SCOTT CHRISTIAN COLLEGE (AUTONOMOUS)

NAGERCOIL

(Estd. 1893)

CURRICULUM AND SYLLABUS

DEPARTMENT OF ZOOLOGY & RESEARCH CENTRE

(Approved by the Standing Committee of the Academic Councils held on 21.10.2023 & 13.01.2024)

POSTGRADUATE PROGRAMME

CBCS-SEMESTER SYSTEM

(For those who join from 2023 to 2026)

An evolution towards revolution …

Education is crucial for attaining full human potential, developing an unbiased and evenhanded society and promoting national and global development. The education sector in India is witnessing a sweeping wave of change. The very first policy for education, *National Policy on Education* (NPE-1968) was promulgated in 1968, with the National Policy on Education (NPE- 1986) following in 1986. The National Policy on Education (NPE- 1992) and the Programme of Action 1992 (POA-1992) refined and implemented the NPE-1986. The National Education Policy 2020 (NEP 2020) is a landmark document and an evolution towards revolution in the Indian educational sector. It presents the vision for greater access, equity, excellence, inclusion, multiple entry and exit and affordability to help India emerge as the global knowledge superpower.

Providing access to quality education is the key to the curriculum and syllabus of Scott Christian College (Autonomous), in terms of social justice and equality, scientific advancement, cultural preservation and national and global integration. Students should have the freedom and flexibility in choosing their courses, skills, and capacities to become moral, successful, innovative, adaptable, and productive human beings.

Higher education plays an important role in promoting human as well as societal wellbeing and in contributing towards sustainable livelihoods and economic development. The present Outcome-Based Education (OBE) curriculum and syllabus, provides valuable insights and recommendations on aspects of education that include moving towards multidisciplinary and holistic education, mastery and high-order learning and promotion of quality research.

The current curriculum has been designed based on NEP 2020, the National Credit Framework (NCrF), the National Higher Education Qualifications Framework (NHEQF) and Curriculum and Credit Framework for Undergraduate Programmes (CCFUP) which envisage that students must develop into good, thoughtful, well-rounded, creative individuals with a standard of achievement. The themed curriculum aims to support teachers and students in developing their understanding of the curriculum design and delivery process as per the requirement of the world of work.

Dr.Sidney Shirly
Dean of Arts
Scott Christian College
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Nagercoil

Dr. V. Robin Perinba Smith
Dean of Science
Scott Christian College
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Dr. B. Shamina Ross
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M.Sc. ZOOLOGY SYLLABUS

(2023 -2026)

The Department of Zoology, Scott Christian College has a long history. B.Sc. Zoology course was introduced in the year 1946. It evolved into a Post graduate Department in 1980 affiliated to the Madurai Kamaraj University and was further upgraded to a Research Department offering M.Phil., from 1985 and Ph.D. from 1996. Presently, it is affiliated to the Manonmaniam Sundaranar University, Tirunelveli.

Presently there are 13 faculty members and all have doctoral titles. The Manonmaniam Sundaranar University has recognized eight of the faculty as research guides. The Zoology Department has a very good museum with almost all representative types of fauna. The Department has a well-equipped laboratory. The principal areas of research undertaken by the faculty members include aquaculture, sericulture, biodiversity, toxicology and biocontrol of insect pests using ecofriendly predators and botanicals.

The Department has received student projects and research funds from various funding agencies like TNSCST, UGC, AIACHE, DOD and BRNS.

The Department has established vermiculture, sericulture, ornamental fish culture, apiculture under integrated farming to train students in various vocations to enable and equip them with an operational know-how to self-employment once they have completed their education. The crown among the achievements of the department lies in the consultancy, service and earn-while-you-learn scheme.

Being a Zoology Department, we are aware of the fact that life is not stationary, the environment is ever changing and one has to adopt to the changing scenario. We believe in the union of teaching and research. We hope that with God's help and guidance, our success will be continuing as success itself is a journey and not a destination.

Vision statement

- To inculcate and motivate genuine interest in animal studies.
- To instil an urge to be advocates for nature and biodiversity conservation.
- To impart research temper.
- To train competent, compatible, employable zoologists.
- To mold humane Indian citizens with a global outlook.

Mission statement

The Department of Zoology strives to

- Provide quality biology education at Graduate, Masters and Research level.
- Implement intensive teaching methods, hands-on technical training and consultation with experts, field studies and laboratory visits.
- Demonstrate the importance of moral and social values, professional integrity and ethics, stewardship towards fellow human beings and
- Preserve, conserve and nurture Eco friendliness, sustainability and biodiversity.

SCOTT CHRISTIAN COLLEGE (AUTONOMOUS)

DEPARTMENT OF ZOOLOGY & RESEARCH CENTRE

Board of Studies Members (2023 – 2026)

Sl. No	Name	Address	Mobile No.	Email Id
	University Nominee: **Dr. L. Jeyaprabha**	Associate Professor & Head, Department of Zoology, Sarah Tucker College(Autonomous,) Tirunelveli – 627007	99940 32157	Jeyaprabha2009@gmail.com
	Subject Exper University:			
1	**Dr. T. Ramesh Kumar**	Professor & Head, Co ordinator , DDE Wing, Department of Zoology, Annamalai University, Annamalai Nagar - 608002	98949 83901 94893 61412	ktrameshau@gmail.com
2	**Dr. P.Velladurai**	Associate Professor P.G & Research Department of Zoology The American College Madurai - 625002	99425 11574	gideonvelladurai@gmail.com
	Industrialist: **Dr. J. Jaslin Edward**	Managing Director, Cape Bio Lab& Research Centre, No. 27, 3rd floor CSI Shopping Complex, Marthandam , Kanniyakumari - 629165	99941 72256 63812 05610	capebiolab@gmail.com
	Alumni: **Dr. Rajkumar Rajan**	Scientist E, Officer in Charge, Marine Biology Regional Centre, Zoological Survey of India, Chennai - 600028	94453 95077	raj@zsi.gov.in

Sl. No.	NAME	DESIGNATION
1.	S/Lt. Dr. V. Robin Perinba Smith	Faculty Head - Associate Professor
2.	**Dr. D. Selvaraj**	Member Secretary - Associate Professor
3.	**Dr. P. Justin Kumar**	Associate Professor
4.	**Dr. M. P. Jeyasekhar**	Associate Professor
5.	**Dr. C. Albert**	Assistant Professor
6.	**Dr. Shirley Daniel**	Assistant Professor
7.	**Dr. R. Leena**	Assistant Professor
8.	**Dr. E. Grace Marin**	Assistant Professor
9.	**Dr. P. Beautlin Sheribha**	Assistant Professor
10.	**Dr. D. DeleepPackiaraj**	Assistant Professor
11.	**Dr. J. Georgina**	Assistant Professor
12.	**Dr. Jebitta M. Shirlin**	Assistant Professor

Scott Christian College (Autonomous) defines the focus reinforcing its academic programmes and student life experience on campus through the Graduate Attributes (GA), that describe the knowledge, competencies, values and skills students imbibe for holistic development, multidisciplinary development and contribution to society. These attributes comprise characteristics that are transferable beyond the sphere of study into the national and international realm through curricular, co-curricular and extra-

curricular engagements. They equip graduates for life long personal development and employment. Every Graduate of Scott Christian College (Autonomous) – (SCC) is desired to possess the following Graduate Attributes:

GA 1: Intellectual Competencies

Graduates of SCC

- have a comprehensive and incisive understanding of their domain of study as well as the ability for cross-disciplinary learning
- have the ability to apply the knowledge acquired through the curriculum as well as self-directed learning to a broad spectrum ranging from analytical thinking to synthesize new knowledge through research
- are able to have critical, independent and individual outlook regarding academic work and socially relevant issues

GA 2: Problem Solving

Graduates of SCC

- have the capacity to extrapolate from what has been learnt, translate concepts to real-life situations and apply acquired competencies in the required contexts to generate solutions to specific problems
- can view a problem or a situation from multiple perspectives and think 'out ofthe box' and generate solutions to complex problems in unfamiliar contexts
- are effective problems-solvers, able to apply critical, creative and evidence- based thinking to conceive innovative responses to challenges

GA 3: Communication Skills

Graduates of SCC

- listen carefully, analyse texts and research papers, and present complexinformation in a clear and concise manner
- express thoughts and ideas effectively in writing and orally and communicatewith others using appropriate media
- confidently express herself/himself and construct logical arguments usingcorrect technical language related to a field of learning and area of professional practice

GA 4: Environmental Awareness

Graduates of SCC

- lessen the effects of environmental degradation, climate change, and pollution

- learn the nuances for cleanliness, conservation and wise use of resources sothat it can be used for generations
- know the nuances of waste management, conservation of biological diversity,management of biological resources and biodiversity, and sustainable development and living

GA 5: Professional Ethics

Graduates of SCC

- develop principled and expert behavior, and this will be showcased in theirchosen careers and constructive roles as citizens of the world at large
- imbibe intellectual integrity and ethics in scholarly engagement and develop a spirit of inclusiveness through interactions with diverse people at all levels in life
- acquire new knowledge and skills, including 'learning how to learn' skills, for pursuing learning activities throughout life and adapting to changing demands of the workplace through knowledge, skill development and reskilling, ethically

GA 6: Leadership Qualities

Graduates of SCC

- inculcate leadership qualities and attitudes, and team behaviour along autonomous lines through curricular, co-curricular and extra-curricular activities
- develop managerial and entrepreneurial skills to create new opportunities fordiverse careers and gear up to take up competitive examinations
- act together as a group or a team in the interests of a common cause andworkefficiently as a member of a team

GA 7: Holistic Skill Development

Graduates of SCC

- develop critical thinking, problem-solving capacity, effective communication, andsocial skills
- are self-aware, flexible, resilient and have the capacity to accept and giveconstructive feedback and cope up with stress
- develop soft skills, e-skills and life skills to live, learn and work in the technicallysound society globally and use appropriate digital methods for analysis of data

GA 8: Cross-Cultural Competencies

Graduates of SCC

- gain cross-cultural competencies through engaging with diverse linguistic, ethnic and religious communities and know how to understand, accept and appreciate individuals at local, national and international levels

- develop a global perspective through contemporary curriculum, culture, language and international exchange programmes
- acquire knowledge of the values and beliefs of multiple cultures and a global perspective to honour diversity, gender sensitivity and adopt gender-neutral approach and show empathy to the less advantaged and the differently-abled

GA 9: Community Engagement

Graduates of SCC

- are sensitive to social concerns and have conviction toward social justice throughactive social engagement
- are endowed with a strong sense of environmental awareness through thecurriculum and a friendly and serene campus eco-system.
- formulate an inspiring vision and build a team that can help achieve the vision, andmotivate people to the right destination

GA 10: Value-Based Ethical Competency

Graduates of SCC

- are rooted in the principles of ethical responsibility and integrity permeated with Christian values, leading to the building of character and constitutional values
- develop virtues such as truth, love, courage, unity, integrity, brotherhood, industryand uprightness
- practise responsible national and global citizenship required for responding to contemporary challenges, enabling learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies

Learning Outcomes Descriptors for a Higher Education Qualification at Level 6 on the NHEQF

The Bachelor's degree (Honors / Honors with Research) or the Post-Graduate Diploma is awarded to students who have demonstrated the achievement of the outcomes located at level 6 on the NHEQF.

Descriptors for qualifications at levels 6 on the NHEQF

Element of the Descriptor	**NHEQF Level Descriptors**
Knowledge and understanding	The graduates should be able to demonstrate the acquisition of: • advanced knowledge about a specialized field of enquiry, with depth in one ormore fields of learning within a broad interdisciplinary context. • a coherent understanding and awareness of the established methods andtechniques of research and enquiry • procedural knowledge required for performing and accomplishingprofessional tasks
General, Technical and Professiona ISkills	The graduates should be able to demonstrate the acquisition of: • a range of cognitive and technical skills required for performing and accomplishing complex tasks required to undertake research to generate solutions to real-life problems • generating solutions to complex problems independently, requiring the exercise of full personal judgement, responsibility, and accountability for the
	output of the initiatives taken as a practitioner • apply advanced knowledge relating to research methods to carry out research and investigations to formulate evidence-based solutions to complex and unpredictable problems
Generic Learning Outcomes	The graduates should be able to demonstrate the ability to: • communicate technical information and explanations, and the findings/ results of the research studies relating to specialized fields of learning and pursue self-paced and self-directed learning • present in a concise manner one's views on the relevance and applications of the findings of research and evaluation studies in the context of emerging developments and issues. • define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and-effect relationships
Constitutional, Humanistic, Ethical, and Moral Values	The graduates should be able to demonstrate the willingness and ability to: • embrace and practice constitutional, humanistic, ethical, and moral values in professional practice and life. • present coherent arguments in support of relevant ethical and moral issues andparticipate in actions to address environmental and sustainable development issues. • follow ethical practices in all aspects of research and

	development
Employability and Entrepreneurship Skills	The graduates should be able to demonstrate the acquisition of knowledge and skills required for: • adapting to the future of work and to the demands of the fast pace of technological developments and innovations that drive a shift in employers' demands for skills • managing complex technical or professional activities or projects • should be willing to take a calculated risk and be open to new ideas
Credit Requirements	A Post-Graduate Diploma programme builds on a 3-year/6-semester bachelor's degree and requires a minimum of 40 credits for individuals who have completed aBachelor's programme.
Entry Requirements	• An individual seeking admission to the bachelor's degree (Honours/ Honourswith Research) in a specified field of learning would normally have completed all requirements of the relevant 3-year Bachelor's degree.

Learning Outcomes Descriptors for a Higher Education Qualification at Level 6.5 on theNHEQF

The Master's degree (e.g. M.A., M.Com., M.Sc., etc.) is awarded to students who havedemonstrated the achievement of the outcomes located at level 6.5 on the NHEQF.

Descriptors for qualifications at levels 6.5 on the NHEQF

Element of theDescriptor	**NHEQF Level Descriptors**
Knowledge and Understanding	The graduates should be able to demonstrate the acquisition of: • advanced knowledge about a specialized field of enquiry with a critical understanding of the emerging developments and issues relating to one or more fields of learning • advanced knowledge and understanding of the research principles, methods, and techniques applicable to the chosen field of learning or professional practice, • procedural knowledge required for performing and accomplishing complex, specialized and professional tasks relating to teaching, and research and development.
General, Technical andProfessional Skills	The graduates should be able to demonstrate the acquisition of: • advanced cognitive and technical skills required for performing and accomplishing complex tasks related to the chosen fields of learning. • advanced cognitive and technical skills required for evaluating research findings and designing and conducting relevant research that contributes to the generation of new knowledge. • specialized cognitive and technical skills relating to a body of knowledge and practice to analyze and synthesize complex information and problems.
Application of Knowledge and Skills	The graduates should be able to demonstrate the ability to: • apply the acquired advanced theoretical and/or technical knowledge about a specialized field of enquiry or professional practice and a range of cognitive and practical skills to identify and analyze problems and issues associated with the chosen fields of learning. • apply advanced knowledge relating to research methods to carry out research and investigations and to formulate evidence-based solutions to complex and unpredictable problems. • develop appropriate tools for data collection for research

Generic Learning Outcomes	The graduates should be able to demonstrate the ability to: • communicate in a well-structured manner, technical information and explanations, and the findings/results of the research studies undertaken in the chosen field of study, • evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and address opposing viewpoints • pursue self-paced and self-directed learning to upgrade knowledge and skills, including research-related skills, required to pursue a higher level of education and research.
Constitutional, Humanistic, Ethical,and Moral Values	The graduates should be able to demonstrate the willingness and ability to: • embrace and practice constitutional, humanistic, ethical, and moral values in one's life and in the field of study and professional practice, • participate in actions to address environmental protection and sustainable development issues, • follow ethical principles and practices in all aspects of research and development, including inducements for enrolling participants and avoid unethical practices
Employability and Entrepreneurship Skills	The graduates should be able to demonstrate the acquisition of knowledge and skill sets required for: • adapting to the future of work and responding to the demands of the fast pace of technological developments and innovations that drive the shift in employers' demands for skills • transition towards more technology-assisted work involving the creation of new forms of work and rapidly changing work and production processes. • exercising full personal responsibility for the output of own work as well as for group outputs and for managing work that is complex and unpredictable requiring new strategic approaches.
Credit Requirements	• The 2-year/4-semester Master's programme builds on a 3-year/6-semester bachelor's degree and requires a total of a minimum of 80 credits from the first and second years of the programme, with a minimum of 40 credits in the first year and minimum of 40 credits in the second year of the programme at level 6.5 on the NHEQF.
Entry Requirements	• A 3-year Bachelor's degree for the 2-year/4-semester Master's degreeprogramme (e.g. M.A., M.Com., M.Sc., etc.).

