14
CO3	Understand pisciculture, prawn, mussel and pearl culture.	PO1,PO2,PO3 PSO2	U	C, F	11

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

MODULE 1: Parasitism in relation to man (11 hrs)

Introduction, classification of parasites and hosts (2 hrs)

Obligatory, facultative, external, internal, hyperparasites. Definitive, intermediate, carrier and reserve hosts. Infection and infestation - Mention Hyper infection and Auto infection. Modes of infection - Inoculative, contaminative, direct and retroinfection, zoonotic diseases

Human Parasites (5 hrs)

Parasitic Protists – *Plasmodium vivax, Entamoeba histolytica*
Cestodes – *Taenia solium*, mention *T. saginata* and *Echinococcus granulosus*
Trematodes (Flukes) – *Schistosoma haematobium*
Nematodes – Ancylostoma duodenale, Wuchereria bancrofti and Enterobius vermicularis

Vectors of human diseases **(4 hrs)**

Insect vectors of human diseases and their control. *Anophales, Culex, Aedes,Xenopsylla, Cimex, Pediculus* and *Pthirus* (Diseases like malaria, filariasis, yellowfever, typhus fever, dengue, plague, chikungunya, kala azar).

[Short answers/Paragraphs]

MODULE 2. Useful Insects, Insect Pests and their control (14 hrs)

Insect Pests **(9 hrs)** Definition of Pests, Kinds of Pests, Causes of pest outbreak. Nature of damage to host plants and control measures of the following pests.

(Exclude structure and Life history of Pests).

a) *Spodoptera* sp. (rice swarming caterpillar)
b) *Leptocorisa* sp. (rice bug)
c) *Rhynchophorus* sp. (red palm weevil)
d) *Opisina* sp. (Black headed caterpillar, mention biological control)
e) *Aceria* sp. (Coconut mite)
f) *Helopeltis* sp. (tea bug)
g) *Cosmopolites* sp. (Banana rhizome weevil)
h) *Bactrocera* sp. (Fruit fly)
i) *Batocera* sp. (mango stem borer)
j) *Sitophilus* sp. (rice weevil)

Insect control **(2 hrs)**

Basic principles of chemical control and biological control. Integrated Pest Management (IPM) (Brief notes).

Useful Insects **(3 hrs)**

Apiculture, Sericulture & Lac culture: Economic importance. Predatory insects, insect parasitoids.

[Short answers/Paragraphs/Essays]

MODULE 3. Aquaculture and Fishery Biology (11 hrs)

Brief Introduction mentioning its scope in Kerala. **(1 hr)**

Pisciculture **(5 hrs)**

Egg collection and hatching, induced spawning. Nursery ponds, manuring, feeding and harvesting, Ornamental fish farming (brief account). Mention common species. Fish utilization

Prawn culture. **(2 hrs)**

Breeding and spawning of prawns, seed collection and culture, types of prawn farms, mention common species.

Mussel farming **(2 hrs)**

Seed collection, artificial collection of seeds, induced spawning, rearing of larvae, farming methods and harvesting.

Pearl Culture **(1 hr)**

Preparation of nuclei, preparation of host and graft tissue, implantation and nursing.

[Short answers/Paragraphs/Essays]

Topics for Assignments/Seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. *Callosobruchus chinensis* (Pulse beetle).
2. *Eomenacanthus stramineus* (Chicken louse).
3. *Hippobosca maculata* (house fly).
4. *Tabanus striatus* (horse fly).
5. *Pediculus humanus* (head louse)

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Semester III

Course Code: SJZOL3C03T

Complementary Course III: PHYSIOLOGY AND ETHOLOGY

54 hours (Credit - 3)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Describe the structure of plasma membrane and the various trans-membrane transport mechanisms.	PO1,PO2,PO3 PSO3	U	C	3
CO2	Enumerate the constituents of normal diet and the mechanism of digestion and absorption of carbohydrates, proteins and lipids and the regulation of gastrointestinal function.	PO1,PO2,PO3 PSO3	R	C, F	4
CO3	Explain the mechanism of transport of respiratory gases, control of respiration, respiratory problems and artificial ventilation	PO1,PO2,PO3 PSO3	U	C	6
CO4	Explain the structure and working of human heart and mechanism of regulation of heart beat; constituents of human blood and blood transfusion and cardiovascular problems	PO1,PO2,PO3 PSO3	U	C, F	7
CO5	Illustrate the structure of human kidney, the mechanism of urine formation, hormonal control of kidney function and kidney disorders; osmoregulation and urea cycle.	PO1,PO2,PO3 PSO3	U	C, F	6
CO6	Enumerate the structure of myofibrils and myofilaments; muscle contractile and regulatory proteins and mechanism of muscle contraction.	PO1,PO2,PO3 PSO3	R	C	7
CO7	Explain different types of nerve cells and glial cells,	PO1,PO2,PO3	U	C	7

	maintenance of resting membrane potential, generation and propagation of action potential and synaptic transmission.	PSO3			
CO8	Describe innate behavior, learned behavior, patterns of behavior and factors that affect behavior.	PO1,PO2,PO3 PSO3	U	C, F	8
CO9	Enumerate biological rhythms, communication in animals and social organization in mammals	PO1,PO2,PO3 PSO3	R	C	6

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

Section A. PHYSIOLOGY (40 hrs)

MODULE 1. Trans-membrane transport mechanisms (3 hrs)

Structure of Plasma membrane. Fluid mosaic model. Trans-membrane transport - passive & active mechanisms, vesicular transport

[Short answers/Paragraphs]

MODULE 2. Nutrition (4 hrs)

Constituents of normal diet. Digestion of carbohydrates, proteins and lipids. Absorption of nutrients (brief account). Brief account on the neural and hormonal control of gastrointestinal function. BMR and obesity

[Short answers/Paragraphs]

MODULE 3. Respiration (6 hrs)

Gas exchange and transport. Respiratory pigment – haemoglobin – properties. Control of respiration – neural & chemical (brief account). Respiratory problems - hypoxia, asphyxia, CO poisoning. Respiratory problem of high altitudes. Physiological adaptive mechanisms of diving mammals. Artificial ventilation; heart lung machine.

[Short answers/Paragraphs/Essays]

MODULE 4. Body fluids and circulation (7 hrs)

Constituents of human blood. Agglutination, coagulation of blood and haemostasis Haemolysis. Blood transfusion (short notes). Brief account on the structure and working of human heart. Pacemaker and conducting system of heart. Cardiac cycle and regulation of heart beat. Blood pressure and pulse. Cardiovascular problems (brief account) - arteriosclerosis and atherosclerosis, myocardial infarction, hypertension and thrombosis.

[Short answers/Paragraphs/Essays]

MODULE 5. Osmoregulation and Excretion (6 hrs)

Osmoconformers and osmoregulators. Water retention and conservation in desert animals. Urea cycle. Ammonotelism, ureotelism and uricotelism. Hormonal control of kidney function. Kidney disorders, renal hypertension, nephritis and renal failure. Dialysis and kidney transplantation (short notes)

[Short answers/Paragraphs/Essays]

MODULE 6. Muscle Physiology (7 hrs)

EM structure of myofibrils and myofilament. Muscle - contractile proteins and major regulatory proteins. Chemistry and mechanism of muscle contraction. Energy for muscle contraction. Muscle twitch and muscle tetanus, isometric and isotonic contraction. All-or-none law and summation of stimuli. Muscle fatigue and rigor mortis.

[Short answers/Paragraphs/Essays]

MODULE 7. Nerve physiology (7 hrs)

Mention different types of nerve cells and glial cells. Maintenance of resting membrane potential; generation and propagation of action potential. Threshold stimulus, all or none response. Synapse, types of synapses, synaptic transmission and neurotransmitters.

[Short answers/Paragraphs/Essays]

Section B. ETHOLOGY (14 hrs)

MODULE 8. Behaviour (8 hrs)

Innate behaviour

Orientation, taxes and kinesis, simple reflexes and instincts, drive and motivation

Learned behaviour

Habituation, conditioned reflex, trial and error learning, latent learning, imprinting, insight learning

Patterns of behaviour

Habitat selection, sexual selection, co-operation, territoriality, aggression, courtship and agonistic behaviour.

Proximate factors

Neurological basis of behaviour, mention hormonal, biochemical, environmental and genetic factors that influence behaviour.

[Short answers/Paragraphs/Essays]

MODULE 9: Biological clocks/rhythms (6 hrs)

Photoperiod, circadian rhythm, migration, navigation and homing instinct, diapause, hibernation and aestivation. Communication in animals. Social organization in mammals – Elephant as example

[Short answers/Paragraphs/Essays]

Topics for Assignments/Seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Role of enzymes in digestion of Carbohydrates, proteins and lipids.
2. Absorption of carbohydrates, proteins, and lipids.
3. Problems of Alcoholism
4. Common renal problems - Renal hypertension, nephritis, renal failure, edema, acidosis, uremia, haematuria and calculi.
5. Minamata disease

REFERENCES

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- Berry, A.K. (2008) *Text Book of Animal Physiology*, 8th Edition, ISBN-10: 8185712034, Emkay Publications, 686 pages
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- Mark Ridley (1995) *Animal Behaviour: An Introduction to Behavioural Mechanisms, Development and Ecology*, 2ndEdition, ISBN-10: 0865423903, Wiley Blackwell, 296 pages.
- Purohit, S.S.and Rajiv Ranjan (2009) Ecology, *Environment and Pollution*, ISBN 10: 8177541692, Agrobios.
- Rastogi, S.C. (2019) *Essentials of Animal Physiology*, 4th Edition, ISBN-10: 8122420141, New Age International, 596 pages
- Reena Mather (2016) *Animal Behaviour*, ISBN-13-9789350780480, Rosthogi Pub.

Semester IV

Course Code: SJZOL4C04T

Complementary Course IV: GENETICS AND IMMUNOLOGY

54 hours (Credit - 3)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Describe human karyotype, chromosomal anomalies and polygenic inheritance.	PO1 PSO2	R	C	6
CO2	Explain the mechanisms of sex determination.	PO1 PSO2	U	C	4
CO3	Enumerate the concept of genes, gene expression, genetic code, transcription and translation.	PO1 PSO2	U	C	8
CO4	Illustrate the mechanism of recombinant DNA technology and its practical applications.	PO3 PSO3	U	P	13
CO5	Explain the types of cancer, causes of transformation and characteristics of transformed cells.	PO2 PSO2	U	C	5
CO6	Identify the cells and organs of immune system, antigens and antibodies.	PO1 PSO3	R	F	7
CO7	Enumerate antigen-antibody interaction, generation of B-cell and T-cell response and major immunotechniques.	PO1 PSO3	R	C	7
CO8	Explain primary and secondary immunodeficiency diseases, autoimmune diseases, vaccination and vaccines.	PO1 PSO3	R	C	4

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

Section A: GENETICS (36 hrs)

MODULE 1. Human Genetics (6 hrs)

Normal human karyotype: Classification and grouping of human chromosomes (Patau's & Denver schemes). Chromosomal anomalies and disorders (short note only). Autosomal anomalies: Phenyl ketonuria & Sickle cell anemia. X-linked – Haemophilia and Colour blindness.

Y-linked – Y-Chromosome infertility. Polygenic inheritance - Cleft palate or Cleft lip and diabetes mellitus. Prenatal diagnosis. Genetic counselling. Eugenics, Euthenics and Euphenics**.**

[Short answers/Paragraphs/Essays]

MODULE 2. Genetic Control of Sex (4 hrs)

Autosomes and sex chromosomes: Mention Barr body and its significance. Chromosomal mechanism of sex determination: genic balance theory. Control of sex; hormonal influence of sex determination; sex mosaics; gynandromorphism

[Short answers/Paragraphs}

MODULE 3. Genes and gene expression (8 hrs)

Modern concept of genes, split genes, pseudogenes, overlapping genes and transposons. Gene expression. Genetic code, transcription and translation (brief account)

[Short answers/Paragraphs/Essays]

MODULE 4. Genetic Engineering (13 hrs)

Brief account of recombinant DNA technology – role of enzymes (restriction endonucleases, exonucleases, DNA polymerase, DNA ligase, reverse transcriptase, alkaline phosphatase, polynucleotide kinase and terminal transferase). Cloning vectors – plasmid vectors (mention pBR322), phage vectors, cosmids, viruses and YAC vector. Construction of recombinant DNA (preparation of vector DNA and donor DNA, joining of vector and donor DNAs, introduction of recombinant DNA into the host cell and selection of transformants). Methods of gene transfer. Practical applications, advantages and potential hazards.

[Short answers/Paragraphs/Essays]

MODULE 5. Cytogenetics of Cancer (5 hrs)

Types of cancer: brief account of sarcomas, carcinomas, melanomas, leukemia, lymphomas and blastomas. Characteristics of cancer cells: uncontrolled multiplication, loss of contact inhibition, metastasis, reduced cellular adhesion, metaplasia, invasiveness, growth factor secretion, cell surface alterations, alterations in transcriptome and proteome and protease secretion. Origin of Cancer: Carcinogens, oncogenic viruses, polygenic basis, hereditary predisposition to cancer.

[Short answers/Paragraphs]

Section B: IMMUNOLOGY (18 hrs)

(Brief account of the following topics)

MODULE 6. Cells and organs of immune system, antigens and antibodies (7 hrs)

Cells and organs of immune system

Innate and adaptive immunity. Cells of immune system- B cell, T cell, NK cell and Antigen Presenting Cells (dendritic cells, macrophage cells). Organs of the immune system- Primary lymphoid Organs (Thymus, Bone Marrow), Secondary lymphoid Organs (Spleen, lymph node, MALT)

Antigens

Antigenicity, Immunogenicity and Haptens. Factors influencing immunogenicity. Mention human immunoglobulin gene families – λ and κ light chain families and heavy chain family and major histocompatibility complex (MHC) group of genes.

Antibodies

Structure, different classes and Function. Monoclonal antibodies-Hybridoma technology and applications.

[Short answers/Paragraphs/Essays]

MODULE 7. Antigen-Antibody interaction & Generation of B-cell and T-cell response (7 hrs)

Antigen - antibody interaction

Strength of Antigen-Antibody interaction. Cross reactivity, Precipitation reactions, and Agglutination reactions. Immunotechniques – Detection of biomolecules using ELISA, RIA, and Western blot. Southern blot, Northern blot and DNA Fingerprinting (Brief)

Generation of B cell and T-cell response:

Humoral and cell-mediated response. Properties of B-cell and T-cell- epitopes. Activation and differentiation of B and T cells. Cytokines- brief

[Short answers/Paragraphs]

MODULE 8. Immunodeficiency diseases, vaccines & vaccination (4 hrs) Immunodeficiency diseases

Primary (Bruton's disease, Di-george syndrome & SCID). Secondary types: AIDS-Mention Acute, Chronic and Crisis phase, Window period. Autoimmune disease-Mention Hashimoto's thyroiditis, Grave's disease, Myasthenia gravis and Systemic Lupus Erythematosus.

Vaccines and Vaccination

Principle of vaccination; mention Attenuated vaccines, Inactivated vaccines, Toxoid vaccines and DNA vaccines.

[Short answers/Paragraphs/Essays]

Topics for Assignments/Seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Human genome
2. DNA tumor viruses
3. Human genome project
4. Structure of immunoglobulins and T-cell receptors

REFERENCES

- Darla J. Wise (2002) *Immunology, A Comprehensive Review*, 8th Edition, ASIN: B000RG1FTW, Blackwel, 182 pages
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- Gangane, S.D (2012) *Human Genetics*, 2nd Edition, ISBN-10: 8131230228, Elsevier, 312 pages
- Ivan Roitt (1994): *Essential Immunology*, 8th Edition, ISBN-10: 0632033134, Blackwell Science, 456 pages
- Jenni Punt, Sharon Stranford, Patricia Jones and Judith A Owen (2018) *Kuby Immunology*, 8th Edition, ISBN-10: 1319114709, W.H. Freeman, 944 pages
- Jogchand, S.N.(2016) *Gene Biotechnology*, ISBN-978-93-5262-087-6, Himalaya Publishing House, 447 pages
- John Playfair and Gregory Bancroft (2014) *Infection and Immunity*, 4th Edition, ISBN: 9780199609505, OUP., 400 pages
- Mange, E.J. & Mange, A.P. (1999) *Basic Human Genetics*, Rastogi Pubs.
- Peter D. Snustad (2015) Principles of Genetics, 7th Edition, ISBN-10: 1119142288, Wiley, 627 pages