PLO & GA Mapping

Programme Learning Outcome #	Programme Learning Outcome(PLO)	Description of PLO	PLO Mapped with GA#
PLO 1	Learning Dispositions	Recognize and reflect on the production ofknowledge in multiple spaces	GA 1 GA 8
		Develop the leadership capacity to negotiateintercultural learning spaces	GA 1 GA 6 GA 8
		Engage dialogically with distinct and/or intersecting intellectual communities todevelop the scope of inquiry	GA 2 GA 3
PLO 2	Domain specific knowledge	Develop intensive and extensive knowledgeand expertise in their respective domains	GA 1
		Formulate and extrapolate the knowledge gained to be applied in real–life situations, for self-directed learning and in competitive examinations	GA 1 GA 2 GA 3
		Evaluate and create domain specific knowledge in areas of learning, research and industry	GA 1 GA 2
PLO 3	Application oriented knowledge and diverse perspectives	Translate theoretical understandingto experimental knowledge for solving complex problems	GA 1 GA 3
		Ability to solve problems using pragmatic, alternative and creative approaches	GA 1 GA 2 GA 3 GA 5
		Capacity to apply advanced knowledge and approaches to solve concrete and abstract problems in domain-related and multi-disciplinary issues.	GA 1 GA 2
PLO 4	Innovation and research	Develop aptitude for innovation and entrepreneurship	GA 6

		Identify contemporary research problems, analyze data qualitatively and quantitatively and propose solutions	GA 1 GA 2 GA 9
		Create new ideas, analyze problems, diagnose them and identify their causes independently and/or in groups	GA 6 GA 7
PLO 5	Scientific communication skills	Document, prepare and present research work as reports and articles in academic Forums	GA 6
		Critically assess, review and present theories and concepts	GA 1
		Take technically complex scientific topics and craft them into accessible, informative, and compelling content for specific audiences	GA 1 GA 2
PLO 6	Digital competency	Use domain-related advanced software resources, computational skills and digital tools for data analysis and interpretation	GA 2 GA 5
		Ethically apply digital skills to creatively communicate ideas and issues related to academic experiences	GA 5 GA 10
		Acquire the ability to leverage digital technologies to communicate, collaborate, and analyze data	GA 5
PLO 7	Ethical reasoning	Apply domain specific ethical principles and practices in academic, professional and social engagements	GA 1 GA 5
		Transform the behaviour of students to preserve public interest, the environment and be a source of help	GA 4 GA 5
		Being honest and taking responsibility for academic work and environmental Sustainability	GA 4 GA 5

PLO 8	Comparative and interdisciplinary knowledge practices	Develop an interdisciplinary approach to Research	GA 1 GA 7
		Compare scientific, social and historical phenomena in order to yield new insights	GA 1 GA 9
		Articulate how the complexities of social differentiation, like sex, gender, disability, race, ethnicity, nation, class, and such give insights and shape intellectual projects	GA 3 GA 5 GA 8 GA 9
PLO 9	Career readiness	Choose from diverse career options available in local, national and international realms.	GA 8
		Find success in workplace, manage one's career and apply the skills learned	GA 7
		Carry out further research or pursue higher education in the country or abroad	GA 1
PLO 10	Creating collaboration with the corporate world	Cultivate relationship with mentors and advisors, whose expertise and experience can assist in the development of work	GA 3 GA 7
		Recognize and reflect on the value, effectiveness, and ethics of collaboration in different settings and situations	GA 5 GA 9
		Produce new knowledge by working at the intersection of multiple disciplines and interdisciplinary fields	GA 1

METHODS OF ASSESSMENT

Remembering (K1)	• The lowest level of questions require students to recallinformation from the course content • Knowledge questions usually require students toidentify information in the textbook
Understanding (K2)	• Understanding of acts and ideas by comprehending organizing, comparing, translating, interpolating andinterpreting in their own words • The questions go beyond simple recall and require students to combine the ideas together
Application (K3)	• Students have to solve problems by using/applying aconcept learned in the classroom • Students must use their knowledge to determineexact response
Analyze (K4)	• Analyzing the question by asking students to breakdown something into its component parts • Analyzing requires students to identify reasons,causes or motives and reach conclusions or Generalizations
Evaluate (K5)	• Evaluation requires an individual to make judgmenton something • Questions to judge the value of an idea, a character, awork of art, or a solution to a problem • Students are engaged in decision-makingandproblem–solving
Create (K6)	• The questions of this category challenge students toget engaged in creative and original thinking • Developing original ideas and problem solving skills

Cognitive Level (CL)

No.	Code	Cognitive Level
1	R	Remember
2	U	Understanding
3	Ap	Apply
4	An	Analyse
5	E	Evaluate
6	C	Create

Knowledge Category (KC)

No	Code	Knowledge
1	F	Factual
2	C	Conceptual
3	P	Procedural
4	M	Metacognitive

Learning Activities

Participative Learning

No	Code	Description
1	GD	Group Discussion
2	SI	Simulation
3	OO	One to One Learning
4	RF	Rapid Fire
5	KWL	Know, Want to Know, Learned
6	Sem	Seminar
7	WSQ	Watch Summarise Question
8	FC	Flipped Class

Cooperative Learning

No	Code	Description
1	Lec	Lecture
2	Soc	Socrates Method
3	BS	Brain Storming
4	GT	Group Learning
5	OT	One to One Tutoring

Peer Learning

No	Code	Description
1	TPS	Think Pair Share
2	RPT	Reciprocal Peer learning
3	PT	Peer Learning

Experiential Learning

No	Code	Description
1	RP	Roleplay
2	FW	Fieldwork
3	MPr	Micro/Mini Project
4	Pr	Project
5	Viv	Viva-Voce
6	Rep	Report Writing
7	Rev	Review Writing
8	CW	Critique Writing

Problem Solving Method

No	Code	Description
1	CS	Case Study
2	Ess	Essay
3	AW	Article Writing
4	SP	Solution to Problem
5	PF	Problem Finding

Assessment Task

No	Code	Description
1	CA	Class Assignment
2	HrA	Hour Assignment
3	CT	Class Test
4	ST	Self Test
5	OT	Online Test
6	OBT	Open Book Test
7	Qui	Quiz
8	HoA	Home Assignment
9	MCQ	Multiple Choice Question
10	SA	Short Answer
11	Ess	Essay

METHODS OF EVALUATION

Evaluation	Methods	Marks
Internal	Continuous Internal Assessment Test	**40**
	Assignments / Snap Test / Quiz	
	Seminars	
	Attendance and Class Participation	
External	End Semester Examination	**60**
Total		**100**

M.Sc. ZOOLOGY CURRICULUM TABLE

Year	Semester	Module No.	Courses	Subject Code	Hours							Total Hours	Credits
					Lecture	Tutorial	Practical	Internship	Self-Learning	Demonstration	Research Project		
I	I	1.1	Core Course 1 - **Structure and Function of Invertebrates**	**23PZ11**	6							6	4
		1.2	Core Course 2- **Comparative Anatomy of Vertebrates**	**23PZ12**	6							6	4
		1.3	Core Course 3 - Practical I- **Lab Course in Invertebrates and Chordates**	**23PZP1**			6					6	4
		1.4	Discipline Specific Elective1 **Molecules and their interaction relevant to Biology**	**23PZEA**	6							6	4
		1.5	Discipline Specific Elective 2- **Biostatistics**	**23PZEB**	6							6	4
		1.6	Project									0	2
			Total									30	20
I	II	2.1	Core Course 4 - **Cellularand Molecular Biology**	**23PZ21**	6							6	4
		2.2	Core Course 5 - - **Developmental Biology**	**23PZ22**	6							6	4

		2.3	Core Course 6 -Practical II - **LabCourse in CellBiology& DevelopmentalBiology**	**23PZP2**			6					6	4
		2.4	Discipline Specific Elective3- **ResearchMethodology**	**23PZEC**	6							6	4
		2.5	Discipline Specific Elective 4-(ID) **Agricultural Entomology**	**23PZN1**	6							6	4
			Total									30	20
II	III	3.1	Core Course 7 - Genetics	**23PZ31**	6							6	4
		3.2	Core Course 8 - Project	**23PZD1**			6					6	4
		3.3	Core Course 9 - Lab course in Genetics and Aquaculture	**23PZP3**			6					6	4
		3.4	Discipline Specific Elective5- Immunology	**23PZED**	6							6	4
		3.5	Discipline Specific Elective6- Aquaculture	**23PZEE**	6							6	4
		3.7	Internship									0	4
			Total									30	24
II	IV	4.1	Core Course 10 - Animal Physiology	**23PZ41**	6							6	4
		4.2	Core Course 11- Environmental Biology	**23PZ42**	6							6	4
		4.3	Core Course 12- Lab course in Ecophysiology	**23PZ43**	6							6	4
		4.4	Discipline Specific Elective7- Animal Behaviour	**23PZEF**	6							6	4

		4.5	Discipline Specific Elective 8-Sericulture	23PZEG			6					6	4
				Total								30	20
	Total Credits for the PG Zoology Programme												84

Frame work / Credit Distribution for M.Sc. Zoology
Semester – I
(Credit Level- 6.0)

List of Courses	Sub. Code	Name	Credits	Credit Points	No. of Hours
Core Course (Major) (CC 1)	23PZ11	Structure and Function of Invertebrates	4	24	6
Core Course (Major) (CC 2)	23PZ12	Comparative Anatomy of Vertebrates	4	24	6
Core Course (Major) (CC 3)	23PZP1	Lab Course in Invertebrates and Chordates	4	24	6
Discipline Specific Elective (DSE1)	23PZEA	Molecules and their interaction relevant to Biology	4	24	6
Discipline Specific Elective (DSE 2)	23PZEB	Biostatistics	4	24	6
	Total		**20**	**120**	**30**

Semester- II
(Credit Level- 6.0)

List of Courses	Sub. Code	Course Title	Credits	Credit Points	No. of Hours
Core Course (Major) (CC 4)	23PZ21	Cellular and Molecular Biology	4	24	6
Core Course (Major) (CC 5)	23PZ22	Developmental Biology	4	24	6
Core Course (Major) (CC 6)	23PZP2	Lab Course in Cell Biology & DevelopmentalBiology	4	24	6

Discipline Specific Elective Course (DSE 3)	23PZEC	Research Methodology	4	24	6
Discipline Specific Elective Course (DSE 4)/ Interdisciplinary Course	23PZN1	Agricultural Entomology	4	24	6
	Total		**20**	**120**	**30**

***Internship during the I year vacation**

Semester- III
(Credit Level- 6.5)

List of Courses	Sub. Code	Course Title	Credits	Credit Points	No. of Hours
Core Course (Major) (CC 7)	23PZ31	Genetics	4	26	6
*Core Course (Major) (CC 8)	23PZ32	Project	4	26	6
Core Course (Major) (CC 9)	23PZP3	Lab course in Genetics and Aquaculture	4	26	6
Discipline Specific Elective Course (DSE 5)	23PZED	Immunology	4	26	6
Discipline Specific Elective Course (DSE 6)	23PZEE	Aquaculture	4	26	6
Internship**			4	26	-
	Total		**24**	**156**	**30**

*** Core Course (CC 8) converted as Project**

****Internship during the I year vacation. The Credits shall be awarded in Semester – III Statement of Marks**

Semester- IV
(Credit Level- 6.5)

List of Courses	Sub. Code	Course Title	Credits	Credit Points	No. of Hours
Core Course (Major) (CC 10)	23PZ41	Animal Physiology	4	26	6
Core Course (Major) (CC 11)	23PZ42	Environmental Biology	4	26	6
Core Course (Major) (CC 12)	23PZ43	Lab Course in Eco-Physiology and	4	26	6
Discipline Specific Elective Course (DSE 7)	23PZEF	Animal Behavior	4	26	6
Discipline Specific Elective Course (DSE 8)	23PZEG	Sericulture	4	26	6
	Total		**20**	**130**	**30**

SEMESTER I
STRUCTURE AND FUNCTION OF INVERTEBRATES

Course Title: **Structure and Function of Invertebrates**	Sub Code: 23PZ11	Course Type: Theory

Total Hours: 90	Hours/Week: 6
Credits: 4	

Pass-Out Policy: Minimum Contact Hours: 54
Total Score %:100 Internal: 40 External: 60
Minimum Pass %: 50[No Minimum for Internal]

Course Creator	Expert 1	Expert 2
Dr. Shirley Daniel	Dr. C. Albert	Dr. E. Grace Marin
Associate Professor	Associate Professor	Assistant Professor
Department of Zoology	Department of Zoology	Department of Zoology
Scott Christian College (Autonomous)	Scott Christian College (Autonomous)	Scott Christian College (Autonomous)

CLO-No.	Course Learning Outcomes *Upon completion of this course, students will be able to:*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA#	Cognitive Level (CL)	Knowledge Category (KC)
CLO-1	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.	3 [15], 5 [5]	6, 7	R	F, M
CLO-2	Understand the evolutionary process. All are linked in a sequence of life patterns.	4 [10], 5 [10]	1, 2, 7	U, R	F, P
CLO-3	Apply this for pre-professional work in agriculture and conservation of life forms.	3 [5], 5 [15]	1, 8	An, Ap	P
CLO-4	Analyze what lies beyond our present knowledge of life process.	5 [8], 8[12]	1, 6	An, C	M, P
CLO-5	Evaluate and to create the perfect phylogenetic relationship in classification.	3 [7], 5 [13]	1, 2, 8	Ev, C	M

Module	Course Description	Hours	% of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
1.1	**Structure and function in invertebrates:** Principles of Animal taxonomy.	4	CO-1[10]	Lec	CT	1, 1
1.2	Species concept.	4	CO-4 [10]	Lec	ST	1, 1
1.3	International code of zoological nomenclature.	3	CO-1[20] CO-5[10]	Rep	OBT	1, 1
1.4	Taxonomic procedures.	4	CO-1[10] CO-5[10]	WSQ	OT	1, 1
1.5	New trends in taxonomy	3	CO-3[10] CO-4[20]	Rep	MCQ	1, 1
2.1	**Organization of coelom:** Acoelomates; Pseudocoelomates.	4	CO-1 [10]	OO	Pr	1, 2
2.2	**Coelomates**	3	CO-2[20] CO-5[10]	Sem	ST	1, 2

2.3	Protostomia and Deuterostomia.	3	CO-1[10] CO-5[10]	KWL	CT	1, 2
2.4	**Locomotion:** Flagella and ciliary movement in Protozoa.	4	CO-3[10]	Lec	OT	1, 2
2.5	Hydrostatic movement in Coelenterata, Annelida and Echinodermata.	4	CO-3[10] CO-4[10] CO-5[10]	Lec	OBT	1, 2
3.1	**Nutrition and Digestion:** Patterns of feeding and digestion in lower metazoan.	4	CO-5[20]	GD	CA	1,3
3.2	Filter feeding in Polychaeta, Mollusca and Echinodermata.	3	CO-5[30]	GT	HrA	1
3.3	**Respiration: Organs of respiration:** Gills, lungs and trachea.	4	CO-1[15]	Rev	CT	2,3
3.4	Respiratory pigments.	3	CO-1[20]	OT	HoA	1
3.5	Mechanism of respiration.	4	CO-1[15]	GT	HoA	1,2
4.1	**Excretion:** ***Organs of excretion:*** coelom, coelomoducts, Nephridia and Malpighian tubules - Mechanisms of excretion.	4	CO-1[10] CO-2[10]	Lec	Qui	1
4.2	Excretion and osmoregulation.	4	CO-2[10] CO-4[10]	PT	MCQ	1
4.3	**Nervous system: Primitive nervous system:** Coelenterata and Echinodermata.	3	CO-2[10] CO-4[10]	Rep	OT	1
4.4	**Advanced nervous system:** Annelida, Arthropoda (Crustacea and lnsecta) and Mollusca (Cephalopoda).	4	CO-3[10] CO-4[10]	Lec	OBT	1
4.5	Trends in neural evolution	3	CO-2[10] CO-5[10]	Lec	OT	1
5.1	**Invertebrate larvae:** Larval forms of free living invertebrates.	4	CO-2[15] CO-3[20]	Rev	HoA	1, 3
5.2	Larval forms of parasites.	3	CO-2[15] CO-3[20]	Lec	GT	1, 2

5.3	Strategies and evolutionary significance of larval forms.	4	CO-4[10]	FW	Ess	1, 3
5.4	**Minor Phyla:** Concept and significance.	4	CO-4[10]	MPr	MCQ	1,4
5.5	Organization and general characters.	3	CO-1[10]	Lec	SA	1, 4

Reference Books

1. Barrington, E. J.W. 1979. Invertebrate Structure and Function. The English Language Book Society and Nelson, pp-765.
2. Barnes, R. D. 1974. Invertebrate Zoology, (Second Edition), Holt-Saunders International Edition, pp-1024.
3. Barnes, R. S. K., P. Calow, P. J. W. Olive, D. W. Golding, J. J. Spicer. 2013. The Invertebrates: A Synthesis. Third Edition. John Wiles & Sons Inc., Hoboken. New Jersey, New Delhi.
4. Dechenik, J. A. 2015. Biology of Invertebrates (Seventh Edition). Published by McGraw Hill Education (India) Private Limited, pp-624.

COMPARATIVE ANATOMY OF VERTEBRATES

Course Title: **Comparative Anatomy of Vertebrates**	Sub Code: 23PZ12	Course Type: Theory

Total Hours: 90 Hours/Week: 6
Credits: 4

Pass-Out Policy: Minimum Contact Hours: 54

Total Score %:100 Internal: 40 External: 60

Minimum Pass %: 50 [No Minimum for Internal]

Course Creator	Expert 1	Expert 2
Dr. Shirley Daniel	Dr. R. Leena	Dr. Jebitta M. Shirlin
Associate Professor	Associate Professor	Assistant Professor
Department of Zoology	Department of Zoology	Department of Zoology
Scott Christian College (Autonomous)	Scott Christian College (Autonomous)	Scott Christian College (Autonomous)

CLO-No.	Course Learning Outcomes *Upon completion of this course, students will be able to:*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA#	Cognitive Level (CL)	Knowledge Category (KC)
CLO-1	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.	8(8), 5(7) 3(5)	1, 2, 7	U	F
CLO-2	Understand the evolutionary process. All are linked in a sequence of life patterns.	2(4), 4(5), 8(6), 5(5)	6,7	U, R	F
CLO-3	Apply this for pre-professional work in agriculture and conservation of life forms.	2(5), 3 (5), 7(5), 8(5)	1	An, R	P
CLO-4	Analyze what lies beyond our present knowledge of life process.	2(6), 5(8), 7(6)	1,6	An, C	M
CLO-5	Evaluate and to create the perfect phylogenetic relationship in classification.	1(10),4 (5), 10 (5)	1, 2	An, Ap	M

Module	**Course Description**	**Hours**	**% of CLO mapping with Module**	**Learning Activities**	**Assessment Tasks**	**Reference**
1.1	Origin of vertebrates: Concept of Protochordata.	5	CO-1[20]	BS	CT	3, 4
1.2	The nature of vertebrate morphology.	4	CO-1[20] CO-2[10]	Lec	ST	3, 4
1.3	Definition, scope and relation to other disciplines.	4	CO-1[20]	Sem	HoA	3, 4
1.4	Importance of the study of vertebrate morphology.	5	CO-3[20] CO-4[10]	AW	MCQ	3, 4
2.1	Origin and classification of vertebrates.	6	CO-1[25]	Lec	Pr	3,4
2.2	Vertebrate integument and its derivatives.	6	CO-2[40]	Rep	ST	1

2.3	Development, general structure and functions of skin and its derivatives - Glands, scales, horns, claws, nails, hoofs, feathers and hairs.	6	CO-2[35]	KWL	CT	1
3.1	**Circulation:** General plan of circulation in various groups.	2	CO-1[10]	GD	CA	3,4
3.2	Blood.	2	CO-1[10]	GT	HrA	3,4
3.3	Evolution of heart.	3	CO-2[10] CO-4[10]	CS	CT	3,4
3.4	Evolution of aortic arches and portal systems.	2	CO-1[10] CO-2[10]	OT	HoA	3,4
3.5	**Respiratory system:** Characters of respiratory tissue.	3	CO-1[20]	Lec	HoA	3,4
3.6	Internal and external respiration.	3	CO-1[10]	KWL	ST	3,4
3.7	Comparative account of respiratory organs.	3	CO-5[10]	WSQ	ST	3,4
4.1	**Skeletal system:** Form, function, body size and skeletal elements of the body.	3	CO-1[20]	Lec	Qui	3,4
4.2	Comparative account of jaw suspensorium.	4	CO-2[10] CO-5[10]	PT	MCQ	3,4
4.3	Comparative account of vertebral column.	4	CO-2[10] CO-5[10]	Rep	OT	3,4
4.4	Comparative account of limbs and girdles.	3	CO-2[10] CO-5[10]	Lec	OBT	3,4
4.5	Evolution of urinogenital system in vertebrate series.	4	CO-5[20]	Lec	OT	3,4
5.1	**Sense organs:** Simple receptors.	2	CO-3[10]	Rev	HoA	3, 4
5.2	Organs of olfaction and taste.	2	CO-3[10] CO-4[5]	Lec	GT	3, 4
5.3	Lateral line system.	2	CO-3[10] CO-4[10]	FW	Ess	3, 4

5.4	Electroreception.	2	CO-3[10] CO-4[10]	MPr	MCQ	3, 4
5.5	**Nervous system:** Comparative anatomy of the brain in relation to its functions.	3	CO-2[10] CO-5[5]	Lec	SA	3, 4
5.6	Comparative anatomy of spinal cord.	3	CO-4[10]	Pr	HoA	3, 4
5.7	Nerves - Cranial, Peripheral and Autonomous nervous systems.	4	CO-4[10]	Lec	Ess	3, 4

Reference Books
1. Swayam Prabha https://www.swayamprabha.gov.in/index.php/program/archive/9
2. Yong, J. Z. 1981. The life of Vertebrates, English language Book society, London, pp-645.
3. Romer, A.S. 1971. The Vertebrate body, W.B.S. Saunders, Philadelphia, pp-600.
4. Waterman, A.J. 1972. Chordate Structure and Function, MacMillan Co., New York, pp.587
5. Parker T. J. and W. A. Haswell. 1962. A text book of Zoology, Vol. 2, Vertebrates, 7th Edition, Mac Millan Press, London, pp-750.
6. Ekambaranatha Ayyar and T. N. Ananthakrishnan. 2009. Manual of Zoology, Vol – II, S. Viswanathan Pvt. Ltd. Chennai.
7. Kotpal, 2019. R.L. Modern Text Book of Zoology Vertebrates, 4th Edition, Rastogi Publications, Meerut, pp-968

LAB COURSE IN INVERTEBRATES & CHORDATES

Course Title: **Lab Course in Invertebrates and Chordates**	Sub Code: 23PZP1	Course Type: Practical

Total Hours: 90 Hours/Week: 6
Credits: 4

Pass-Out Policy: Minimum Contact Hours: 54

Total Score %:100 Internal: 40 External: 60

Minimum Pass %: 30 [No Minimum for Internal]

Course Creator	Expert 1	Expert 2
Dr. P. Justin Kumar Associate Professor Department of Zoology Scott Christian College (Autonomous)	Dr. Shirley Daniel Associate Professor Department of Zoology Scott Christian College (Autonomous)	Dr. R. Leena Associate Professor Department of Zoology Scott Christian College(Autonomous)

CLO-No.	**Course Learning Outcomes** *Upon completion of this course, students will be able to:*	**% of PLO Mapping with CLO**	**CLO & PLO Mapped with GA#**	**Cognitive Level (CL)**	**Knowledge Category (KC)**
CLO-1	Understand the structure and functions of various systems in animals	1[20]	6, 7	U, An	P
CLO-2	Learn the significant features of different groups of animals	2[20]	2, 6	R, U	P
CLO-3	Learn the adaptive features of different groups of animals	1[20]	1, 2, 7	App	P
CLO-4	Learn the mounting techniques	2 [20]	1, 8	Ap, C	P
CLO-5	Acquire strong knowledge on the animal skeletal system	3 [20]	1, 6	An	P

Module	Course Description
1.1	**Invertebrates** **Dissection** Earthworm: Nervous system *Pila*: Digestive and nervous systems *Sepia*: Nervous system Cockroach: Nervous system Grasshopper: Digestive system and mouth parts Prawn: Appendages, nervous and digestive systems
1.2	Crab: Nervous system
2.1	**Spotters** 1. Scorpion 2. *Penaeus indicus* 3. *Emerita* (*Hippa*) *Perna virids*
2.2	**Mounting** Earthworm: Body setae *Pila*: Radula Cockroach: Mouth parts Grasshopper: Mouth parts
3	**Chordates:** **Study the nervous system of Indian dog shark - Dissection** 1. Nervous system of *Scoliodon laticaudatus* – 5^{th} or Trigeminal nerve 2. Nervous system of *Scoliodon laticaudatus* – 7^{th} or Facial nerve Nervous system of *Scoliodon laticaudatus* – 9^{th} & 10^{th} or Glossopharyngeal & Vagus nerve

4	**Study of the following specimens with special reference to their salient features and their modes of life** 1. *Amphioxus* sp. (Lancelet) 2. *Ascidia* sp. (sea squirt) 3. *Scoliodon laticaudatus* (Indian dog shark) 4. *Trygon* sp. (Sting ray) 5. *Torpedo* sp. (Electric ray) 6. *Arius maculatus* (Cat fish) 7. *Belone cancila* (Flute fish) 8. *Exocoetus poecilopterus* (Flying fish) 9. *Mugil cephalus* (Mullet) 10. *Tilapia mossambicus* (Tilapia) 11. *Rachycentron canadum* (Cobia) 12. *Tetrodon punctatus* (Puffer fish) 13. *Dendrophis* sp. (Tree snake)
5.1	**Study of the different types of scales in fishes** 1. Cycloid scale 2. Ctenoid scale 3. Placoid scale
5.2	**Study of the frog skeleton system (Representative samples)** 1. Entire skeleton 2. Skull 3. Hyoid apparatus 4. Pectoral girdle & sternum 5. Pelvic girdle 6. Fore limb Hind limb
5.3	**Mounting** Weberian ossicles of fish

Reference Books:

1. Preeti, G., and C. Mridula, 2000. Modern Experimental Zoology, Indus International Publication.
2. Sinha, J., A. K. Chatterjeee, P. Chattopadhya. 2011. Advanced Practical Zoology, Arunabha Sen Publishers, pp-1070.
3. Lal, S.S. 2009. Practical Zoology, Rastogi Publications, pp-484.
4. Iuliis G. D. and D. Pulerà, 2007. The Dissection of Vertebrates: A Laboratory Manual. Academic Press, Imprint of Elsevier Publication, pp-416.
5. Verma, P.S. 2000. Manual of Practical Zoology: Chordates, S. Chand Publishing Company, pp-528

MOLECULES AND THEIR INTERACTION RELEVANT TO BIOLOGY

Course Title: **Molecules and their interaction relevant to Biology**	Sub Code: 23PZEA	Course Type: Theory

Total Hours: 90 Hours/Week: 6 Credits: 4

Pass-Out Policy: Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50 [No Minimum for Internal]

Course Creator	Expert 1	Expert 2
Dr. V. Robin Perinba Smith	Dr. D. Selvaraj	Dr. P. Beautlin Sheribha
Associate Professor	Associate Professor	Assistant Professor
Department of Zoology	Department of Zoology	Department of Zoology
Scott Christian College (Autonomous)	Scott Christian College (Autonomous)	Scott Christian College (Autonomous)

CLO-No.	**Course Learning Outcomes** *Upon completion of this course, students will be able to:*	**% of PLO Mapping with CLO**	**CLO & PLO Mapped with GA#**	**Cognitive Level (CL)**	**Knowledge Category (KC)**
CLO-1	Learn the structure, properties, metabolism and bioenergetics of biomolecules	2 [8], 3 [12]	1	U	F
CLO-2	Acquire knowledge on various classes and major types of enzymes, classification, their mechanism of action and regulation	3 [20]	1, 2	U, R	F
CLO-3	Understand the fundamentals of biophysical chemistry and biochemistry, importance and	2[10], 3[10]	2	U, E	P

	applications of methods in conforming the structure of biopolymers				
CLO-4	Comprehend the structural organization of and proteins, carbohydrates, nucleic acids and lipids	2 [20]	2, 3	U, An	P
CLO-5	Familiarize the use of methods for the identification, characterization and conformation of biopolymer structures	5 [20]	1, 2, 6	U, Ap	M

Module	Course Description	Hours	% of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
1.1	Basics of biophysical chemistry and biochemistry: Structure of atoms and molecules	6	1[20]	BS	OBT	1, 4
1.2	Chemical bonds	6	1[20] 3[20]	Lec	CT	1,4
1.3	Principles of biophysical chemistry -pH, buffer, reaction kinetics, thermodynamics, colligative properties.	6	1[20] 3[20]	Lec	HoA	2,3
2.1	Biomolecular interactions and their properties: Stabilizing interactions- Vander Waals, electrostatic, hydrogen bonding, hydrophobic interaction	9	3[50]	Lec	CT	1,4
2.2	Composition, structure, metabolism and function of biomolecules- Carbohydrates, lipids, proteins, nucleic acids and vitamins.	9	4[50]	Rev	MCQ	1,3

3.1	**Bioenergetics and enzymology:** Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers	7	1[40]	Lec	OBT	1,4
3.2	Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation	7	2[40]	GT	HrA	1,4
3.3	Mechanism of enzyme catalysis, isoenzymes	4	2[20]	CS	ST	1,2
4.1	**Structural conformation of proteins and nucleic acids**: Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motifs and folds.	9	3[20] 5[30]	Lec	Qui	3,4
4.2	Conformation of nucleic acids (A-, B-, Z-DNA), t-RNA, micro-RNA).	9	3[20] 5[30]	PT	MCQ	3,4
5.1	Stabilizing interactions in biomolecules	6	3[20], 4[30]	Rev	HoA	1, 2
5.2	Stability of protein and nucleic acid structures	6	3[10], 4[5], 5[10]	Lec	GT	1, 4
5.3	Hydrogen bonding, covalent bonding, hydrophobic interactions and disulfide linkage.	6	3[10], 4[5], 5[10]	TPS	OBT	3, 4

Reference Books

1. Berg, J. M., J. L. Tymoczko and L. Stryer 2002. Biochemistry. 5th Ed., W.H. Freeman & Co., New York, pp-1050.

2. Kuchel P.W. and G. B. Ralston. 2008. Biochemistry. McGraw Hill (India) Private Limited, UP, pp-580.

3. McKee T. and J. R. McKee. 2012. Biochemistry: The Molecular Basis of Life. (7th Edition). Oxford University Press, US, pp-793.

4. Nelson D.L. and M.M. Cox. 2012. Lehninger's Principles of Biochemistry. (6th Edition). W. H. Freeman Publishers, New York, pp-1158.

5. Satyanarayana U. and U. Chakrapani, 2006. Biochemistry. (3rd Edition). Books and Allied (P) Ltd. Calcutta, pp-695.

6. Buchanan, B.B., W. Gruissem and R.L. Jones. 2015. Biochemistry and Molecular Biology of Plants. John Wiley and Sons Ltd., UK, pp-1280.
7. Murray, R.K., D.K. Granner, P.A. Mayes and V.W. Rodwell. 2003. Harper's Illustrated Biochemistry (26th Edition), The McGraw-Hill Companies, Inc., USA, pp-704.