- Ricki, L. (2014) *HumanGenetics: Concepts and Application*, 11h tEdition, ISBN-10: 0076701654, McGraw Hill Education, 480 pages
- Scot F. Gilbert (2013) Developmental Biology, 10th Edition, ISBN-10: 0878939784, Sinauer Associates, 750 pages
- Twyman R M. (2001) *Instant notes in Developmental Biology*, Viva Books, 421 pages

Semester IV

Course Code: SJZOL4C05P

Complementary Course: ZOOLOGY COMPLEMENTARY PRACTICAL

144 hours (Credit - 4)

COs	Course Outcome	POs/ PSOs	CL	KC	Class Sessions (appr.)
CO1	Identify the salient features of the phylum; taxonomic position, habit, habitat, adaptations/importance of selected protists, non-chordates and chordates	PSO4 PO1	R	P	36
CO2	Describe major human parasites and economically important insects, mollusks and fishes	PSO4 PO1	R	C	36
CO3	Perform detection of human blood groups and prepare human blood smear as per laboratory standards; mounting of specialized organs of selected non-chordates and chordates, and demonstrate the presence of biomolecules in samples by standard laboratory protocols.	PSO4 PO3	A	P	36
CO4	Illustrate the normal and selected abnormal human karyotypes and mode of inheritance of selected human genetic disorders and perform the dissection of earthworm and sardine to demonstrate the alimentary canal and *Penaeus* to demonstrate the nervous system.	PSO4 PO3	U	P	36

*R-remember, U-understand, A-apply, Z-analyze, E-evaluate, C-create

*F-factual, C-conceptual, P-practical/procedural

FIRST SEMESTER COMPLEMENTARY COURSE [PRACTICAL I *A]
[36 hrs] [2 hrs/week]

A. Animal Diversity

Phylum Dinoflagellata : *Noctiluca*
Ciliophora : *Vorticella*
Porifera : *Leucosolenia*
Coelenterata : *Obelia, Physalia, Rhizostoma* (Any 2).

Platyhelminthes : *Fasciola*
Aschelminthes : *Ascaris*
Annelida : *Chaetopterus / Arenicola, Hirudinaria.*
Arthropoda : *Eupagarus, Belostoma, Limulus, Sacculina* (Any 3).
Onychophora : *Peripatus*
Mollusca : *Chiton, Sepia/ Loligo, Octopus* (Any 2)
Echinodermata : *Asterias, Holothuria.*

Chordata

Prochordates : *Ascidia/ Branchiostoma.*
Cyclostomata : *Petromyzon.*

Superclass: Pisces : *Narcine, Echeneis, Hippocampus, Heteropneustes, Anguilla, Pomfret* (Any 3)

Class Amphibia : *Ichthyophis, Axolotl* larva, *Rhacophorus* (Any 2)

Class Reptilia : *Chamaeleo, Daboia, Bungarus*

Class Aves : *Columba*

Class Mammalia : *Pteropus* or any other Bat.

B. Histology: Study of the T.S. of *Hydra*, *Ascaris*, Earth worm (through typhlosolic region).

C. Osteology: Dentition (Rabbit), Pectoral and Pelvic girdles, typical vertebra

REFERENCES

- Jordan E. L. and P S Verma (2013) *Chordate Zoology*, 14th Edition, ISBN-10: 8121916399, S. Chand Publishres, 1076 pages
- Jordan E. L. and P S Verma (2009) *Invertebrate Zoology*, 15th Edition, ISBN-
- 10: 9788121903677, S. Chand Publishres
- Jayasurya; N.C. Nair; N. Soundara Pandian; N. Arumugam; S. Leelavathy and T. Murugan: *Saras Practical Zoology Vol.1: Invertebrata*; ISBN : 9789382459231, Saras Publication, 424 pages
- Ghose K. C. and B. Manna (2007) *Practical Zoology*, ISBN-8173811822, New Central Book Agency 481 pages
- S.S. Lal (2016) *Practical Zoology INVERTEBRATE*, ISBN-10: 9350780089, Rastogi Publications

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- Verma P S (2010) *A Manual of Practical Zoology Invertebrates*, ISBN-10: 8121908299, S. Chand Publishers

SECOND SEMESTER COMPLEMENTARY COURSE [PRACTICAL I *B]

[36 hrs] [2 hrs/week]

Study of the following items

Parasites
Entamoeba, Plasmodium, Schistosoma, Taenia, Ancylostoma, Enterobius, Wuchereria, Hirudinaria, Cimex (Any 5).

Insect pests
Spodoptera, Leptocorisa, Oryctes, Rhynchophorus, Opisina; Batocera, Termite, *Sitophilus* (Any 5).

Useful insects
Apis (worker), *Bombyx* female (any one)

Ornamental fishes
Poecilia reticulata (guppy), *Poecilia sphenops* (Black molly), *Carassius auratus* (Gold fish), *Puntius denisonii, Pterophyllium scalare* (Angel fish), *Colisa* sp. (Gaurami), *Betta* sp. (Fighting fish), *Danio malabaricus* (Giant Danio) (Any three)

Culture fishes
Catla catla (Catla), Labeo rohita (Rohu), Cirrhinus mrigala (Mrigal), Ctenopharyngodon idellus (Grass Carp) (Any three)

Economically important items
Perna, Pinctada, Teredo, Loligo, Penaeus, Scoliodon, Sardinella, Rastrelliger, Cybium (Any 5).

REFERENCES

- Dhaliwal G.S., Ram Singh and Chhillar B.S. (2014) *Elements of Agricultural Entomology*, ISBN-10: 8127226300, Kalyani Publishers
- John O Donel Alexander (1984*) Arthropods and Human Skin*, ISBN 978-1-4471-1356-0, Springer.

- *'Living Jewels':* A hand book on freshwater ornamental fish, The Marine Products Export Development Authority, Ministry of Commerce & Industry, Govt. of India.
- "*Commercial Fin Fishes and Shell Fishes of India*", The Marine Products Export
- Development Authority, Ministry of Commerce & Industry, Govt. of India.

THIRD SEMESTER COMPLEMENTARY COURSE [PRACTICAL I *C]

[36 hrs] [2 hrs/week]

Section A: Physiology

1. Blood smear preparation and study of RBC and different types of WBCs.
2. Human blood grouping – ABO and Rh systems.
3. Detection of monosaccharides, polysaccharides, proteins & lipids.

Section B: Mounting

1. Earth worm: Setae in situ (minor), Spermatheca (minor)
2. *Penaeus*: Appendages (minor)
3. Cockroach: Salivary apparatus (major).
4. Honeybee: Mouth parts (minor).
5. Shark: Placoid scales (minor).

REFERENCES

- Jayasurya; N.C. Nair; N. Soundara Pandian; N. Arumugam; S. Leelavathy and T. Murugan: *Saras Practical Zoology Vol.1: Invertebrata*; ISBN : 9789382459231, Saras Publication, 424 pages
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- William Lutterschmidt and Deborah Lutterschmidt (2008) *Laboratory Excercises in Human Physiology*, 2nd Edition, ISBN-10: 0077229738, Mc Graw Hill, 256 pages.

FOURTH SEMESTER COMPLEMENTARY COURSE [PRACTICAL I *D]

[36 hrs] [2 hrs/week]

Section A: Dissections

Earthworm: Alimentary canal upto 25th segment (minor)
Penaeus: Nervous system (major)
Sardinella: Alimentary canal (major)

Section B: Genetics

Study of the following (use slides/ models / charts / photographs)

1. Study of sex linked inheritance (haemophilia, sickle cell anaemia, color blindness)
2. Study of normal human karyotype (male and female) and abnormal karyotypes – Down's syndrome, Klinefelter's syndrome, Turners syndrome, Edwards syndrome (Any two)

REFERENCES

- Jayasurya; N.C. Nair; N. Soundara Pandian; N. Arumugam; S. Leelavathy and T. Murugan: *Saras Practical Zoology Vol.1: Invertebrata*; ISBN : 9789382459231, Saras Publication, 424 pages
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- S.S. Lal (2015) *Practical Zoology VERTEBRATE*, ISBN-10: 935078016X, Rastogi Publications
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MODEL QUESTION PAPERS

MODEL QUESTION PAPER

FIRST SEMESTER B.Sc. DEGREE EXAMINATION

(CBCSS –UG)

Zoology: Core course

SJZOL1B01 - ANIMAL DIVERSITY: NON-CHORDATA PART- I

Time: Two Hours **Maximum: 60 Marks**

Section A

I. Short answer questions. Each question carries 2 marks.

1. What is cladistics?
2. Explain molecular systematics.
3. Enumerate the eight kingdom classification.
4. What are protostomes? Give examples.
5. Explain mutualism with reference to *Trychonympha.*
6. Describe the characteristic features of *Rhopalura*.
7. What is gemmule? Mention its significance.
8. What are comb jellies?
9. Comment on measly pork.
10. Write a short account on the salient features of Phylum Gastrotricha.
11. What is wheel organ?
12. Differentiate between filariasis and elephantiasis.