8. Palmer, T. 2004. Enzymes. Affiliated East-West Press Pvt. Ltd., New Delhi, pp-416.

9. Voet D. and J.G. Voet. 2011. Biochemistry. (4th Edition). John Wiley & Sons (Asia) Pvt. Ltd., pp-1428.

BIOSTATISTICS

Course Title: **Biostatistics**	Sub Code: 23PZEB	Course Type: Theory

Total Hours: 90 Hours/Week: 6
Credits: 4

Pass-Out Policy: Minimum Contact Hours: 54

Total Score %:100 Internal: 40 External: 60

Minimum Pass %: 50 [No Minimum for Internal]

Course Creator	Expert 1	Expert 2
Dr. V. Robin Perinba Smith	Dr. M. P. Jeyasekhar	Dr. J. Georgina
Associate Professor	Associate Professor	Assistant Professor
Department of Zoology	Department of Zoology	Department of Zoology
Scott Christian College (Autonomous)	Scott Christian College (Autonomous)	Scott Christian College (Autonomous)

CLO-No.	Course Learning Outcomes *Upon completion of this course, students will be able to:*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA#	Cognitive Level (CL)	Knowledge Category (KC)
CLO-1	Clear understanding of design and application of biostatistics relevant to experimental and population studies.	4 [20]	6, 7	U	F
CLO-2	Acquired skills to perform various statistical analyses using modern statistical techniques and software.	5 [20]	1	U, Ap	P
CLO-3	Knowledge on the merits and limitation of practical problems in biological/ health management study as well as to propose and implement appropriate statistical design/ methods of analysis.	8 [20]	1, 7	U, Ap, E	P
CLO-4	Statistically analyze and compare raw biological data	2 [20]	2, 3	U, An	P
CLO-5	Practically apply software such as SPSS	5 [20]	1, 2, 6	U, Ap	P, M

Module	Course Description	Hours	% of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
1.1	Definition, scope and application of statistics.	2	1[10]	BS	OBT	1, 2
1.2	Primary and secondary data: Source and implications.	2	1[10] 3[10]	Lec	SA	1,2
1.3	Classification and tabulation of biological data: Types and applications.	3	1[10] 3[10]	CS	HoA	2,3
1.4	Variables: Definition and types.	2	1[10]	Lec	HrA	2,4

1.5	Frequency distribution: Construction of frequency, distribution table for grouped data.	3	1[10] 3[10]	OO	OT	1,3
1.6	Graphic methods: Frequency polygon and ogive curve.	3	3 [10]	GT	OBT	4,4
1.7	Diagrammatic representation: Histogram, bar diagram, pictogram and pie chart.	3	1[10]	GT	OBT	2,5
2.1	Measures of central tendency: Mean, median and mode for continuous and discontinuous variables.	9	3[50]	Lec	CT	2,4
2.2	Measures of dispersion: Range, variation, standard deviation, standard error and coefficient of variation.	9	4[50]	Lec	MCQ	3, 4
3.1	Probability: Theories and rules.	4	5[40]	Lec	OBT	1,2
3.2	Probability - Addition and multiplication theorem.	7	4[20], 5[10]	Sem	HrA	2,4
3.3	Probability distribution: Properties and application of Normal, Binomial and Poisson distributions.	7	5[20]	TPS	ST	1,3
4.1	Hypothesis testing: Student'*t*' test - paired sample and mean difference'*t*' tests.	6	3[20] 5[20]	Lec	Qui	3,4
4.2	Correlation: Types - Karl Pearsons Co-efficient, Rank correlation, Significance test for correlation coefficients.	6	3[20] 5[20]	PT	MCQ	3,4
4.3	Regression analysis: Computation of biological data, calculation of regression co-efficient, graphical representation and prediction.	6	3[10] 5[10]	Lec	Qui	3,2
5.1	Analysis of variance: one way and two way classification.	9	3[20], 4[30]	Lec	HoA	1, 2
5.2	Data analysis with comprehensive statistical software using Statistical Package for the Social Sciences (SPSS).	9	3[10], 4[10], 5[30]	Lec	HoA	1, 4

Reference Books

1. Arora, P. N. and P. K. Malhan. 1996. Biostatistics, Himalaya Publishing House, Mumbai, pp-447.
2. Gurumani, N. 2005. Introduction to Biostatistics, M.J.P. Publishers, Delhi, pp-407.
3. Das, D. and A. Das. 2004. Academic Statistics in Biology and Psychology, Academic Publisher, Kolkata, pp-363.
4. Palanichamy, S. and Manoharan, M. 1990. Statistical Methods for Biologists, Palani Paramount Publications, Tamil Nadu, pp-264.
5. Bailey, N. T. J. 1959. Statistical in Biology, English Universities Press, London, pp-48.
6. Sokal, R. R. and F. J. Rohlf, 1973. Introduction to Biostatistics, W.H. Freeman, London, pp-467.
7. Sokal, R.R. and F.J. Rohlf. 1981. Biometry: The principles and practice of statistics in biological research, San Francisco: W.H. Freeman, London, pp-859.
8. Zar, J.H. 1998. Biostatistical Analysis, Pearson Education (Singapore) Pvt. Ltd., Delhi, India, pp-660.
9. Bailey, N. T. J. 1994. Statistical Methods in Biology (Third Edition), Cambridge University Press, Cambridge, pp-255.
10. Wayne W. Daniel. Biostatistics: A Foundation for Analysis in the Health Sciences, John Wiley & Sons Inc, USA, pp-443.
11. Snedecor, G. W. and W. G. Cochran. 1967. Statistical Methods (Sixth Edition), Oxford & IBH Publishing Co., New Delhi, pp-593.
12. Pagano, M. and K. Gauvreau. 2008. Principles of Biostatistics (Second Edition), Cengage Learning, New Delhi, pp-525.

SEMESTER II
CELLULAR AND MOLECULAR BIOLOGY

Course Title: **Cellular and Molecular Biology**	Sub Code: 23PZ21	Course Type: Theory

Total Hours: 90	Hours/Week: 6	Credits: 4

Pass-Out Policy :	Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50 [No Minimum for Internal]

Course Creator	Expert 1	Expert 2
Dr. Shirly Daniel Assiociate Professor Mobile: 9789367480 Scott Christian College (Autonomous)	Dr. R. Leena Assistant Professor Mobile: 9442704679 Scott Christian College (Autonomous)	Dr. P. Justin Kumar Assiociate Professor Mobile: 9486140253 Scott Christian College (Autonomous)

CLO-No.	**Course Outcomes** *Upon completion of this course, students will be able to:*	**% of PLO Mapping with CLO**	**CLO & PLO Mapped with GA#**	**Cognitive Level (CL)**	**Knowledge Category (KC)**
CLO-1	Understand the general concepts of cell and molecular biology.	1(8), 2(8), 3(4)	1, 2	U, R	F,M
CLO-2	Visualize the basic molecular processes in prokaryotic and eukaryotic cells, especially relevance of molecular and cellular structures influencing functional features.	2(8), 3(6), 5(6)	1, 2	An, E	P , M
CLO-3	Perceive the importance of physical and chemical signals at the molecular level resulting in modulation of response of cellular responses.	2(8), 3(7), 8(5)	1, 2, 3	An, E	P, M
CLO-4	Updated the knowledge on the rapid advances in cell and molecular biology for a better understanding of onset of various diseases including cancer.	2(8),3(6), 8(6)	1, 2, 3	Ap, C, An	P, M
CLO-5	Understand the general concepts of cell and molecular biology.	2(5), 3(6), 4(6), 8(3)	1	An,E, Ap	F, P, M

Module	Course Description	Hours	% of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
1.1	General features of the cell: Basic structure of prokaryotic and eukaryotic cells -	5	1[30]	BS	MCQ	2
1.2	Protoplasm and deutroplasm, cell organelles;	6	1[30]	CS	Q	2
1.3	cell theory; Diversity of cell size and shapes.	4	1[40]	TPS	Sem	3
2.1	**Cellular organization**: Membrane structure and functions - Structure of model membrane,	3	2[30]	TPS	Ess	1
2.2	lipid bilayer and membrane proteins diffusion, osmosis, ion channels, active transport, ion pumps, mechanism and regulation of intracellular transport, electrical properties of membranes	6	2[30]	PT	Sem	1
2.3	Structure and functions of Intracellular organelles: Nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles and chloroplasts	6	2[40]	BS	Ess	2
3.1	Cell division and Cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle and control of cell cycle.	6	3[40]	TPS	Sem	2
3.2	Molecular biology of cell: Structure of DNA and RNA; Process of DNA replication, transcription and translation in pro- and eukaryotic cells;	6	3[40]	PT	Asgn	3
3.3	Genetic maps.	3	3[20]	BS	Ess	3
4.1	Cell communication and cell signaling: Membrane- associated receptors for peptide and steroid hormones - signaling through G-protein coupled	7	4[50]	GD	Sem	2

4.2	General principles of cell communication: extracellular space and matrix, interaction of cells with other cells and non-cellular structures.	8	4[50]	TPS	Ess	3
5.1	Cancer cells: Characteristic features of normal and cancer cells; Carcinogens: types and cancer induction; Metastasis	8	5[50]	BS	Sem	3
5.2	Oncogenes and tumor suppressor genes, apoptosis; therapeutic interventions of uncontrolled cell growth.	7	5[50]	Lec	Ess	3

Reference Books

1. Karp, G. 2010. Cell Biology (Sixth Edition), John Wiley & Sons, Singapore, pp-765.
2. Lodish, H., C. A. Kaiser, A. Bretscher, *et al*., 2013. Molecular Cell Biology (Seventh Edition), Macmillan, England, pp-1154
3. De Robertis, E.D.P. and E. M. F. De Robertis Jr, 1987. Cell and Molecular Biology. Info-Med, Hong Kong, pp-734
4. Abbas, A. K., A. H. Lichtman and S. Pillai, 2007, Cell and Molecular Immunology (Sixth Edition), Saunders, Philadelphia, pp-566
5. Loewy, A.G., P. Siekevitz and J. R. Menninger, *et al*., 1991, Cell Structure and Function
(Third Edition), Saunders, Philadelphia, pp-947
6. Watson, J. D., N.H. Hopkins, J.W. Roberts, *et al*., 1987, Molecular Biology of the Gene (Fourth Edition), Benjamin/Cummings, California, pp-1163
7. Han, S. S. and J. Holmstedt. 1979, Cell Biology, McGraw Hill, pp-319
8. Alberts, B., A. Johnson, J. Lewis, *et al*., 2015, Molecular Biology of the Cell (Sixth Edition), Garland Science, New York, pp-1342
9. Clark, D.P., 2005. Molecular Biology, Elsevier, China, pp-784
10. Tropp, B. 2008. Molecular Biology Genes to Proteins (Third Edition), Jones & Bartlett, US, pp-1000

DEVELOPMENTAL BIOLOGY

Course Title: **Developmental Biology**	Sub Code: 23PZ22	Course Type: Theory

Total Hours: 90	Hours/Week: 6
Credits: 4	

Pass-Out Policy : Minimum Contact Hours: 54
Total Score %:100 Internal: 40 External: 60
Minimum Pass %: 50[No Minimum for Internal]

Course Creator	Expert 1	Expert 2

Dr. E. Grace Marin	Dr. P. Beautlin Sheribha	Dr. J. Georgina
Assistant Professor	Assistant Professor	Assistant Professor
Mobile: 9442006494	Mobile: 9487386886	Mobile: 9524632400
Scott Christian College (Autonomous)	Scott Christian College (Autonomous)	Scott Christian College (Autonomous)

CLO - No.	**CourseOutcomes** *Upon completion of this course, students will be able to:*	**% of PLO Mapping with CLO**	**CLO & PLO Mapped with GA#**	**Cognitive Level (CL)**	**Knowledge Category (KC)**
CLO-1	Define the concepts of embryonic development	2(8), 3(12)	1, 2, 3, 9	U	F,C
CLO-2	Observe various stages of cell divisions under microscope	2(6), 3(7), 8(7)	1, 2, 3, 9	An, E	C, P
CLO-3	Understand the formation of zygote	2(2), 3(8), 5(7), 8(3)	1, 2, 3, 9	U	C, M
CLO-4	Differentiate the blastula and gastrula stages	2(5), 3(8), 8(7)	1, 2, 3, 9	An E	C, M
CLO-5	Learn the distinguishing features of three different germ layers and formation of various tissues and	2(3), 3(9), 5(2), 8(6)	1, 2, 3, 9	An,E	C, F

Module	CourseDescription	Hours	% of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
1.1	**Pattern of animal development**: Chief events in animal development; History of thoughts and conceptual developments.	4	1[30]	GD	Asgn	1
1.2	**Gametogenesis**: Origin of germ cells, Spermatogenesis - Sperm morphology in relation to the type of fertilization,	4	1[30]	GD	Qui	1
1.3	**Oogenesis** - Oogenesis in insects and amphibians; Composition and synthesis of yolk in invertebrates (insects and crustaceans) and vertebrates;	4	1[30]	GD	Mcq	1
1.4	Genetic control of vitellogenin synthesis in amphibians	3	1[10]	, Sem	Ess	1
2.1	**Fertilization:** Sperm aggregation, Sperm activation, Chemotaxis, Sperm maturation and capacitaion in mammals, Acrosome reaction	4	2[30]	Sem	Asgn	2
2.2	. Sperm – egg interaction. Sperm entry into the egg - Egg activation - Intracellular calcium release - Cortical reaction	4	2[20]	GD	Asgn	2
2.3	Physiological polyspermy - Fusion of male and female pronuclei - Post fertilization metabolic activation	5	2[30]	Sem	Qui	2
2.4	Parthenogenesis	2	2[20]	Sem	Mcq	2
3.1	Cleavage and gastrulation: Pattern of embryonic cleavage, mechanisms of cleavage, mid blastula transition		3[15]	Sim	Sem	1
3.2	Determinate and regulatory embryos, Factors affecting gastrulation,	3	3[25]	Sem	Qui	1
3.3	mechanisms and types of gastrulation in respective animal embryos (Sea urchin, *Amphioxus*, Amphibians, Aves, Mammals); Fate maps - (Amphibian and Chick),	5	3[35]	GD, PT	Asgn	1

3.4	Epigenesis and preformation – Formation of primary germ layers	3	3[25]	GD	Asgn	2
4.1	**Embryonic Development;** Embryonic development of fish and birds, formation of extra embryonic membranes in mammalian	3	4[15]	Sem	Qui	1
4.2	**Organogenesis** - Development of endodermal, mesodermal and ectodermal derivatives.	4	4[25]	Sim	MCQ	2
4.3	Embryonic Induction and neurulation Formation and migration of neural crest cells - types of neural crest cells and their patterning - primary and secondary neurulation	4	4[35]	Sem	Ess	2
4.4	Gene and development; Anterior- posterior axis in determination in drosophila, Maternal effect genes - *Bicoid* and *Nanos* proteins; Generation of dorsal - ventral polarity- Genetic control of segmentation – Gap genes; pair rule genes; Homeotic genes	4	4[25]	, Sem	Asgn	1
5.1	Post embryonic development metamorphosis: Endocrine control of metamorphosis in insect and amphibian - Endocrine control of moulting and growth in crustaceans and insects - Neoteny and pedogenesis	3	5[20]	GD,	Asgn	2
	Regeneration: Formation of ectodermal cap and regeneration blastema – Types of regeneration in planaria, Regenerative ability in different animal groups, Factors stimulating regeneration – Biochemical changes assosciated with regeneration.	4	5[30]	GD	MCQ	2
5.2	Aging and senescences: Biology of senescences-cause of aging- mechanism involved in apoptosis.	3	5[10]	GD	MCQ	1
5.3	Experimental Embryology: Mammalian reproduction: Mammalian reproductive cycle, Hormonal regulation, Endocrine changes associated with normal pregnancy	3	5[20]	GD	Asgn	1
5.4	Induced ovulation in humans – Cryopreservation of gametes/embryos - Ethical issues in cryopreservation	2	5[20]	GD	MCQ	2

Reference Books

1. Balinsky, B. I. 1981. Introduction to Embryology (5th Edition), CBS College Publishers, New York, pp-782.
2. Gilbert. S. F. 2006. Developmental Biology, 8th Edition, INC Publishers, USA, pp-785.
3. Berrill, N.J. 1974. Developmental Biology, Tata Mc-Graw Hill Publications, New Delhi, pp-535.
4. Tyler, M.S. 2000. Developmental Biology - A Guide for Experimental Study, Sunderland, MA, pp-208.
5. Subramoniam, T. 2011. Molecular Developmental Biology (2nd Edition), Narosa Publishers, India, pp-364.
6. Wilt, F.H. and N.K. Wessel. 1967. Methods in Developmental Biology, Thomas Y Crowell, New York.
7. Slack J.M.W. 2012. Essential Developmental Biology (3rd Edition), Wily-Blackwell Publications, USA, pp-496.
8. Mari-Beffa, M. and J. Knight. 2005. Key Experiments in Practical Developmental Biology, Cambridge University Press, UK, pp-404.
9. www.easybiologyclass.com › developmental-biology-e
10. www.studocu.com › document › lecture-notes › view
11. *ocw.mit.edu* › courses › 7-22-developmental-biology-f.