(Ceiling: 20 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

13. Write a note on International Code of Zoological Nomenclature.
14. Describe the types and mechanisms of coelome formation.
15. Explain the various systems of nomenclature.
16. Write a brief account on the canal system in sponges.
17. Explain metagenesis with reference to *Obelia*
18. With a labeled diagram explain the digestive system of *Dugesia*.
19. Explain the salient features of Nemotdes.

(Ceiling: 30 marks)

Section C

III. Essay questions. Answer any *one* question.

20. Explain the process of conjugation in *Paramecium.*
21. Write an essay on polymorphism in Cnidarians.

(1x10 = 10 marks)

MODEL QUESTION PAPER

SECOND SEMESTER B.Sc. DEGREE EXAMINATION

(CBCSS –UG)

Zoology: Core course

SJZOL2B02- ANIMAL DIVERSITY: NON-CHORDATA PART – II

Time: Two Hours **Maximum: 60 Marks**

Section A

I. Short answer questions. Each question carries 2 marks.

1. Comment on heteronereis
2. What is parasitic castration?
3. Write an account on Trilobites.
4. Explain the features of trochophore larva.
5. Write a note on the peculiarities of *Troides minos*.
6. Comment on Malabar Banded Peacock.
7. Write the branchial formula of *Penaeus indicus.*
8. What is osphradium? Mention its function.
9. Discuss the salient features of Phylum Phoronida.
10. Explain the peculiarities of *Bonellia*.
11. Write a note on the salient features of Ectoprocta.
12. What is evisceration?

(Ceiling: 20 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

13. Explain the respiratory system of *Pila globosa*.
14. Write a note on the salient features of class Clitellata
15. Explain the salient features of class Merostomata with a suitable example.
16. Describe the digestive system of *Neanthes.*
17. Write an account on the affinities of *Peripatus*.
18. Explain the salient features of Cephalopoda with a suitable example.
19. Describe the affinities of *Balanoglossus.*

(Ceiling: 30 marks)

Section C

III. Essay questions. Answer any *one* question.

20. Write an essay on the appendages of *Penaeus indicus*.
21. With a suitable diagram describe the water vascular system of starfish.

(1x10 = 10 marks)

MODEL QUESTION PAPER

THIRD SEMESTER B.Sc. DEGREE EXAMINATION

(CBCSS –UG)

Zoology: Core course

SJZOL3B03 - ANIMAL DIVERSITY: CHORDATA PART - I

Time: Two Hours **Maximum: 60 Marks**

Section A

I. Short answer questions. Each question carries 2 marks.

1. Explain retrogressive metamorphosis.
2. What is paedogenesis?
3. Describe the structure of pharynx of *Ascidia*.
4. Explain the classification of Phylum Chordata down to classes.
5. Write the salient features of Agnatha.
6. Explain the peculiarities of Ammocoetes larva.
7. Illustrate the distribution of lung fishes.
8. Comment on the 9th vertebra of Frog.
9. What is neurotoxic snake venom? Give an example.
10. Describe the distribution of sphenodon.
11. Write a note on synapsida.
12. Give the scientific name of any four venomous snakes of Kerala.

(Ceiling: 20 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

13. Give an account on urinogenital system of Mullet.
14. Write an account on *Latimeria.*
15. Describe the respiratory system of *Hoplobatrachus tigerinus.*
16. Explain the affinity of Urochordates with Cephalochordates and Vertebrates.
17. Give an account on the morphology of *Amphioxus*.
18. Write the identification key for venomous and non-venomous snakes.
19. Distinguish between Osteichthyes and Chondrichthyes.

(Ceiling: 30 marks)

Section C

III. Essay questions. Answer any *one* question.

20. Give an account on the arterial system of *Calotes*.
21. Write the salient features of class Amphibia and classify down to order, giving specific features with examples.

(1x10 = 10 marks)

MODEL QUESTION PAPER

FOURTH SEMESTER B.Sc. DEGREE EXAMINATION

(CBCSS –UG)

Zoology: Core course

SJZOL4B04 - ANIMAL DIVERSITY: CHORDATA PART-II

Time: Two Hours **Maximum: 60 Marks**

Section A

I. Short answer questions. Each question carries 2 marks.

1. List out the characteristic features of Order *Monotremata*.
2. What is synsacrum? Comment on its composition.
3. Comment on *Cursorius bitorquatus*
4. What is a brood parasite?
5. Write an account on any two extinct birds.
6. Briefly explain the salient features of super order Paleognathae.
7. What is dental formula? Write the dental formula of *Oryctolagus cuniculus.*
8. What is coprophagy?
9. Write an account on Golden Mole of South Africa.
10. Distinguish between an Indian and an African elephant.
11. What is metanephric kidney?
12. Write an account on meninges?

(Ceiling: 20 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

13. Explain the respiratory system of *Columba livia.*
14. Write a note on the evolutionary significance of *Archaeopteryx lithographica*.
15. With a labeled diagram explain the pelvic girdle of *Oryctolagus cuniculus.*
16. Write notes on the adaptations of Chiropterans.
17. Discuss the peculiarities of Order *Marsupialia.*
18. Explain the salient features of Order *Cetacea* with examples.
19. Compare the circulatory systems of Class Amphibia and Reptilia.

(Ceiling: 30 marks)

Section C

III. Essay questions. Answer any *one* question.

20. Explain the flight adaptations of birds.
21. Describe the digestive system of *Oryctolagus cuniculus.*

(1x10 = 10 marks)

MODEL QUESTION PAPER

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION

(CBCSS –UG) Zoology: Core course

SJZOL5B06T – **CELL BIOLOGY AND GENETICS**

Time: 2.5 Hrs **Maximum: 80 Marks**

Section A

I. Short answer questions. Each question carries 2 marks.

1. What is camera lucida? Mention its use.
2. Write a note on apoptosis.
3. Explain the significance of membrane fluidity.
4. Write a note on the structural organization of microtubules.
5. Explain the concept of GERL.
6. Describe the biogenesis of mitochondria.
7. How will you demonstrate the presence of proteins in tissue sections?
8. What are modifying genes? Give an example.
9. Write a note on disorders of sexual development.
10. Explain dosage compensation.
11. Write a short note on chromosomal mutations.
12. Explain sex chromosomal mutations with suitable examples.
13. What is gynandromorphism?
14. Comment on eugenics?
15. Explain environmental influence on sex determination with a suitable example.

(Ceiling: 25 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

16. Describe the principle and applications of electron microscope.
17. Explain the structural organization of chromatin.
18. You are provided with a tissue sample. How will you process it for light microscopy.
19. Describe polygenic inheritance with a suitable example.
20. Explain incomplete linkage with an example.
21. What are gene mutations? Comment on different types of gene mutations.
22. Explain the Patau's scheme of classification of human chromosomes.
23. Illustrate the modifications of plasma membrane.

(Ceiling: 35 marks)

Section C

III. Essay questions. Answer any *two* questions

24. Explain meiosis with the help of labelled diagrams.
25. Describe the various mechanisms of sex determination.
26. Write an essay on trans-membrane transport.
27. Explain multiple allelism with a suitable example. **(2x10 = 20 marks)**

MODEL QUESTION PAPER

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION

(CBCSS –UG) Zoology: Core course

SJZOL5B07T – **BIOTECHNOLOGY, MICROBIOLOGY AND IMMUNOLOGY**

Time: 2.5 Hrs **Maximum: 80 Marks**

Section A

I. Short answer questions. Each question carries 2 marks.

1. Explain the structure of Yeast Artificial Chromosome.
2. Comment on knockout mice.
3. What are molecular markers? Mention their applications.
4. Write an account on viral vaccines.
5. What is Gram staining? Mention its application.
6. Comment on different types of bacterial culture.
7. Write a note on various types of oncogenic viruses.
8. Comment on interferons.
9. Write a note on the normal microflora of the human body.
10. What are adjuvants? Explain Freund's adjuvant.
11. Comment on cytokines.
12. Explain autoimmune disease with an example.
13. What are transplantation antigens? Mention their role in graft rejection.
14. Write a note on immune response to tumor antigens.
15. Differentiate between primary and secondary immunodeficiency diseases.

(Ceiling: 25 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

16. Explain the steps in the production of monoclonal antibodies.
17. Write an account on the various methods of transfection.
18. Comment on the various methods of sterilization.
19. Differentiate between lysogenic and lytic phages.
20. Write an account on various culture preservation techniques.
21. Add notes on primary organs of the immune system.
22. What is immunization? Add notes on various vaccines.
23. With the help of a labeled diagram explain the structure of HIV.

(Ceiling: 35 marks)

Section C

III. Essay questions. Answer any *two* questions.

24. Explain the various steps in the construction of recombinant DNA.
25. Give a brief account on the structure of immunoglobulin and mention its classification.
26. Write an essay on the applications of biotechnology.
27. Explain the industrial applications of microorganisms. **(2x10 = 20 marks)**

MODEL QUESTION PAPER

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION

(CBCSS –UG) Zoology: Core course

SJZOL5B08T – BIOCHEMISTRY AND MOLECULAR BIOLOGY

Time: 2.5 Hrs **Maximum: 80 Marks**

Section A

I. Short answer questions. Each question carries 2 marks.

1. Write a short note on Hydrogen bonding.
2. What are glycosidic bonds?
3. Enumerate the biological functions of carbohydrates.
4. What are peptide bonds?
5. Explain the clinical significance of lipid profile estimation.
6. Differentiate between glycogenesis and gluconeogenesis.
7. Explain oxidative phosphorylation.
8. Illustrate the central dogma.
9. Explain gene concept.
10. Describe the role of tRNA in translation.
11. What are amino acyl tRNA synthetases? Mention their function.
12. Write an account on the active centers of ribosomes.
13. Explain RNA interference.
14. What is c-value paradox?
15. Explain transduction.

(Ceiling: 25 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

16. Give an outline classification of carbohydrates.
17. Write an account on the classification of enzymes.
18. Explain the β oxidation of fatty acids.
19. Write a note on amino acid oxidation.
20. Explain the properties of genetic code.
21. Write a note on the post translational modification of the peptide chain.
22. Explain the positive control of *trp* operon.
23. Briefly explain the life cycle of a temperate phage.

(Ceiling: 35 marks)

Section C

III. Essay questions. Answer any *two* questions.

24. Write an essay on the hierarchial levels of protein structure.
25. Describe the Watson – Crick model of DNA.
26. Explain the mechanism of replication of DNA.
27. Write an essay on the post transcriptional processing of hnRNA

(2x10 = 20 marks)

MODEL QUESTION PAPER

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION

(CBCSS –UG) Zoology: Core course

SJZOL5B09T – METHODOLOGY IN SCIENCE, BIOSTATISTICS AND BIOINFORMATICS

Time: 2.5 Hrs **Maximum: 80 Marks**

Section A

I. Short answer questions. Each question carries 2 marks.

1. Give a short account on Gen Bank.
2. Expand the abbreviations of (1) BLAST & (2) FASTA.
3. What is the principle behind microarray?
4. Define metabolomics.
5. Distinguish cladistics and ontogeny.
6. What is Empiricism?
7. Differentiate auxiliary and adhoc hypothesis.
8. What is virtual testing? Comment on its importance in experiments.
9. Write notes on primary depository of scientific information.
10. Comment on Plagiarism.
11. Differentiate between primary and secondary data.
12. What are the different types of kurtosis?
13. Differentiate between census and sampling.
14. Define standard deviation.
15. Explain the advantages and disadvantages of standard deviation. **(Ceiling: 25 marks)**

Section B

II. Paragraph questions. Each question carries 5 marks

16. Give an account on Database Search Engines.
17. Explain briefly about types of sequence alignment.
18. What is phylogenetics? Give account on phylogenetic tree construction methods.
19. Discuss in detail about Sanger's method of DNA sequencing.
20. Explain various thought process in developing hypothesis.
21. Write notes on prevention of cruelty to animal act.
22. The average marks secured by 40 students were found to be 100. It was later found that one figure was wrongly read as 59 instead of the correct value of 67. Find the correct mean of marks?
23. Calculate Mean and SE of the following data.

Marks x	**10-20**	**20-30**	**30-40**	**40-50**	**50-60**	**60-70**	**70-80**
F	3	5	6	7	3	2	1

(Ceiling: 35 marks)

Section C

III. Essay questions. Answer any *two* questions.

24. Write an essay on Biological databases, highlighting any three biological databases.
25. Discuss in detail about principle and procedure involved in proteomics. What is protein-protein interaction mapping?

26. Give an account on principles and procedure of designing an experiment.

27. Certain manure was used on four plots of land A, B, C and D.
The output of the crop in the beds of plots A, B, C and D is given below. Check the difference in crop production by using ANOVA.

(2x10 = 20 marks)

A	**B**	**C**	**D**
6	15	9	8
8	10	3	12
10	4	7	1
8	7	1	3

MODEL QUESTION PAPER

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION

(CBCSS –UG)

Zoology-Open Course

SJZOL5D01- REPRODUCTIVE HEALTH AND SEX EDUCATION

Time: Two Hours **Maximum: 60 Marks**

Section A

I. Short answer questions. Each question carries 2 marks.

1. What is Barr body? Mention its significance.
2. What is Turner's syndrome? Explain.
3. What is spermatogenesis?
4. What are the accessory structures of Male reproductive system?
5. Differentiate GIFT and ZIFT.
6. Distinguish between Vasectomy and Tubectomy.
7. What is POSCO Act 2012?
8. Write a note on Gonorrhea? How it is transmitted?
9. Briefly explain sexual hygiene.
10. What is Gender discrimination?
11. Comment on Trichomonal vaginitis?
12. Give the symptoms of Syphilis.

(Ceiling: 20 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

13. Discuss various sex determination mechanisms in animals.
14. Explain spermatogenesis.
15. With the help of a neatly labeled diagram explain the structure of Graafian follicle.
16. What is prenatal diagnosis? Briefly describe amniocentesis and chorionic villus sampling.
17. Briefly describe the various fertility control methods.
18. Explain how to maintain healthy relationship with opposite sex.
19. Discuss the causes, symptoms, transmission and diagnosis of AIDS.

(Ceiling: 30 marks)

Section C

III. Essay questions. Answer any *one* question.

20. Discuss the various technologies used to solve infertility problems.
21. Explain menstrual cycle and its hormonal control in human.

(1x10=10 marks)

MODEL QUESTION PAPER

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION

(CBCSS – UG) Zoology: Core course

SJZOL6B10- PHYSIOLOGY AND ENDOCRINOLOGY

Time: Two Hours **Maximum: 60 Marks**

Section A

I. Short answer questions. Each question carries 2 marks.

1. What is balanced diet?
2. Distinguish between neurogenic and myogenic heart.
3. Differentiate osmoconformers and osmoregulators.
4. What is colostrum? Give its significance.
5. What are respiratory pigments? Name the blue-coloured respiratory pigment present in Arthropods and Molluscs.
6. What are neurotransmitters? Give one example each for excitatory and inhibitory neurotransmitters.
7. Differentiate arteriosclerosis and atherosclerosis.
8. Give any two functions of testosterone.
9. What is diabetes insipidus? How is it caused?
10. Which hormone is called "fight or flight hormone? Name the gland that secretes it.
11. What is exophthalmic goitre? How is it caused?
12. Differentiate between gonadial hormones and gonadotrophic hormones with examples.
13.

(Ceiling: 20 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

13. Explain the osmoregulatory mechanisms in fresh water and marine animals.
14. Give a brief notes on coagulation of blood.
15. Explain Oxygen-Haemoglobin dissociation curve and its significance.
16. Write notes on physiology and significance of bioluminescence in organisms.
17. What is ornithine cycle? Explain.
18. Explain the role of sex hormones in menstrual cycle.
19. Describe role of hormones in insect metamorphosis.