LAB COURSE IN CELL AND MOLECULAR BIOLOGY AND DEVELOPMENTAL BIOLOGY

Course Title: **Lab Course in Cell and Molecular Biology and Developmental Biology**	Sub Code: 23PZP2	Course Type: Practical

Total Hours: 90	Hours/Week: 6	Credits: 4

Pass-Out Policy :	Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50 [No Minimum for Internal]

Course Creator	Expert 1	Expert 2

Dr. P. Justin Kumar	Dr. Shirley Daniel	Dr. R. Leena
Assiociate Professor	Assiociate Professor	Assistant Professor
Mobile: 9443001698	Mobile: 9442303359	Mobile: 9524632400
Scott Christian College (Autonomous)	Scott Christian College (Autonomous)	Scott Christian College (Autonomous)

CLO-No.	Course Outcomes *Upon completion of this course, students will be able to:*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA#	Cognitive Level (CL)	Knowledge Category (KC)
CLO-1	Acquire knowledge to differentiate the cells of various living organisms and become aware of physiological processes of cells e.g. cell divisions, various stages of fertilization and	2(8), 3(8), 6(4)	1, 2, 7	Ap	P, M
CLO-2	Understand and observe as well as correctly identify different cell types, cellular structures using different microscopic techniques.	2(8), 4(12)	1, 7	AP, E	P, M
CLO-3	Develop handling - skills through the wet-lab course.	2(5), 3(8), 4(7),	2, 7	An, E	P
CLO-4	Learn the method of blastoderm mounting and identification of various developmental stages	3(10), 4 (10)	1, 2, 5, 7	Ap, E, An	P, M
CLO-5	Gain practical knowledge and learn regeneration and metamorphosis	3(12), 4 (8)	1, 2, 7	Ap, An, E	P, M

Module	Course Description
1.1	**Cell and Molecular Biology:** Determination of cell size using micrometer
1.2	Mitosis in root meristematic cells of plants
1.3	Identification of various stages of meiosis in the testes of grasshopper
2.1	Detection of polytene chromosome in salivary gland cells of the larvae of the Chironomus
2.2	Detection of sex chromatin
2.3	Identification of blood cells in the haemolymph of the of the cockroach
2.4	Human blood smear preparation
3.1	Isolation of genomic DNA from eukaryotic tissue
3.2	Isolation of total RNA from bacterial cells/tissues

3.3	Agarose gel electrophoresis of DNA
3.4	SDS-Polyacrylamide gel electrophoresis
3.1	**Developmental Biology** Gametogenesis - Observation of gametes from gonadal tissue sections Oogenesis: Section through ovary of shrimp, fish, frog and mammals Spermatogenesis: Section through testis of shrimp, fish, calotes and mammals
3.2	Fertilization: Induced spawning in polycheate worm *Hydroids elegans* *In vitro* fertilization and development in a polycheate worm *Hydroids elegans* v Observation of egg developmental stages in *Emerita emeritus*
4.1	Embryogenesis Observation and whole mount preparation of the chick blastoderm – 18 hours of development Chick embryonic stage - 24 hours of development Chick embryonic stage - 48 hours of development Chick embryonic stage - 72 hours of development Chick embryonic stage - 96 hours of development
4.2	Histological observation: Section through various developmental stages in chick embryo
5.1	Experimental Embryology Regeneration in Frog Tadpoles Blastema formation Demonstration of regenerative process in tadpole
5.2	Metamorphosis Demonstration of metamorphosis in Frog Tadpole using exogenous Iodine
5.3	Cryopreservation Demonstration of cryopreservation of gametes of fin fish/shell fish

Reference:

1) Cell Biology Laboratory Manual. William H. Heidcamp, Gustavus Adolphus College Saint Peter, Minnesota, USA.

2) Cell Biology and Genetics Lab Manual. Dr. N Haraprasad and Dr. B.P. Hema, Department of Biotechnology, JSS Mahavidyapeetha JSS science and Technology University, Sri Jayachamarajendra College of Engineering, Mysuru.

3) Practical Manual of Developmental Biology. 2021. Varsha Baweja and Monica Misra

4) Developmental Biology Lab Manual. https://bio-22-lab.webflow.io/

5) Developmental Biology Practical Manual. Dr. Karri Rama Rao. 2020. https://www.academia.edu/43807065/

RESEARCH METHODOLOGY

Course Title: **Research Methodology**	Sub Code: 23PZEC	Course Type: Theory

Total Hours: 90	Hours/Week: 6	Credits: 4

Pass-Out Policy : Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]

Course Creator	Expert 1	Expert 2
Dr. P.Robin Perinba Smith	Dr. M.P. Jeyasekar	Dr. J. Georgina
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Mobile: 9443001698	Mobile: 9442303359	Mobile: 9524632400
Scott Christian College (Autonomous)	Scott Christian College (Autonomous)	Scott Christian College (Autonomous)

CLO-No.	CourseOutcomes *Upon completion of this course, students will be ableto:*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA#	Cognitive Level (CL)	Knowledge Category (KC)
CLO-1	Collect research literature using the	3(8), 5(8), 6(4)	1, 2, 5, 10	Ap, C	F,M
CLO-2	Conduct independent scientific investigation using tools of biology with soft ware assisted data processing.	4(8), 5(6), 6(6)	1, 2, 5, 10	An, E, C	P , M
CLO-3	Write a report based on the analysis of data collected.	3(8), 4(7), 5(5)	1, 2, 5, 10	An, E, C	C, M
CLO-4	Practice ethics in research and use reference management software.	4(8), 5(6), 6(4), 7(2)	1, 2, 5, 10	Ap, C, An	C, M
CLO-5	Write a research paper and present posters.	3(8), 4(7), 5(5)	1, 2, 5, 10	An,E, C	C, F

Module	Course Description	Hours	% of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
1.1	**Fundamentals of Research** Introduction – objectives and motivation towards research.	2	1[20]	GD	Sem	1
1.2	Need for research design: Features of good design, important concepts related to good design.	3	1[30]	BS	Sem	1
1.3	Research Methods *vs* Methodology. Types of research: Analytical *vs*; Research Methods *vs* Methodology.	4	1[20]	GD	Asgn	1
1.4	Observation and facts, prediction and explanation, development of models.	3	1[10]	GD	Asgn	1
1.5	Hypothesis and hypothesis testing	3	1[20]	Sem	Ess	2

2.1	**Research Design:** Experimental design- topic selection- planning research—defining objectives -preparation of work plans.	3	2[10]	GD	Asgn	2
2.2	Developing a research plan: Problem identification, experimentation, determining experimental and sample designs	3	2[20]	GD	Pro	2
2.3	Literature collection- Use of internet– literature citation.	2	2[20]	SeM	Pro	2
2.4	News articles–Newsletters–Journals	2	2[20]	*GD*	Sem	2
2.5	Digital library and search of articles- key words and search —internet.	2	2[10]	Qui	Pro	2
2.6	Google Scholar— Pub Med—Inflibnet—Medline—Agricola—Science Direct- Open Access Journals- virtual and Other sources.	3	2[20]	Qui	Pro	1
3.1	**Data Collection, Analysis and Report Writing** Collection of samples/ data. Data processing and analysis strategies. Tabulation - construction of tables— headings – footer. Hypothesis testing – test of significance. Data presentation using digital technology-Microsoft Excel.	4	3[15]	Qui	Pro	1
3.2	Types of scientific writings: Thesis or dissertation writing. Thesis structure/ components. Title. Writing an introduction - rationale. Purpose of writing a review of literature.	3	3[15]	Sim	Asgn	1
3.3	Materials and methods–steps involved in the experiment. Presentation and interpretation of results.	3	3[25]	SIM	Asgn	1
3.4	Discussion with conclusion of results based on literature. Summarizing the thesis	3	3[25]	SIM	Asgn	2
3.5	Arrangement of bibliography and how to quote reference in thesis. Tables— figures—plates and appendix.	2	3[20]	SIM	Pro	4
4.1	**Ethics in research** Bioethics and bio-safety regulations.	2	4[15]	Lec, Sem	Qui	4

4.2	**IPR:** Definition - Forms of IPR protection, WTO-definition—functions-international treaties for IPR protection	3	4[25]	PT, Sim	MCQ	2
4.3	**Patents:** Definition - conditions for patentablity-test of novelty of patents— composition of a patent - patenting of biotechnological discoveries. Patent laws.	3	4[25]	Sem	Ess	2
4.4	**Other forms of IPR protection:** Copyright - Trademark - Designs - importance in Indian scenario & laws in India for IPR protection. commercialization, royalty.	4	4[15]	FC	Asgn	2
4.5	Ethics in publishing and plagiarism issues. Use of software for reference management—(Mendeley/ End Note) and detection of plagiarism (turnitin).	3	5[20]	GD,	Asgn	4
5.1	**Presentation and publishing Oral Presentation:** Planning oral presentations with visuals - In-class discussion (Students in small groups or individually will take up the assignments or select a research project/ topic and prepare oral presentations followed by a Q&A sessions).	3	5[20]	RP	MPr	2
5.2	**Poster Presentation:** Elements and significance of poster presentations - planning and designing a poster – Individual Poster presentation (Students select a research project/ topic and prepare posters followed by a Q&A sessions).	2	5[20]	RP	MPr	1
5.3	Research paper writing; Types of publications - Open access and subscription based resources. Open educational resources (OER).	3	5[10]	SIM	Sem	1
5.4	Manuscripts preparation for journals: Scientific paper writing - choosing a journal - instructions to authors - structure and style - Authorships—figures tables with legends-references and citations—acknowledgements- Submission and publication.	2	5[20]	SIM	Asgn Pro	2
5.5	Conflict of interest; Peer review mechanism and publication process.	1	5[10]	SIM	Sem	2

5.6	Scientometric analyses of a paper/ journal - ISSN number—SCOPUS - peer reviewed journals—science citation index–H index-impact factor	2	5[10]	SIM	Pro	2
5.7	Research project proposal, preparation And presentation– funding agencies– Student project scheme of TNSCST & TANSCHE	2	5[10]	SIM	Pro	1

Reference Books

1. Dr.S.PalanichamyandDr.M.Shunmugavelu,ResearchMethodsinBiological Sciences, Palani Paramount Publications, 1997.
2. N.Gurumani,Researchmethodologyforbiologicalsciences.M.J.P.Publishers,2006.
3. Wadhera, B.L.: Law Relating to Patents, Trade Marks, Copyright Designs and Geographical Indications, Universal Law publishing, 2002.
4. SreeKrishnaV.,BioethicsandBiosafetyinBiotechnology,NewAgeInternatio nal(P)Ltd., Publ., Mumbai. 2007.
5. Rajendrakumar C, Research Methodology, SB Nanja for APHA publishing Corporation New Delhi, 2008.
6. C.R.Kothari:ResearchMethodology,NewAgeInternational,2009
7. Ramadass,P.andWilsonAruni,A.,ResearchandWriting-acrosstheDisciplines.MJP Publishers, Chennai, 2009.
8. DeborahE.Bouchoux,IntellectualProperty:TheLawofTrademarks,Copyrig hts,Patents, and Trade Secrets, CENGAGE Learning Custom Publishing, 4/e, 2013.
9. DeepaGoelandShominiParashar.,IPR,BiosafetyandBioethics,Pearson,2013.
10. J.R.Matthews and R.W.Matthews,SuccessfulScientific Writing:A Step-by-Step Guide for the Biological and Medical Sciences, 4/e, Cambridge University Press. 2014.
11. Ruxton,G.D.andColegrave,N.,Experimentaldesignforthelifesciences,4/e, Oxford University Press, Oxford, 2017.
12. PadmaNambisan, AnIntroductiontoEthical, Safety andIntellectual Property RightsIssuesin Biotechnology, Academic Press, 2017.

DISCIPLINE SPECIFIC ELECTIVE (DSE 4)/ INTERDISCIPLINARY COURSE
(For I PG Botany)
AGRICULTURAL ENTOMOLOGY

Course Title: **Agricultural Entomology**	Sub Code: 23PZN1	Course Type: Theory

Total Hours: 90	Hours/Week: 6	Credits: 4

Pass-Out Policy :	Minimum Contact Hours: 54
	Total Score %:100 Internal: 40 External: 60
	Minimum Pass %: 50[No Minimum for Internal]

Course Creator	Expert 1	Expert 2
Dr. P. Justin Kumar	Dr. C. Albert	Dr. Jebitta M. Shirlin
Assiociate Professor	Assistant Professor	Assistant Professor
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CLO-No.	**CourseOutcomes** *Upon completion of this course, students will be able to:*	**% of PLO Mapping with CLO**	**CLO & PLO Mapped with GA#**	**Cognitive Level (CL)**	**Knowledge Category (KC)**
CLO-1	Understand taxonomy, classification and life of insects in the animal kingdom.	1(8), 2(8), 3(4)	2, 3	U, R	F,M
CLO-2	Know the life cycle, rearing and management of diseases of beneficial insects.	2(8), 3(6), 5(6)	5	An, E	P , M
CLO-3	Know the type of harmful insects, life cycle, damage potential and management of pests including natural pest control	2(8), 3(7), 8(5)	6, 9	An, E	P, M
CLO-4	Recognize insects which act as vectors causing diseases in animals and human.	2(8),3(6), 8(6)	3	Ap, C, An	P, M
CLO-5	Overall understanding on the importance of insects in human life.	2(5), 3(6), 4(6), 8(3)	2, 5	An,E, Ap	F, P, M

Module	CourseDescription	Hours	% of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
1.1	Insect Taxonomy Introduction - outline classification of insects up to super families.	5	1[30]	BS	MCQ	1
1.2	Key to the identification of various orders Coleoptera, Hemiptera, Diptera, Orthoptera, Dictyoptera, Lepidoptera, Thysanura, Hymenoptera, Phasmida of insects with common South Indian examples	4	1[30]	CS	Q	1
1.3	Insect biodiversity.	6	1[40]	TPS	Sem	2
2.1	**Injurious Insects** Methods of injury by insects	4	2[20]	TPS	Ess	2
2.2	Destruction of all kinds of growing crops and other valuable plants by chewing, sucking and boring.	4	2[30]	PT	Sem	5
2.3	Insects causing annoyance to man, domestic and wild animals - insect venoms- parasitism - dissemination of diseases.	4	2[20]	BS	Ess	5
2.4	Stored grain pests - types of damage, different coleopteran and lepidopteran pests of stored grains.	3	2[30]	GD	Asgn	8
3.1	**Beneficial Insects** The value of insects to man - insect products and articles of commerce - Lac, silk and honey - secretions of insects.	4	3[25]	TPS	Sem	2
3.2	Insects as pollinators.	3	3[15]	PT	Asgn	8
3.3	Insects as protein sources of human and animal feeds.	3	3[25]	BS	Ess	8

3.4	Medicinal use of insects.	3	3[25]	GD	Asgn	8
3.5	Insect Galls.	2	3[10]	TPS	Ess	8
4.1	**Insect Pests** Field key for the identification and control measures of insect pests of i)Paddy.	4	4[15]	GD	Sem	5
4.2	Field key for the identification and control measures of insect pests of ii) Coconut.	3	4[20]	TPS	Ess	5
4.3	Field key for the identification and control measures of insect pests of iii) Vegetable Crops.	3	4[25]	PT	Asgn	8
4.4	Field key for the identification and control measures of insect pests of iv) Human belongings.	3	4[20]	BS	Ess	2
4.5	Field key for the identification and control measures of insect pests of v) Storedgrains.	2	5[20]	GD	Asgn	8
5.1	**Pest Management** Chemical control - physical and mechanical control - cultural control • biological control.	2	5[20]	BS	Sem	8
5.2	Botanicals and microbes, IPM - *Bacillus thuringiensis, B. sphararicus.*	2	5[20]	Lec	Ess	1
5.3	Transgenic plants with Bt genes, NPV -Culture using cell lines.	3	5[10]	Lec	Ess	1
5.4	Pheromone traps.	1	5[10]	PT	Asgn	2
5.5	Natural enemies of insects.	1	5[10]	BS	Sem	2
5.6	Kairomones.	2	5[10]	Lec	Ess	8

5.7	Hymenopterans: egg and larval parasites.	2	5[10]	BS	Asgn	8
5.8	Heteropterans: Reduviid bugs.	2	5[10]	GD	Sem	5

Reference Books:

1. Nayar, K. K., David, B. V. and Anantha Krishnan, T. N., General and applied entomology,Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1976.
2. Mani, M. S., General Entomology, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. 1982.
3. Rathnasamy, A. K., S. Viswanathan, A handbook of medical entomology and elementary parasitology, Printers and Publishers Pvt. Ltd., Chennai. 1986.
4. Kumar, A. and Nigam, P. M., Economic and applied entomology, Emkay Publication, NewDelhi. 1989.
5. Tembhare, D.B. Modern Entomology. Himalaya Publishing House, 1997.
6. David B. V. and Kumarasamy T., Elements of economic entomology, Popular Book Depot,Chennai. 2000.
7. D. P. Ambrose, The insects: Structure, function and biodiversity, Kalyani Publishers,Ludhiana. 2004.
8. D. P. Ambrose, The insects: beneficial and harmful aspects, Kalyani Publishers, Ludhiana.2007.
9. Wigglesworth, V. B., Insect physiology, ELBS, London, 2006.
10. Richards, O. W. and Davies, R. G., General textbook of entomology, (Vol. 1: StructurePhysiology and Development) BI publications Pvt. Ltd., New Delhi. 1993.
11. Richards, O. W. and Davies, R. G., General textbook of entomology – (Vol. 2: Classification and Biology) BI Publication Pvt. Ltd., New Delhi. 1993.
12. Pedigo, L. P., Entomology and pest management, 2/e, Upper Saddle River, N. J. Prentice Hall. 1996. Malmfors Nottingham University Press, 2011

GENETICS

Course Title: **Genetics**	Sub Code: 23PZ31	Course Type: Theory

Total Hours: 90 Hours/Week: 6
Credits: 4

Pass-Out Policy: Minimum Contact Hours: 54

Total Score %:100 Internal: 40 External: 60

Minimum Pass %: 50[No Minimum for Internal]

Course Creator	Expert 1	Expert 2
Dr. D. Selvaraj Associate Professor Department of Zoology Scott Christian College (Autonomous)	Dr. P. Justin Kumar Associate Professor Department of Zoology Scott Christian College (Autonomous)	Dr. R. Leena Assistant Professor Department of Zoology Scott Christian College (Autonomous)

CLO-No.	**Course Learning Outcomes** *Upon completion of this course, students will be able to:*	**% of PLO Mapping with CLO**	**CLO & PLO Mapped with GA#**	**Cognitive Level (CL)**	**Knowledge Category (KC)**
CLO-1	Explain the organization and functions of genetic material in the living system.	2(8), 3(7) 5(5)	6, 7, 1, 2	U	F
CLO-2	Understand various sequential processes in protein synthesis	7(8), 8(3), 4(5) 2(4)	2	U, An	C
CLO-3	Explicate the structures and functions of chromosomes and identify the diseases caused by the chromosomal abnormalities.	2(5), 3 (5), 7(5), 8(5)	6, 7	R, E	P
CLO-4	Able to distinguish lytic and lysogenic cycle and explain the mechanisms of genetic recombination of the microbes.	7(6), 2(6), 3(8)	1,7	An	M
CLO-5	Understand the principle and application of rDNA technology for the welfare of human being.	4(10), 5(5), 10(5)	1, 2	An, Ap	M

Module	Course Description	Hours	% of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
1.1	Structure, properties and functions of genetic materials	2	2[20]	Q	CT	1
1.2	DNA as the genetic Materials	2	2[10]	Asgn	ST	8
1.3	Basic structure of DNA	2	1[10]	MCQ	HoA	7
1.4	Basic structure of RNA	2	2[20]	Asgn	ST	6
1.5	Alternate and unusual forms of DNA	3	5[10]	Sem	OT	2
1.6	Physical and Chemical properties of nucleic acid	2	2[10]	Sem	Qui	1
1.7	Base properties, denaturation and renaturation	3	1[10]	PT	SA	1
1.8	Tm and cot values, hybridization	2	2[10]	PT	Ess	2
2.1	Genetic code	3	1[20]	Lec	MCQ	5
2.2	Methods of deciphering the genetic code and general features of the code word dictionary	3	5[20]	Rev	CT	5
2.3	Chromosomal genetics: Molecular structure of chromosomes	3	2[30]	Lec	ST	3
2.4	Variation in chromosome number and structure	3	5[10]	PT	OT	4
2.5	Chromosome nomenclature	3	1[10]	KWL	HoA	8
2.6	Chromosomal syndromes	3	1[10]	KWL	HoA	9
3.1	Microbial Genetics: Genetics of Virus - Viral chromosome	4	2[30]	Lec	CA	11
3.2	Lytic cycle, Lysogenic cycle	5	2[20]	GT	CT	12
3.3	Bacterial genetics -Bacterial genome	4	7[30]	Lec	ST	1
3.4	Gene transfer mechanisms in bacteria and virus - conjugation, transduction and transformation	5	3[20]	Sem	OBT	2

4.1	Recombinant DNA technology - Overview	3	2[20]	Lec	SA	3
4.2	Tools for Recombinant DNA Technology	3	1[20]	Rep	HoA	6
4.3	Vectors – types	4	5[30]	Sem	ST	8
4.4	Techniques used in recombinant DNA technology- Generation of DNA fragments	4	2[20]	Lec	OBT	10
4.5	Restriction endonucleases, DNA modifying enzymes, Ligases	4	1[10]	PT	HrA	12
5.1	Introduction of rDNA into host cell - calcium chloride mediated gene transfer	3	4[20]	Lec	CT	3
5.2	*Agrobacterium* mediated DNA transfer	3	5[20]	OO	OT	4
5.3	Electroporation, microinjection, liposome fusion, particle gun bombardment	4	4[20]	Pr	OBT	5
5.4	Selection and screening of transformed cells - Expression of cloned gene	4	5[20]	Lec	MCQ	2
5.5	Application of rDNA technology in human welfare - Environment, Medicine and Agriculture	4	10[20]	Rev	SA	1

Reference Books

1. Gardner, E. J., M. J. Simmons and D.P. Snustad. 2006. Principles of Genetics. 8th Edition, John Wiley & Sons. INC. New York, pp-740.
2. Brooker, R. J. 2014. Genetics: Analysis and Principles. 5th Edition, McGraw Hill Publsiher, pp-880.
3. Russell, P.J. 2005. Genetics: A Molecular Approach (2nd Edition). Pearson/Benjamin Cummings, San Francisco, pp-850.
4. Griffiths, A. J. F., H. J. Muller, D. T. Suzuki, R. C. Lewontin and W. M. Gelbart.
   2012.An Introduction to Genetic Analysis.11th Edition,W. H.Greeman. New York.
5. Snustad, D.P., Simmons, M.J. 2015. Principles of Genetics, John Wiley Publications, pp-784.
6. Watson, J. D., T. A. Baker, S. P. Bell, Alexander Gann, Michael Levine, Richard Losick. 2003. Molecular Biology of the Gene, (5th Edition). Cold Spring Harbor Laboratory Press, pp-912.
7. Klug, W. S. and M. R. Cummings, C. A. Spencer. 2005. Concepts of Genetics, Benjamin - Cummings Publishing Company.
8. Harti, D. L. 2002. Essential Genetics, A Genomic Perspective, Jones & Bartlet.
9. Krebs, J. E., E.S. Goldstein, S.T. Kilpatrick. 2018. Lewin's Genes XII,

Jones & Bartlet Publisher, pp-613.
10. Watson, J. D., T. A. Baker S. P. Bell, A. Cann, M. Levine and R. Losick, 2014. Molecular Biology of Gene 7th Edition, Pearson Education RH Ltd. India.
11. https://onlinecourses.swayam2.ac.in/cec21_bt02/preview
12. https://www.khanacademy.org/science/high-school-biology/hs-molecular-genetics/hs-rna-and-protein-synthesis/a/the-genetic-code

PROJECT

Hours: 06 **Credits: 06**

SEM- 1, II & III

COURSE OBJECTIVES: To enable the students to identify a research problem, perform review of literature, plan a study to address the same and frame a research proposal and defend the same.

Course Plan–

This course will have the following components–

1. Identifying a research problem.
2. Undertake review of literature.
3. Plan and design a study to address the research question.
4. Presentation and oral defense of the research proposal.

COURSE OUTCOME: The students will learn to–

- Identify research gaps through study of scientific literature and device ways to address the same.
- Review Literature in their respective field of Research.
- Gain the experience of presenting a research proposal before an evaluating committee.

SEM- III

DISSERTATION

COURSE OBJECTIVES: To enable the students to have hands-on research experience and write a comprehensive report, present, and defend the same.

Course Plan-

This course will have the following components–

1. Conceptualization and execution of the proposed research plan.
2. Designing and planning experiments.
3. Performing experiments or insilico studies based on the criteria.
4. Writing a comprehensive research report.
5. Presentation of findings in an oral defence of the dissertation.

COURSE OUTCOME: The students will learn to execute a research proposal, prepare a project report and present, and defend the same.

Note: Projects must begin in the I Semester and assessment will be made in the III Semester. A minimum of 2 reviews per semester. Students must

present a research paper in a National Conference/ Seminar or publish a paper in a reputed journal.
Dissertation activity must be completed within prescribed time frame for the semester.

LAB COURSE IN GENETICS & AQUACULTURE

Course Title: **Lab Course in Genetics and Aquaculture**	Sub Code: 23PZP3	Course Type: Practical

Total Hours: 90 Hours/Week: 6 Credits: 4

Pass-Out Policy: Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]

Course Creator	Expert 1	Expert 2
Dr. D. Selvaraj	Dr. M. P. Jeyasekhar	Dr. C. Albert
Associate Professor	Associate Professor	Assistant Professor
Department of Zoology	Department of Zoology	Department of Zoology
Scott Christian College (Autonomous)	Scott Christian College (Autonomous)	Scott Christian College (Autonomous)

CLO-No.	**Course Learning Outcomes** *Upon completion of this course, students will be able to:*	**% of PLO Mapping with CLO**	**CLO & PLO Mapped with GA#**	**Cognitive Level (CL)**	**Knowledge Category (KC)**
CLO-1	Acquire ability to perform/ demonstrate various basic concepts in Genetics and Aquaculture	8(8), 9(7) 10(5)	1, 3, 5, 9	U	F
CLO-2	Acquire the potential to do genetic experiments and apply	7(8), 8(7),	3, 9	U, Ap	P, M

	the learned concepts in population genetics	9(5)			
CLO-3	Acquire knowledge about fossils and connecting links	8(15), 10(5)	1, 5	U, E	P
CLO-4	To gain practical knowledge on construction of pond for Aquaculture practices	9(10), 10(10)	1, 5, 9	Ap	M
CLO-5	To learn techniques related to aquaculture practices and be trained as an entrepreneur in aquaculture	7(10), 8(5), 9(5)	3, 5, 9	Ap	P

Module	**Course Description**
1.1	Genetics Estimation of gene and genotypic frequencies in the light of Hardy-Weinberg law based on facial traits and ABO blood group data, in a large sample of human population or classroom sample.
1.2	Demonstration of Sewall Wright's effect in small samples of Drosophila populations.
1.3	Demonstration of natural selection in animal population using beads.
2.1	Genetics based variations in vertebrates.
2.2	Spotters: Fossils, Living fossils, Connecting links.
2.3	Specimens/ models related to theory syllabus.
3.1	Morphometry of a pond.
3.2	Estimation of fish population by mark and recapture method.
3.3	Length-weight relationship of fish *Oreochromis mossambicus*.
3.4	Primary productivity of a macrophyte.

3.5	Morphological features of prawn–penaeids and non-penaeids.
3.6	Sex identification of prawn and fishes.
4.1	Fish Pathology-Disease diagnosis- White spot disease- Ichthyophthiriasis. Costiasis. Mycosis. Anchorworm– *Lernea*. Aquaticsnail- *Lymnaea*.
4.2	Taxonomic description of some fishes– Indian major carps: *Catla catla, Labeo rohita*, *Cirrihinus mrigala*. Exotic carp: *Cyprinus carpio*. Silver carp: *Hypophthalmichthys molitrix*. Grass carp: *Ctenopharyngodon idella.* Cat fishes: *Clarius batrachus*, *Heteropneustes fossilis.* Other cultivable fishes: *Oreochromis mossambicus, Channa morulius*.
4.3	Life stages of fishes.
5.1	Determination of age and growth in fishes
5.2	Visit to a coastal/ aquaculture research centre-report submission mandatory

Record of Laboratory work shall be submitted at the time of practical examination.

References:

1) A practical manual on Fundamentals of Genetics. 2019. Shweta Singh Assistant Professor, Department of Agriculture, Faculty of Science and Engineering, Jharkhand Rai University, Namkom.

2) Genetics Laboratory Manual. 2018. Prof. Christopher Blair Department of Biological Sciences New York City College of Technology.

3) Principles of Aquaculture: Practical Manual. C. Judith Betsy and S. Felix. 2019. Narendra Publishing House.

IMMUNOLOGY

Course Title: **Immunology**	Sub Code: 23PZED	Course Type: Theory

Total Hours: 90	Hours/Week: 6
Credits: 4	

Pass-Out Policy: Minimum Contact Hours: 54

Total Score %:100 Internal: 40 External: 60

Minimum Pass %: 50[No Minimum for Internal]

Course Creator	Expert 1	Expert 2

Dr. V. Robin Perinba Smith	Dr. M. P. Jeyasekhar	Dr. P. Beautlin Sheribha
Associate Professor	Associate Professor	Assistant Professor
Department of Zoology	Department of Zoology	Department of Zoology
Scott Christian College (Autonomous)	Scott Christian College (Autonomous)	Scott Christian College (Autonomous)

CLO-No.	**Course Learning Outcomes** *Upon completion of this course, students will be able to:*	**% of PLO Mapping with CLO**	**CLO & PLO Mapped with GA#**	**Cognitive Level (CL)**	**Knowledge Category (KC)**
CLO-1	Various basic concepts in immunology and organization of immune systems.	8(8), 5(7) 3(5)	1, 2, 7	U	F
CLO-2	Mechanisms of immune response in health and their defects in various diseases.	2(4), 4(5), 8(6), 5(5)	6,7	U, R	F
CLO-3	The application of immunological principles in biomedical sciences including blood transfusion, tissue grafting and organ transplantation.	2(5), 3 (5), 7(5), 8(5)	1	An, R	P

CLO-4	Describe the techniques adopted to understand immune reactions	2(6), 5(8), 7(6)	GA 1,6	An, C	M
CLO-5	Highlights the various immunity diseases, types of immunization and its importance in disease management	1(10), 4(5), 10(5)	1, 2	An, Ap	M

Module	Course Description	Hours	% of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
1.1	Introduction to Immunology: An overview; History and Scope of immunology	2	1[20]	BS	CT	1
1.2	Recognition of self and non-self as a basic functional feature of immune system	2	2[10]	Lec	ST	2
1.3	Concepts of external and internal defense systems; External (first line / innate) defense system: components, distribution, salient functions; Internal (second line / acquired) immune system	2	2[10]	MCQ	HoA	3
1.4	Cellular and humoral immune components-distribution, salient functions-primary and secondary immune responses	2	3[20]	Rev	ST	8
1.5	Immune tissues / organs: types, anatomical location, structure and development	3	1[10]	Sem	OT	2
1.6	Lymphocyte traffic during development	2	1[10]	Lec	Qui	3
1.7	Types of immunity: innate and acquired - types, functional features	3	1[10]	GT	SA	1
1.8	Concept of adaptive immunity	2	2[10]	PT	Ess	4
2.1	Antigens: Definition, characteristic features and classification	6	1[30]	Lec	MCQ	7
2.2	Antigenicity versus immunogenicity	6	2[30]	BS	CT	9

2.3	Adjuvants: definition, types and applications	6	2[40]	KWL	ST	11
3.1	Major effector components of cellular immune system	4	2[20]	Lec	CA	10
3.2	Lymphocytes - types, morphology, clones; sub-populations, distribution	4	2[20]	GT	CT	11
3.3	B and T cell receptors, B and T cell epitopes, Toll-like receptors	4	1[30]	Lec	ST	1
3.4	Antigen presenting cells: antigen processing and presentation	4	2[20]	Sem	OBT	2
3.5	MHC molecules and their immunologic significance	2	2[10]	Lec	WSQ	3
4.1	Major effector components of humoral immune system: Antibodies - Primary structure, classification, variants and antigen-antibody interactions	3	3[20]	Lec	SA	3
4.2	Structural and functional characteristics of various antibody classes; Generation of diversity	2	4[10]	Rep	HoA	6
4.3	Monoclonal antibodies: definition, production and applications; Antibody engineering and its applications.	2	4[10]	Sem	ST	7
4.4	Complement system - Components, three major activation pathways, and immune functions including anaphylaxis and inflammation.	3	4[10]	Lec	OBT	9
4.5	Cytokines - Definition and salient functional features	3	4[10]	PT	HrA	10
4.6	Interleukins: definition, types (lymphokines and monokines), and functions	3	4[20]	Sem	Ess	12
4.7	Interferons - Origin, types and functions	2	4[20]	PT	Ess	9
5.1	Diseases and immune responses: Hypersensitivity: definition, Types I to IV and immune manifestations	4	5[20]	OT	OBT	1
5.2	Auto-immune diseases: onset, spectrum of diseases, and major immune responses	4	5[20]	Lec	HoA	3

5.3	Immunodeficiency diseases: types including SCID and consequences	3	5[20]	FC	Ess	5
5.4	Viral (HIV), bacterial (tuberculosis) and parasitic (malaria) diseases: etiology, host immune responses and evasion by pathogens	4	5[20]	Lec	MCQ	3
5.5	Vaccines: types, preparations, efficacies and recent developments	3	5[20]	AW	OT	1

Reference Books

1. Kuby, J. 1997. Immunology. W. H. Freeman & Co., New York, pp-670.
2. Male, D. J. Brostoff, D. B. Roth and I. Roitt. 2006. Immunology (7th edition), Mosby / Elsevier, Philadelphia, pp-472
3. Abbas, A. K and A. H. Lichtman. 2007. Cellular and Molecular Immunology (6th edition), W. B. Saunders, Philadelphia, pp-564
4. Coica, R. Sunshine, G. 2015. Immunology (Seventh Edition), Wiley Blackwell,
5. Weir, D. M and J. Stewart. 1997. Immunology, Churchill Livingstone, London, pp-362
6. Janeway, C. A and P. Travers. 1997. Immunology, Garland Publ. Inc., London, pp-904
7. Peakman, M and D. Vergani. 1997. Basic and Clinical Immunology, Churchill Livingstone, London, pp-366
8. Parham, P. 2009. The Immune System (Third Edition), Garland Science, USA, pp-506
9. Weissman, I. Hood, L. Wood, W. 1978. Essential Concepts in Immunology, the Benjamin/Cummings, California, pp-165.
10. Hood, L. Weissman, I. Wood, W. Wilson, J. 1984. Immunology (Second Edition), the Benjamin/Cummings, California, pp-558.
11. Coica, R and Sunshine, G. 2009. Immunology A Short Course (Sixth Edition), John Wiley & Sons, USA, pp-391.
12. Doan, T. Melvold, R. Viselli, S. *et al*., 2013. Immunology (Second Edition), Lippincott Williams & Wilkins, Maryland, pp-376.
13. Owen, J. A. Punt, J. Stanford, S. A. 2013. Kuby Immunology (7th Edition), Macmillan, England, pp-692.
    UK, pp-406.