(Ceiling: 30 marks)

Section C

III. Essay questions. Answer any *one* question.

20. Describe the physiology and chemistry of the muscle contraction.
21. What are neurons? Describe the physiology involved in the transmission of nerve impulses.

(1x10 = 10 marks)

MODEL QUESTION PAPER

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION

(CBCSS –UG) Zoology: Core course

SJZOL6B11- REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY

Time: Two Hours **Maximum: 60 Marks**

Section A

I. Short answer questions. Each question carries 2 marks.

1. Enlist the hormones and their role in lactation.
2. Explain ZIFT and GIFT.
3. What are homeotic genes? Explain their significance.
4. Differentiate between arrehenotoky and thelytoky.
5. Define capacitation of sperm.
6. What is embryonic induction?
7. Mention 4 important functions of Allantois.
8. Explain cell lineage.
9. Describe the process of implantation in man.
10. Define fate map. Draw the fate map of Frog blastula.
11. Define teratogenesis. Explain the effects of nicotine and alcohol.
12. Explain the theory of epigenesis.

(Ceiling: 20 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

13. Briefly describe barrier methods of fertility control.
14. With the help of a neatly labeled diagram explain the structure of Graafian follicle.
15. What is prenatal diagnosis? Briefly describe amniocentesis and chorionic villus sampling.
16. With labelled diagram, describe the salient features of 33 hour chick embryo.
17. Describe the hormonal control of amphibian metamorphosis.
18. Give an account of Spemann's constriction experiments.
19. With reference to *Drosophila*, explain the role of genes in development.

(Ceiling: 30 marks)

Section C

III. Essay questions. Answer any *one* question

20. What is cleavage? Write an essay on the different types cleavages with suitable examples.
21. Describe the development of brain in frog embryo.

(1x10 = 10 marks)

MODEL QUESTION PAPER

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION
(CBCSS –UG)
Zoology: Core course
SJZOL6B12 – ENVIRONMENTAL AND CONSERVATION BIOLOGY

Time: Two Hours **Maximum: 60 Marks**

Section A

I. Short answer questions. Each question carries 2 marks.

1. Explain ecotone and edge effect.
2. Write a note on adaptations of animals of rocky shore.
3. Differentiate between primary and secondary productivity.
4. Mention the components of an ecosystem.
5. Enumerate the faunal characteristics of animals of lotic habitats.
6. Write a short account on ecological succession.
7. Explain commensalism with a suitable example.
8. What is proto-cooperation? Give an example.
9. Explain remote sensing and its applications in ecological studies.
10. Write notes on Ramsar convention.
11. Give a short account on various toxicants that cause health hazards.
12. Write a note on Rio convention on biodiversity.

(Ceiling: 20 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

13. Give a detailed account on the energy flow in an ecosystem.
14. Explain the different types of population growth forms.
15. Write a note on the properties of a population.
16. Explain habitat destruction and its consequences.
17. Describe the various mechanisms employed for trapping and collection of insects.
18. Explain the major threats to biodiversity.
19. Write an account on hot spots of biodiversity.

(Ceiling: 30 marks)

Section C

III. Essay questions. Answer any *one* question.

20. What are biogeochemical cycles? Explain Nitrogen cycle.
21. Explain the strategies for the conservation of biodiversity.

(1x10 = 10 marks)

MODEL QUESTION PAPER

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION

(CBCSS –UG)

Zoology: Core course

SJZOL6B13 – ETHOLOGY, EVOLUTION AND ZOOGEOGRAPHY

Time: Two Hours **Maximum: 60 Marks**

Section A

I. Short answer questions. Each question carries 2 marks.

1. Explain innate behaviour with suitable examples.
2. Describe photoperiodism.
3. What are pheromones? Mention their biological roles.
4. Write a note on navigation and homing.
5. Explain punctuated equilibrium.
6. Describe natural selection with suitable examples.
7. Write a note on Neo-Darwinism.
8. What are living fossils? Give examples.
9. Describe Lamarck's theory of evolution.
10. Write a brief note on Wallace line.
11. Distinguish between continental and oceanic islands.
12. Write the faunal characteristics of Australian region.

(Ceiling: 20 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

13. Write a note on various patterns of behaviour.
14. Explain the role of hypothalamus in the control of behaviour.
15. Write a brief account on the evolution of man.
16. Explain adaptive radiation with suitable examples.
17. Describe the isolating mechanisms and their role in speciation.
18. Explain Hardy-Weinberg Equilibrium and the factors that upset it.
19. Give an account of various barriers in animal distribution.

(Ceiling: 30 marks)

Section C

III. Essay questions. Answer any *one* question.

20. Describe the Oparin-Haldane concept of origin of life on earth.
21. Write an essay on evidences of organic evolution.

(1x10 = 10 marks)

B.Sc. DEGREE EXAMINATION (CBCSS –UG)
Zoology: Core course (Elective)
SJZOL6B14(E)01 – HUMAN GENETICS AND GENDER STUDIES

Time: Two Hours **Maximum: 60 Marks**

Section A

I. Short answer questions. Each question carries 2 marks.

1. Write a note on FISH.
2. Explain non-disjunction of chromosomes.
3. Give an account on Ehler's Danlos syndrome.
4. Write an account on maternal effect genes.
5. Explain the inheritance of intelligence.
6. Comment on alzheimer's disease.
7. What is genomic imprinting?
8. Explain genetic counselling.
9. Comment on consanguinity.
10. Describe karyotyping
11. Write a short note on Indian Genome Variation Initiative.
12. What is phenocopy?

(Ceiling: 20 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

13. Describe the classification and nomenclature of human chromosomes.
14. Write a note on autosomal recessive human disorders.
15. Comment on gender studies.
16. Briefly explain X- linked dominant and recessive human disorders.
17. Explain the structural modifications of human chromosomes and their phenotypic effects.
18. Describe the biology of twinning and method of analysis of twin data.
19. Write a note on errors in sexual development.

(Ceiling: 30 marks)

Section C

III. Essay questions. Answer any *one* question.

20. Explain the various chromosome banding techniques.
21. Write an essay on various prenatal diagnostic techniques.

(1x10 = 10 marks)

MODEL QUESTION PAPER

FIRST SEMESTER B.Sc. DEGREE EXAMINATION

(CBCSS –UG)

Zoology: Complementary course

SJZOL1C01 - ANIMAL DIVERSITY AND WILDLIFE CONSERVATION

Time: Two Hours **Maximum: 60 Marks**

Section A

I. Short answer questions. Each question carries 2 marks.

1. Describe the salient features of phylum Dinoflagellata with a suitable example.
2. Comment on *Plasmodium vivax* as a human pathogen.
3. What is gemmule?
4. Explain mutualism with respect to sea anemone.
5. Write a note on biodiversity hotspots.
6. What is Red Data book?
7. Write a short account on pearl formation.
8. Explain the adaptations of *Echeneis*.
9. Write a note on strategies for conservation.
10. Explain the adaptations of *Rhacophorus*.
11. What is neurotoxic venom? Give an example
12. Explain sustainable development.

(Ceiling: 20 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

13. Write a note on the evolutionary significance of *Peripatus.*
14. Explain metagenesis with respect to *Obelia*
15. Write a note on the parasitic adaptations of *Fasciola*.
16. Explain the structure of typical vertebra of Rabbit with labeled diagram.
17. Describe the salient features of subphylum Urochordata with a suitable example.
18. Write a note on the adaptations of *Pteropus*.
19. Describe the various threats to biodiversity.

(Ceiling: 30 marks)

Section C

III. Essay questions. Answer any *one* question.

20. Explain the salient features and classification of phylum Annelida down to classes with example from each class.
21. With a neat labelled diagram, describe structure of heart of *Oryctolagus*.

(1x10 = 10 marks)

MODEL QUESTION PAPER

SECOND SEMESTER B.Sc. DEGREE EXAMINATION

(CBCSS –UG)

Zoology: Complementary course

SJZOL2C02 – ECONOMIC ZOOLOGY

Time: Two Hours **Maximum: 60 Marks**

Section A

I. Short answer questions. Each question carries 2 marks.

1. What is ancylostomiasis?
2. Differentiate between infection and infestation
3. What are zoonotic diseases?
4. What is bladder worm?
5. Discuss the damages caused and control measures of coconut mite.
6. What is induced spawning? Mention its application.
7. Discuss the damages caused by *Spodoptera sp.*
8. What are the different types of prawn farms?
9. Explain the control measures of *Cosmopolites* sp.
10. What are insect parasitoids?
11. Comment on *Sitophilus* sp.
12. Name the common cultivable prawn species.

(Ceiling: 20 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

13. Discuss mosquitoes as vectors of human diseases.
14. Write a note on *Wuchereria bancrofti*.
15. Comment on *Plasmodium vivax* as a human pathogen.
16. Write a short note on integrated pest management.
17. Give an outline classification of pests and the causes of pest outbreak.
18. Write a short account on pearl culture.
19. Comment on common cultivable ornamental fishes.

(Ceiling: 30 marks)

Section C

III. Essay questions. Answer any *one* question.

20. Explain the various insect pest management strategies.
21. Describe the various steps in pisciculture.

(1x10 = 10 marks)

MODEL QUESTION PAPER
THIRD SEMESTER B.Sc. DEGREE EXAMINATION
(CBCSS –UG) Zoology: Complementary course
SJZOL3C03 - PHYSIOLOGY & ETHOLOGY

Time: Two Hours **Maximum: 60 Marks**

Section A

I. Short answer questions. Each question carries 2 marks.

1. What is circadian rhythm.
2. Write a note on social organization in elephants.
3. Differentiate between hibernation and aestivation.
4. Explain the mechanism of absorption of nutrients.
5. What is BMR? Mention the factors affecting it.
6. Differentiate between arteriosclerosis and atherosclerosis.
7. Write a note on respiratory problems of high altitudes.
8. Explain cardiac cycle.
9. What is summation of stimuli?
10. Differentiate between osmoconformers and osmoregulators.
11. Write a note on hormonal control of kidney function.
12. Explain all or none law.

(Ceiling: 20 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

13. Explain briefly the mechanism of muscle contraction.
14. Write a short account on the structure of the human heart.
15. Describe urea cycle.
16. Explain the neural and chemical control of respiration.
17. Briefly explain the digestion of carbohydrates, proteins and lipids.
18. Describe the fluid mosaic model of plasma membrane.
19. Give an account on communication behavior in animals.

(Ceiling: 30 marks)

Section C

III. Essay questions. Answer any *one* question.

20. Describe the mechanism of nerve impulse transmission.
21. Explain the different kinds of behavior.

(1x10 = 10 marks)

MODEL QUESTION PAPER

FOURTH SEMESTER B.Sc. DEGREE EXAMINATION

(CBCSS –UG)

Zoology: Complementary course

SJZOL4C04 – GENETICS AND IMMUNOLOGY

Time: Two Hours **Maximum: 60 Marks**

Section A

I. Short answer questions. Each question carries 2 marks.

1. Write a note on cytokines.
2. What are haptens?
3. Mention the various cells of the immune system.
4. What is adaptive immunity?
5. Write a note on viral origin of cancer.
6. What are cosmids?
7. Comment on pseudogenes.
8. Explain the practical applications of genetic engineering.
9. What are transposons?
10. Explain genic balance theory.
11. Comment on gynandromorphism.
12. Explain polygenic inheritance

(Ceiling: 20 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

13. Explain the Patau's scheme of classification of human chromosomes.
14. Describe the features of genetic code.
15. Write a note on various gene transfer methods.
16. Write a note on the process of transcription.
17. Describe the structure of immunoglobulin.
18. Explain the characteristics of cancer cells.
19. Write a note on ELISA

(Ceiling: 30 marks)

Section C

III. Essay questions. Answer any *one* question.

20. Explain the steps in the construction of recombinant DNA.
21. Write an essay on immunodeficiency diseases.

(1x10 = 10 marks)

MODEL QUESTION PAPER

FOURTH SEMESTER B.Sc. ZOOLOGY PROGRAMME
(CBCSS-UG) CORE PRACTICAL
EXAMINATION

PRACTICAL I: ANIMAL DIVERSITY [Non chordata and Chordata]

[ZOL4B05 P]: [Practical I* A, I* B, I *C, & I *D]

(Digital versions of the mountings and dissections are to be done as per UGC guide lines if the software is available)

Time: 4 hours **Max: 80 Marks**

I. Q. 1-6. Spotters: Do as directed. 6 items **(6 x 3 =18 Marks)**

(Non-chordata - 2; Chordata – 2; Histology/Key – 1; Osteology – 1)

II. Q. 7. Minor: Mount one of the following **(9 Marks)**

Earthworm: Mount a few setae on a clean slide.

OR

Honey bee/ Plant bug: Mount the mouth parts on a clean slide.

III. Q. 8. Minor: Mount one of the following. Sketch and label

(Mounting-9 + Sketch-3 =12 Marks)

Nereis: Mount the parapodium on a clean slide. Sketch and label

OR

Mullet/Sardine: Mount a few cycloid scales on a clean slide. Sketch and label

IV. Q .9. Major: One of the following. Dissections (18 Marks) & Display (4 Marks).

(22 Marks)

Prawn: Dissect and display the Nervous system.

OR

Shark: Digitally dissect/dissect and display the Heart and ventral aorta with branches on both sides.

Viva voce **(3 marks)**

V. Record **(14+2=16 Marks)**

MODEL QUESTION PAPER

SIXTH SEMESTER B.Sc. ZOOLOGY PROGRAMME (CBCSS-UG)

CORE PRACTICAL EXAMINATION

PRACTICAL II: Cell Biology, Genetics, Biotechnology, Microbiology, Immunology, Biochemistry, Molecular Biology, Methodology in Science, Biostatistics and Bioinformatics

[ZOL6B15 P]: [Practical II* A+ II* B]

Time: 4 hours **Max: 80 Marks**

I. Q. 1-6. Spotters: Do as directed. (*6 items*) **(6 x 3 =18 Marks)**

(**Cell Biology & Genetics** (2) – polytene chromosome, mitotic/meiotic stages, tissues, Barr body, micrometry, pedigree charts, karyotypes, male or female *Drosophila*, genetic traits; **Biotechnology, Microbiology & Immunology** (2) – electrophoretic apparatus, PCR, Southern blotting, milk quality, bacterial motility, blood grouping, section of spleen, thymus or lymph node, ELISA, western blotting; **Biochemistry, Molecular Biology, Methodology in Science, Biostatistics & Bioinformatics** (2) paper chromatography, colorimeter, electrophoretic apparatus, preparation of solutions of various normality/molarity or serial dilutions, phylogenetic tree, sequence similarity search, multiple sequence alignment).

II. Q. 7. Minor: Any *one* of the following **(9 Marks)**

Stain the buccal epithelial cells (striated muscle cells provided) with methylene blue. Submit the slide for valuation. Write down the principle of methylene blue staining of tissues/cells and the staining procedure.

(*Slide - 6, Principle - 2,Procedure -1*)

OR

Detect biochemically the presence of reducing disaccharides/monosaccharides in the given sample. Conduct appropriate confirmatory tests also. Report the results in tabular form.

(*Expt. - 6, Report of the results in tabular form - 3*)

OR

Retrieve sequence of the beta-lactamase OXA gene for the organism *Escherichia coli* and *Pseudomonas taiwanensis* from NCBI in fasta format. Generate pairwise alignment for the sequences using BLAST. Analyze the result and note down the e-value and percentage identity. Write down the procedure.

(Procedure - 5, Sequence retrieval - 2, e-value -1, % identity -1)

OR

Identify the group of your own blood. Write down the principle and procedure.

(Experiment and result - 5, Principle and procedure - 4)

OR

Demonstrate the effect of colchicine on cell division using *Allium cepa*. Write the principle and procedure.