AQUACULTURE

Course Title: **Aquaculture**	Sub Code: 23PZEE	Course Type: Theory

Total Hours: 90 Hours/Week: 6 Credits: 4

Pass-Out Policy: Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal]

Course Creator	Expert 1	Expert 2
Dr. C. Albert	Dr. M. P. Jeyasekhar	Dr. D. Deleep Packia Raj
Associate Professor	Associate Professor	Assistant Professor
Department of Zoology	Department of Zoology	Department of Zoology
Scott Christian College (Autonomous)	Scott Christian College (Autonomous)	Scott Christian College (Autonomous)

CLO-No.	**Course Learning Outcomes** *Upon completion of this course, students will be able to:*	**% of PLO Mapping with CLO**	**CLO & PLO Mapped with GA#**	**Cognitive Level (CL)**	**Knowledge Category (KC)**
CLO-1	Explain the salient features of Aquaculture	8(8), 5(7) 3(5)	1, 2, 7	U	F
CLO-2	Impart information on the construction and maintenance of ponds for fish culture	2(4), 4(5), 8(6), 5(5)	6,7	U, R	F
CLO-3	To develop knowledge on the fish farm and their maintenance. Understand the methods of fish seed and feed production and develops knowledge on hatchery	2(5), 3 (5), 7(5), 8(5)	1	An, R	P

	techniques, fishing crafts and gears				
CLO-4	To apply the knowledge about different culture methods in aquaculture and gain knowledge on fish and shrimp breeding techniques and larval culture	2(6), 5(8), 7(6)	1,6	An, C	M
CLO-5	Identifies the different fishes diseases, diagnosis and their management strategies. Understands Ornamental fishes and central aquaculture organizations	1(10), 4(5), 10(5)	1, 2	An, Ap	M

Module	Course Description	Hours	% of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
1.1	Importance of aquaculture- Present status, prospects and scope in India.	3	1[20]	BS	CT	1
1.2	Freshwater aquaculture- Brackishwater aquaculture- Mariculture - Metahaline culture in India.	3	1[10]	Lec	ST	2, 3
1.3	Types of fish culture -Types of fish ponds for culture practice. Topography, site selection - water quality - soil condition and quality – structure and construction design and layout - inlet and outlet.	3	4[10], 3[20]	MCQ	HoA	3, 1
1.4	Water quality management for aquaculture. Control of parasites, predators and weeds in culture ponds.	3	4[20]	Rev	ST	4

1.5	Fish farm implements - Secchi disc - aerator - pH meter - tools for hypophysation - feeding trays	3	2[10]	Sem	OT	2
1.6	Fishing gears used in aqua farming.	3	3[10]	Lec	Qui	3
2.1	Procurement of seed from natural resources-collection methods and segregation.	3	3[20]	Lec	Qui	1
2.2	Hatchery technology for major carps and freshwater prawn.	4	4[30]	CS	CT	4
2.3	Artificial seed production –Breeding under control conditions, induced breeding technique, larval rearing, packing and transportation	4	3[20]	KWL	ST	1
2.4	Commercial substitute for pituitary extracts.	3	3[10]	Lec	OT	1,2
2.5	Classification of fish feed- Artificial feedsTypes, Feed - formulation - feeding methods. Live feed- Microalgae, Rotifer, Artemia and their culture.	4	4[20]	WSQ	PT	2,3
3.1	Shrimp hatchery technology - Hatchery design, brood stock management, spawning, larval rearing, Shrimp developmental stages, algal culture, packing and transportation.	3	3[20]	GD	CA	1
3.2	Shrimp culture technology - extensive culture methods semi- intensive - intensive culture methods - Biofloc technology - Culture operations (water quality, feed and health management) - harvesting, preservation and marketing.	3	4[20]	GT	HrA	1,2
3.3	Brackish water fish culture.	3	4[20]	CS	CT	1,3
3.4	Edible and Pearl oyster culture - pearl production.	3	3[10]	OT	HoA	2,4
3.5	Crab culture.	2	3[10]	Lec	HoA	3
3.6	Economic importance of Lobster, Sea urchin and Sea cucumber - their by-products.	2	4[10]	KWL	ST	1,3
3.7	Types of Seaweeds - species and methods of culture – by-products	2	3[10]	WSQ	ST	2
4.1	Fish and Shrimp diseases and health management	4	5[30]	CS	Qui	1

4.2	Infectious diseases - Bacterial, Fungal, Viral, Protozoan	5	5[20]	AW	HoA	2
4.3	Non-infectious - environmental and nutritional diseases	5	5[20]	Sem	CA	4
4.4	Diseases diagnosis, prevention and control measures	4	5[30]	Lec	OBT	3
5.1	Types of ornamental fishes (freshwater and marine), their breeding behavior and biology	4	4[30]	Rev	HoA	1
5.2	Oviparous, Ovo-viviparous and Viviparous fishes.	4	5[20]	Lec	GT	3
5.3	Setting and maintenance of freshwater Aquarium tanks.	5	5[30]	FW	Ess	4
5.4	Central aquaculture research organizations- CMFRI, CIBA, CIFT, CIFA, CIFE, MPEDA and its activities.	5	5[20]	MPr	MCQ	1

Reference Books

1. Pillay, T. V. R. (1990). Aquaculture: Principles and Practices. Blackwell Scientific Publications Ltd.
2. Santhanam, R. (1990). Fisheries Science. Daya Publishing House.
3. Sinha, V.R. P. and Srinivastava, H. C. (1991). Aquaculture Productivity. Oxford and IBH Publications CO., Ltd., New Delhi.
4. Yadav, B. N. (1997). Fish and fisheries.Daya Publishing house, New Delhi.
5. Das M. C. and Patnaik, P. N. (1994) Brackish water culture. Palani paramount Publications, Palani, T. N.
6. Day, F (1958). Fishes of India, VoL I and Vol. II. William Sawson and Sons Ltd., London.
7. hingran, V. G. (1991). Fish and Fisheries of India. Hindustan Publishing Co., India
8. Maheswari. K. (1983) Common fish disease and their control. Institute of Fisheries Education, Powarkads (M.P).

SEMESTER IV
ANIMAL PYSIOLOGY

Course Title: **Animal Physiology**	Sub Code: 23PZ41	Course Type: Theory

Total Hours: 90 Credits: 4	Hours/Week: 6

Pass-Out Policy: Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal

Course Creator	Expert 1	Expert 2
Dr. D. Selva Raj	Dr.P. Justin Kumar	Dr.E. Grace Marin
Associate Professor	Associate Professor	Assistant Professor
Department of Zoology	Department of Zoology	Department of Zoology
Scott Christian College (Autonomous)	Scott Christian College (Autonomous)	Scott Christian College (Autonomous)

CLO-No.	**Course Learning Outcomes** *Upon completion of this course, students will be able to:*	**% of PLO Mapping with CLO**	**CLO & PLO Mapped with GA#**	**Cognitive Level (CL)**	**Knowledge Category (KC)**
CLO-1	Familiarize the principles and bacic factors of Animal Physiology	2(15), 3(5)	GA1, 2	U	F
CLO-2	Understand the functions of different systems of animals	2(10), 5(10)	GA 1,2,7	U, An	C
CLO-3	Learn the comparative anatomy of heart structure and functions	2(8),3(8),5 (4)	GA1,2,8,10	E	P

CLO-4	Know the transport and exchange of gases, neural and chemical regulation of respiration	2(15),5(5)	GA 1,2	An	F
CLO-5	Acquire knowledge on the organization and structure of central and peripheral nervous systems	1(10),5(5),7(5)	GA 1,2,5	E	M

Module	Course Description	Hours	% of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
1.1	Blood and circulation: Blood corpuscles, haemopoiesis and formed elements.	2	1[20]	GD	CT	2
1.2	Plasma function, blood volume, blood volume regulation,	3	1[20]	KWL	ST	10
1.3	Blood groups, haemoglobin, immunity, haemostasis	3	1[10]	Sem	Qui	13
1.4	Cardiovascular system : Comparative anatomy of heart structure, myogenic heart, specialized tissue,	3	1[20]	GD	HrA	15
1.5	ECG – its principle and significance,	3	1[20]	Lec	Qui	11
1.6	cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above	4	1[10]	Lec	CT	9
2.1	Respiratory system: Comparison of respiration in different species	3	2[10]	GD	HoA	8
2.2	Anatomical considerations	2	2[10]	Lec	MCQ	11
2.3	Transport of gases	3	4[30]	Lec	HoA	4

2.4	Exchange of gases	3	4[30]	Sem	CT	12
2.5	Waste elimination	3	5[10]	RP	ST	12
2.6	Neural and chemical regulation of respiration	4	5[10]	Lec	CA	9
3.1	Nervous system: Neurons,	2	5[20]	BS	MCQ	8
3.2	Action potential	2	5[10]	WSQ	CT	5
3.3	Gross neuro-anatomy of the brain and spinal cord	4	5[20]	Lec	MCQ	4
3.4	Central and peripheral nervous system,	4	5[20] 1[10]	BS	OBT	15
3.5	Neural control of muscle tone and posture.	2	5[10]	Sem	OBT	15
3.6	Sense organs: Vision, hearing and tactile response	4	2[10]	Sem	HoA	10
4.1	Digestive system: Digestion, absorption,	2	1[10]	Sem	SA	11
4.2	Energy balance, BMR	2	5[10]	CS	Qui	9
4.3	Excretory system: Comparative physiology of excretion,	3	5[20]	CS	Qui	7
4.4	Kidney, urine formation, urine concentration,	4	1[20]	Rep	HoA	4
4.5	Waste elimination, micturition, regulation of water balance	3	1[20]	GT	MCQ	3
4.6	Blood volume, blood pressure,	2	1[10]	FW	OT	2
4.7	Electrolyte balance, acid-base balance	2	5[10]	MPr	OBT	1
5.1	Endocrinology and reproduction: Endocrine glands	4	1[20]	SP	HoA	3
5.2	Basic mechanism of hormone action	3	1[10]	Lec	Ess	8
5.3	Hormones and diseases	3	2[20]	GD	OBT	8

5.4	Reproductive processes, gametogenesis,	2	2[10]	Lec	HrA	7
5.5	Ovulation, neuroendocrine regulation.	2	1[20]	Lec	CT	2
5.6	Thermoregulation: Comfort zone, body temperature-physical, chemical, neural regulation, acclimatization:	2	1[10]	GD	ST	15
5.7	Stress and adaptation	2	2[10]	Sem	SA	14

Reference Books

1. Prosser C. L. 1991, Comparative Animal Physiology. Part A: Environmental and Metabolic Animal Physiology. Wiley-Liss Publishers, pp-592
2. Hoar, S.W. 1983, General and Comparative Physiology, Prentice Hall Publication, pp-928.
3. Randall, D., W. Burggren, K. French and R. Eckert. 2001, Animal Physiology Mechanisms and Adaptations, New York : W.H. Freeman and Co., pp-
4. Nelson K. S. 1997. Animal Physiology: Adaptation and Environment, Cambridge University Press, pp- 617.
5. Dantzler, W.H. 1997. Comparative Physiology (Handbook of Physiology), Volumes I and II. Edited by William H. Dantzler. pp - 1824 Published for the American Physiological Society by Oxford University Press Inc., New York. Oxford University Press Canada, Toronto.
6. https://swayam.gov.in/nd1_noc20_bt42/preview
7. https://www.classcentral.com/course/swayam-animal-physiology-12894
8. https://swayam.gov.in/nd1_noc20_hs33/preview
9. Shepherd, G. M. 1994. Neurobiology, OUP USA Publsiher, pp-774.
10. Hainsworth , F.R. 1981. Animal Physilogy: Adaptation in function, Addison Wesley Longman Publishers, pp-669.
11. Mcfarland, D. 1999. Animal Behaviour: Psychobiology, Ethology and Evolution, Longman Publisher, pp-592.
12. Gorden, M.S. *et al.,* 1977. Animal Physiology: Principles and Adaptation, New York, Third Edition.
13. Ahearn, G.A. *et al*., 1988. Advances in Comparative and Environmental Physiology – 2, Springer Publishers, pp-252.
14. Hill, R.W. 1976. Comparative Physiology of Animals: Environmental Approach, Longman Higher Education Publisher, pp-656.
15. Withers, P.C. 1992. Comparative Animal Physiology, Brooks/Cole Publisher, pp-900.