(Experiment and result – 5, Principle and Procedure - 4)

III. Q. 8. Minor: Any *one* of the following. **(3+9=12 Marks)**

a) Genetics Problem-(Monohybrid, dihybrid crosses; blood groups; sex-linked inheritance) *(3 marks)*

b) Measure the length of the leaves provided. Using the data plot a Frequency Polygon with mean ± SD and submit it for evaluation. *(9 marks)*

(*Measurement and Preparation of the data in table- 6, Graphical representation- 3*)

OR

a) Genetics Problem *(3 marks)*
b) Stain the mitochondria in human cheek epithelial cells (insect flight muscle/yeast) using Janus green B. Observe and submit the preparation for evaluation. Write the principle and procedure. (*Preparation – 5, Principle and procedure* 2, *Sketch and label - 2*) *(9 marks)*

OR
a) Genetics Problem *(3 marks)*
b) Prepare a smear of the fungal sample provided to you. Write down the principle and procedure (*Preparation 6, Principle and procedure- 3 (9 marks)*

OR

a) Genetics Problem *(3 marks)*
b) Find out the homologous sequences in *Enterobacteriaceae, Escherichia albertii, Cronobacter sakazaki, Shigella sonnei* and *Shigella flexneri* by performing BLASTp for the sequence given below and save the file as protein. fasta and execute their MSA using clustal omega and study the percentage similarity of each pair of sequences. Based on these scores identify which sequences are the most similar to each other. Also save the alignment file in fasta format.

>seq
MACKGTGNRTIAVYDLGGGTFDISIIEIDEVDJEKTFEVLATNGDTHL
GGEDFDSRLINYLVEEFKKDQG
IDLRNDPLAMQRLKEAAEKAKIELSSAQQTDVNLPYITADATGPKHMN
IKVTRAKLESLVEDIVNRSIEP
LKVALQDAGLSVSDIDVILVGGQTRMPMVQKKVAEFFGKEPRKDVNP
DEAVAIGAAVQGGVLTKCL (The sequence must be provided on the desktop)

(9 marks)
(Procedure 3, MSA 3, % similarity 2, Identification 1)

IV. Q. 10. Major: Any *one* of the following. **(22 Marks)**
Prepare a smear of your buccal epithelium to demonstrate Barr body. Write the principle and procedure. Comment on your results.
(Experiment and result – 18, Principle & Procedure – 2, Comment 2)

OR
By performing appropriate biochemical tests analyze the given three sample solutions for the presence of organic constituents, such as monosaccharides, polysaccharides, proteins and lipids. Submit the report in tabular form.
(*Expt. and result - 18, Report of the results in tabular form - 4*)

OR
Prepare a neatly stained squash preparation of onion root tip. Identify any two mitotic stages. Sketch and label.
(*Expt. and result- 18, Identification - 2, Sketch - 2*)

OR
Prepare a squash preparation of onion root tip. Calculate the mitotic/metaphase index. Write the procedure.

(Expt. and result – 18, Calculation – 4)

OR

Find out the diameter/length of the given object using stage and ocular micrometer. Write down the principle and procedure.

(Expt. and result – 15, Calculation. 4, Principle and Procedure – 3)

OR

Identify whether the given bacteria is Gram positive or negative by the Gram staining technique. Write the principle and procedure.

(Expt. and result – 18, Principle and procedure – 4)

Viva-voce **(3 marks)**

V. Record: **(16 Marks)**

MODEL QUESTION PAPER

SIXTH SEMESTER B.Sc. ZOOLOGY PROGRAMME (CBCSS-UG)

CORE PRACTICAL EXAMINATION

PRACTICAL III: *Physiology, Endocrinology, Reproductive and Developmental Biology, Environmental and Conservation Biology, Ethology, Evolution, Zoogeography and Elective course.*

[ZOL6B16P] [Practical: III*A+ III*B]

Time: 4 hours **Max: 80 Marks**

I. Q. 1-6. Spotters: Do as directed. *6 items*. (**6 x 3 =18 Marks**)

(**Physiology & Endocrinology** (Any 1) – Haemoglobinometer, sphygmomanometer, osmotic response of RBC, blood cells, sections of pituitary, thyroid, adrenal or endocrine pancreas, pregnancy detection; **Reproductive and Developmental Biology** (Any 2) - embryo/developmental stages/larval forms, placenta, *Drosophila* life cycle; **Ethology** (Any 1) phototaxis, chemotaxis, locomotory behaviour**; Evolution** (Any 2) - homologous/analogous organs, vestigial organs, adaptive radiation, connecting links, evolution of man**.**

II. Q. 7. Minor: *One* or *two* items from elective course. **(9 Marks)**
(Human Genetics & Gender Studies)
Entomology)

III. Q. 8. Minor: Any *one* of the following. **(3+9=12 Marks)**

a. Mark the Australian realm in the map supplied and comment on its faunal characteristics. *(3 marks)*

b. Determine the haemoglobin content of human blood. Write the procedure *(9 marks)*

(Expt. and result – 7; Procedure – 2)

OR

a. Mark the Galapogos islands in the map supplied and comment on its faunal characteristics. *(3 marks)*

b. Determine the pH of the two samples provided by using pH indicator paper/pH meter. Write the procedure. Comment on its significance. *(9 marks)*

(Expt. and result – 5, Procedure - 3, Comment - 1)

OR

a. Comment on the faunal characteristics of the marked region in the world map provided to you *(3 marks)*

b. Detect the presence of starch and urea in the given sample of milk. Write down the procedure. *(9 marks)*

(Expt. & Result - 6, Procedure – 3)

OR

a) Comment on the special features of the marked region in the world map provided to you. *(3 marks)*

b) Construct a food web with specimens/names of items provided. Define and add a note on its ecological significance. (Mouse, Snake, Rabbit, Grasshopper, Grass, Lizard, Hawk Grasshopper)
(Food web - 6, Definition - 1, significance - 2)

(9 marks)

OR

a. Mark the distribution of lung fishes in the world map provided. *(3 marks)*

b. Mount any two marine planktons in glycerin on clean slides. Identify them up to class and write notes on planktonic adaptations. *(Mountings - 2+2, Identification - 2, Adaptations - 3*)

(9 marks)

IV. Q. 9. Major: *Any one* of the following. (22 Marks)

You are provided with three urine samples. Analyze them for the presence of glucose, albumin and ketone bodies. Present your results in tabular form. Comment on your results.
(Experiment results - 18, report of the results in tabular form – 2, Comment - 2)

OR

Prepare a smear of your own blood. Identify any two WBCs. Sketch and label. *(Expt. and result - 18, Identification - 2, Sketch - 2)*

OR

Estimate the amount of dissolved oxygen in the given sample using Winkler's method. Write down the principle and procedure. (*Expt. and result-16, Principle and procedure - 4, Calculation - 2*)

OR

Estimate the amount of dissolved Carbon dioxide in the given sample. Write down the principle and procedure.

(*Expt. and result-16, Principle and procedure - 4, Calculation - 2*)

OR

Estimate the hardness of the given water sample. Write down the principle and procedure.

(*Expt. and result -16, Principle and procedure - 4, Calculation - 2*)

Viva-voce (3 marks)

V. Record:

MODEL QUESTION PAPER

FOURTH SEMESTER B.Sc. ZOOLOGY (CBCSS-UG) COMPLEMENTARY PRACTICAL EXAMINATION

PRACTICAL: Animal diversity, wildlife conservation, Economic zoology, Physiology, Ethology, Genetics and Immunology

[ZOL4C05P]: [Practical I*A, I*B, I*C & I*D]

(Digital versions of the mountings and dissections are to be done as per UGC guide lines if the software is available)

Time: 4 hours **Max. : 80 Marks**

I. Q. 1-6. Spotters: Do as directed. (6 items): **18 Marks**

(Non chordata -1; Chordata - 2; Histology/Osteology –1; Economic Zoology-1; Genetics - 1) *(6 x 3 =18 Marks)*

II. Q.7. Minor: Any one item from the following: **(9 Marks)**

Identify your own blood group and submit the slide for valuation. Write down the principle and procedure involved.

(*Expt. and result - 6, principle and procedure – 3*)

OR

Detect biochemically the presence of glucose, protein or lipid in the sample provided Conduct an appropriate confirmatory test also. Submit the result in tabular form.

(Expt. and result - 6, Report of the results in tabular form – 3)

III. Q.8. Minor: Any one item from the following: **(12 Marks)**

Honey bee: Mount the mouth parts on a clean slide. Sketch and label.

(10 + 2 = 12)

OR

Shark: Mount a few placoid scales on a clean slide. Sketch and label.

(10 + 2 = 12)

IV. Q.9. Major: One of the following: **(22 Marks)**

Penaeus: Dissect and display the nervous system.

(18+4 =22)

OR

Make a neatly stained smear of your own blood. Identify any two immunologically significant cells.

(Preparation - 18, Identification – 2, Sketch and label – 2)

Viva – voce **(3 marks)**

V. Record: (**16 Marks)**