ENVIRONMENTAL BIOLOGY

Course Title: **Environmental Biology**	23PZ42	Course Type: Theory

Total Hours: 90 Hours/Week: 6 Credits: 4

Pass-Out Policy: Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal

Course Creator	Expert 1	Expert 2
Dr. V. Robin Perinba Smith	Dr. Shirly Daniel	Dr.P .Beautlin Sheribha
Associate Professor	Associate Professor	Assistant Professor
Department of Zoology	Department of Zoology	Department of Zoology
Scott Christian College (Autonomous)	Scott Christian College (Autonomous)	Scott Christian College (Autonomous)

CLO-No.	**Course Learning Outcomes** *Upon completion of this course, students will be able to:*	**% of PLO Mapping with CLO**	**CLO & PLO Mapped with GA#**	**Cognitive Level (CL)**	**Knowledge Category (KC)**
CLO-1	Learn about the ecosystem, biotic communities and utilizing the energy processing	2(8),3(8),5(4)	GA2,3,4	E	P
CLO-2	Study the various community and population and population control	1(5),2(6),4(4),5(5)	GA 4,6,9	U, An	F
CLO-3	Understand the fundamentals of climatic conditions and its impact on environment	3(5),4(10),5(3),8(2)	GA2,4	E	P

CLO-4	Realizing the nature of pollution and the ways for its control/reduction	3(8),4(7),5(5)	GA 2,4,5,6	An	C
CLO-5	Impact of environmental studies on solid waste management	1(10), 3(10)	GA 2,4	An	M

Module	Course Description	Hours	% of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
1.1	The Environment: Physical environment resource partitioning	4	1[20]	GD	CT	2
1.2	Biotic environment; biotic and abiotic interactions.	3	1[30]	Lec	ST	4
1.3	Habitat and niche: Concept of habitat and niche;	3	1[10]	KWL	HrA	7
1.4	Niche width and overlap; fundamental and realized niche;	4	1[20]	Lec	Qui	8
1.5	Character displacement.	4	1[20]	Lec	Qui	5
2.1	Population ecology: Characteristics of a population; population growth curves; population regulation;	4	2[30]	GD	CT	9
2.2	Life history strategies (*r* and *K* selection)	3	2[10]	Lec	HoA	2
2.3	Concept of metapopulation	2	2[10]	BS	MCQ	1
2.4	Demes and dispersal, interdemic extinctions	3	2[10]	Lec	ST	4
2.5	Age structured populations	3	2[10]	Sem	CT	6
2.6	Action taken to control population explosion	3	4[30]	RP	ST	7

3.1	Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.	2	2[20]	GD	MCQ	3
3.2	Community ecology: Nature of communities	3	2[20]	WSQ	CT	4
3.3	Community structure and attributes	3	2[20]	Lec	MCQ	2
3.4	Levels of species diversity and its measurement.	4	2[20]	Lec	OBT	7
3.5	Edges and ecotones	3	1[10]	Sem	MCQ	3
3.6	Ecological succession: Types; mechanisms; changes involved in succession; concept of climax	3	3[10]	WSQ	HoA	5
4.1	Ecosystem: Structure and function;	3	1[30]	Sem	ST	6
4.2	Energy flow and mineral cycling (CNP); primary production and decomposition	4	5[10]	CS	Qui	4
4.3	Structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine)	4	5[20]	SP	HoA	2
4.4	Biogeography: Major terrestrial biomes; theory of island biogeography	4	1[20]	Rep	HoA	1
4.5	Biogeographical zones of India.	3	1[20]	GT	MCQ	7
5.1	Applied ecology: Environmental pollution; global environmental change;	4	4[20]	Lec	HoA	7
5.2	Biodiversity-status, monitoring and documentation	3	1[10]	Lec	Ess	8
5.3	Major drivers of biodiversity change; biodiversity management approaches	4	2[20]	Lec	OBT	6
5.4	Waste management.	3	5[20]	GD	Qui	3

5.5	Conservation biology: Principles of conservation, major approaches to management,	3	1[20]	Lec	CT	2
5.6	Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).	1	5[10]	GD	Ess	4

Reference Books

1. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publication, India, pp-616.
2. Calabrese, E.J. 1978. Pollutants and High-Risk Groups, John Wiley, pp-286.
3. Raven, P.H. and L.R. Berg, G.B. Johnson, 1993. Environment, Saunders College Publishing, pp-579.
4. Cunningham, W. P. and B. W. Saigo, 1999. Environmental Science, McGraw Hill Boston, 5th Edition.
5. Online courses.nptel.ac.in / noc 19 - g e 23/preview
6. Class central.com/course/swayam -ecology - and environment – 14021.
7. Odum, E.P. 1893. Basic Ecology, Saunders & Co., Philadelphia, pp-383.
8. Barthwl, R.R. 2002. Environmental Impact Assessment, New Age International Publishers, New Delhi, India, pp-425.
9. United Nations Environment Programme (UNEP). 1995. Global Biodiversity Assessment, Cambridge University Press, pp-1140.

LAB COURSE IN ECO PHYSIOLOGY

Course Title: **Lab Course in Eco Physiology**	Sub Code: 23PZP4

Course Type: Practical

Total Hours: 90 Hours/Week: 6
Credits: 4

Pass-Out Policy: Minimum Contact Hours: 54

Total Score %:100 Internal: 40 External: 60

Minimum Pass %: 50[No Minimum for Internal]

Course Creator	Expert 1	Expert 2
Dr. P. Justin Kumar	Dr. C. Albert	Dr. E. Grace Marin
Associate Professor	Associate Professor	Assistant Professor
Department of Zoology	Department of Zoology	Department of Zoology
Scott Christian College (Autonomous)	Scott Christian College (Autonomous)	Scott Christian College (Autonomous)

CLO-No.	Course Learning Outcomes *Upon completion of this course, students will be able to:*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA#	Cognitive Level (CL)	Knowledge Category (KC)
CLO-1	To demonstrate an understanding of core ecological principles, and define scientific principles and concepts as related to environmental studies and sustainability.	8(8), 9(7) 10(5)	GA 1, 3, 5, 9	U	F
CLO-2	To understand the physiological processes that regulate body functions.	7(8), 8(7), 9(5)	GA 3, 9	U, Ap	P, M
CLO-3	To strive to demonstrate the role of experimentation in developing our understanding of living animals.	8(15), 10(5)	GA 1, 5	U, E	P
CLO-4	To attain knowledge of important biomolecules such as carbohydrates, lipids, amino acids, proteins and enzymes.	9(10), 10(10)	GA 1, 5, 9	Ap	M
CLO-5	Measure and interpret experimental data and demonstrate laboratory skills in animal physiology and ecology.	7(10), 8(5), 9(5)	GA 3, 5, 9	Ap	P

Module	Course Description	Hours	% of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
1.1	Genetics Estimation of gene and genotypic frequencies in the light of Hardy-Weinberg law based on facial traits in a large sample of human population or classroom sample.	6	1[20], 2[30]			1
1.2	Estimation of gene and genotypic frequencies in the light of Hardy-Weinberg law based on ABO blood group data, in a large sample of human population or classroom sample.	6	2[30], 3[20]			
2.1	Digestive Enzymes: Survey of digestive enzymes in Cockroach.	6	2[20]			1
2.2	Ptyalin activity in relation to temperature and pH in human saliva.	6	3[30]			
2.3	Ecological Methods: Estimation of oxygen consumption in an aquatic and a terrestrial animal.	6	3[50]			
3.1	Biochemical Tests: Use of pH meter for estimation of pH in water and soil samples.	3	2[10], 3[10]			
3.2	Study of micro arthropods of water and soil samples (Tullgren's funnel method and Ladell's Floating Method).	6	1[10], 5[10]			1
3.3	Collection, isolation, identification and mounting of marine and freshwater plankton.	3	1[10], 5[10]			
3.4	Study of sandy shore fauna- Study of rocky shore fauna.	3	1[10], 5[10]			
3.5	Study of animal Association.	3	5[20]			

4.1	Qualitative Detection of Biomolecules: Qualitative tests for identification of carbohydrates, proteins and lipids.	6	4[20]			
4.2	Amino acid in haemolymph of any insect by chromatographic technique.	3	3[10]			1
4.3	Estimation of Haemoglobin by Cyanmethemoglobin method.	3	3[10]			
4.4	Blood grouping	3	3[20]			1
4.5	Total and differential counts- Total erythrocyte and leucocyte count by hemocytometer.	3	3[20]			
4.6	Determination of plasma hemoglobin.	3	3[20]			1
5.1	**Field Work**: Visit to a local area to document environmental assets river/forest/grassland/hill/mountain.	6	1[40]			
5.2	Visit to a local polluted site- Urban/ Rural/ Industrial/ Agricultural.	6	1[20]			
5.3	Study of common plants, insects, birds.	3	1[20]			
5.4	Study of simple ecosystems-pond, river, hill slopes, etc.	6	1[20]			

Record of Laboratory work and Field study report should be submitted at the time of practical examination.

Reference:

1) A Lab Text Book on Environmental Studies. 2011. Dr. A.K. Jain, Dr. Era Upadhyay & Mr Anupam Adhikary, School of Applied. Science Ansal Institute Of Technology HUDA Sector 55, Gurgaon , Haryana.

ANIMAL BEHAVIOR

Course Title: **Animal Behavior**	Sub Code: 23PZEF	Course Type: Theory

Total Hours: 90 Hours/Week: 6 Credits: 4

Pass-Out Policy: Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal

Course Creator	Expert 1	Expert 2
Dr. C. Albert	Dr. R. Leena	Dr. Jebitta M. Shirlin
Associate Professor	Associate Professor	Assistant Professor
Department of Zoology	Department of Zoology	Department of Zoology
Scott Christian College (Autonomous)	Scott Christian College (Autonomous)	Scott Christian College (Autonomous)

CLO-No.	Course Learning Outcomes *Upon completion of this course, students will be able to:*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA#	Cognitive Level (CL)	Knowledge Category (KC)
CLO-1	Recall and record genetic basis and evolutionary history of behaviour	3(12),4(8)	GA1, 2,3,5	R	F
CLO-2	Analyse and identify innate, learned and cognitive behaviour and differentiate between various mating systems.	7(10),8(10)	GA 1,4,5,7	An,E	F
CLO-3	Classify movement and migration behaviours and explain environmental influence upon behaviour.	1(8),2(8),4(4)	GA 1,2,3,6,8	C	C
CLO-4	Explain why behavioural changes occur and how they are controlled	2(6).5(5),7(9)	GA1,2.4.5	U	P
CLO-5	Infer how animals cooperate with each other and why conflicts occur	2(12),5(8)	GA1,2,6	E	M

Module	Course Description	Hours	% of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
1.1	Genetic material, Genes and chromosomes, Genetic variation, Single and Polygenic inheritance of behaviour,	4	1[10]	Lec	Qui	1
1.2	Heritability of behaviour	3	1[10] 4[20]	Lec	ST	3
1.3	Natural selection and behaviour	2	3[10]	GD	HrA	5
1.4	Frequency distribution of phenotypes	3	1[20]	KWL	CT	1
1.5	Darwinian fitness	3	1[20]	Lec	Qui	1
1.6	Evolution of adaptive strategies.	3	1[10]	WSQ	MCQ	3
2.1	Sexual selection, Altruism, Sexual strategy and social organization	4	1[30]	GD	CT	2
2.2	Animal perception,	3	4[20]	Lec	MCQ	4
2.3	Neural control of behaviour	4	1[10]	Lec	ST	5
2.4	Sensory processes and perception	3	3[20]	BS	MCQ	4
2.5	Visual adaptations to unfavourable environments	4	3[20]	Lec	ST	3
3.1	Coordination and Orientation, Homeostasis and Behaviour,	4	2[10]	WSQ	CT	5
3.2	Physiology and Behaviour in changing environments	3	4[10]	WSQ	CT	4
3.3	Animal Learning, Conditioning and Learning,	3	2[10]	GD	MCQ	3
3.4	Biological aspects of learning	4	4[20]	Lec	OBT	1
3.5	Cognitive aspects of learning.	4	2[50]	Sem	MCQ	1

4.1	Instinct and learning, Displacement activities, Ritualization and Communication,	3	1[20]	Sem	OBT	2
4.2	Decision making behaviour in Animals,	2	3[10]	CS	Qui	9
4.3	Complex behaviour of hobey bees	2	3[20]	Sem	HoA	8
4.4	Evolutionary optimality, Mechanism of Decision making.	3	1[20]	Rep	HoA	7
4.5	The mentality of Animals: Languages and mental representation, non-verbal communication in human, mental images, Intelligence, tool use and culture	4	4[20]	GT	MCQ	2
4.6	Animal awareness and Emotion.	4	5[10]	Sem	CT	3
5.1	Organization of circadian system in multi cellular animals; Concept of central and peripheral clock system;	4	4[10]	Lec	HoA	1
5.2	Circadian pacemaker system in invertebrates with particular reference to Drosophila;	4	5[20]	Lec	Ess	4
5.3	Photoreception and photo- transduction	3	5[20]	Lec	OBT	5
5.4	Molecular bases of seasonality;	2	5[10]	Lec	Qui	7
5.5	The relevance of biological clocks for human welfare - Clock function (dysfunction);	3	4[20]	Lec	Ess	2
5.6	Human health and diseases – Chrono pharmacology, chrono medicine, chrono therapy.	2	4[20]	GD	Ess	3

Reference Books

1. David McFarland, 1985.Animal Behaviour, Longman Scientific & Technical, UK.576pp.
2. HarjindraSingh, 1990. A TextBook of Animal Behaviour, AnomolPublication, 293pp.
3. Hoshang S.Gundevia and Hare Goving Singh, 1996. Animal Behaviour,S.Chand&Co, 280pp.
4. Shukla, J. P 2010, Fundamentals of Animal Behaviour, Atlantic, 587pp.
5. Vinod Kumar, 2002. Biological Rhythms. Narosa Publishing House, Delhi.

SERCULTURE

Course Title: **Sericulture**	Sub Code: 23PZEG	Course Type: Theory

Total Hours: 90 Hours/Week: 6 Credits: 4

Pass-Out Policy: Minimum Contact Hours: 54 Total Score %:100 Internal: 40 External: 60 Minimum Pass %: 50[No Minimum for Internal

Course Creator	Expert 1	Expert 2
Dr .C. Albert	Dr .Shirly Daniel	Dr.P. Beautlin Sheribha
Associate Professor	Associate Professor	Assistant Professor
Department of Zoology	Department of Zoology	Department of Zoology
Scott Christian College (Autonomous)	Scott Christian College (Autonomous)	Scott Christian College (Autonomous)

CLO-No.	**Course Learning Outcomes** *Upon completion of this course, students will be able to:*	**% of PLO Mapping with CLO**	**CLO & PLO Mapped with GA#**	**Cognitive Level (CL)**	**Knowledge Category (KC)**
CLO-1	To understand the various practices in sericulture. To know the needs for sericulture and the status of India in global market.	4(10),10(10)	GA1, 2,5,9	U	F
CLO-2	Understand the practices followed in the culture and management of mulberry	1(5),3(5),4(5),5(5)	GA 1,2,3,8	U, An	M
CLO-3	Detail the various techniques involved in the rearing and management of non mulberry and mulberry silkworm	4(5),5(10),8(5)	GA1,2,6,7	E	C
CLO-4	Explain the different reeling techniques and marketing of raw silk.	3(5),4(9),6(6)	GA 1,2.3,9	An, C	P
CLO-5	Impart expertise on sericultural practices to rural sericulture farmers	1(7), 2(6), 3(7)	GA 1,2,6,8	E,R	M

Module	Course Description	Hours	% of CLO mapping with Module	Learning Activities	Assessment Tasks	Reference
1.1	Introduction to textile fibers	3	1[10]	GD	CT	1
1.2	Types- natural and synthetic fibers	3	1[10] 2[10]	Sem	ST	2
1.3	Sources of silk fiber- Tasar, Muga, Anaphe, Gonometa, Fagara, spider and mussel	3	1[20] 2[10]	Lec	Qui	1
1.4	Properties and importance of silk fiber.	4	1[20]	GD	HrA	3
1.5	History, development, status, characteristics and advantages of sericulture in India.	5	1[20]	Lec	CT	
2.1	Host plants	2	2[10]	GD	HoA	4
2.2	Moriculture- distribution, morphology,	3	2[10]	Lec	MCQ	1
2.3	Propagation- seedling, cutting, grafting, layering and micropropagation methods,	5	2[30]	Lec	HoA	2
2.4	Maintenance- irrigation, manuring and pruning,	4	2[20]	Sem	CT	2
2.5	Pests and diseases of mulberry.	4	2[10] 3[20]	RP	CT	3
3.1	*Bombyx mori*- morphology,	3	3[20]	BS	MCQ	2
3.2	Anatomy	3	3[20]	OT	ST	4
3.3	Life cycle, geographical locations	3	3[10]	Lec	CT	4
3.4	Larval moults, voltinism, indigenous and commercial races.	5	3[20]	GD	ST	1
3.5	Diapause. Egg-storage and transportation.	4	2[20] 3[10]	BS	OBT	1

4.1	Rearing operations- disinfection, brushing, feeding and spacing.	4	4[20]	GD	SA	1
4.2	Moulting and spinning. Harvest	3	4[20]	Sem	Qui	2
4.3	Rearing methods- Chawki, Lasso, Showa, shelf-rearing, floor-rearing and shoot rearing.	4	4[20]	CS	Qui	2
4.4	Diseases of *Bombyx mori*- protozoan, bacterial, viral and fungal.	4	3[20]	Rep	ST	4
4.5	Pests of silkworm- Uzi fly, desmestids, mites, ants, nematodes, aves and mammals.	3	3[20]	Rep	MCQ	3
5.1	Physical and commercial characteristics of cocoons.	3	4[20]	SP	HoA	3
5.2	Cocoon harvesting and marketing	3	4[10]	Lec	Ess	2
5.3	Cocoon sorting, stifling, deflossing, riddling, cooking	4	4[20]	GD	OBT	1
5.4	Brushing, reeling and re-reeling.	3	4[10]	Lec	HrA	4
5.5	Weaving.	2	4[20] 5[10]	Lec	CT	4
5.6	By-products of sericulture industry	3	5[10]	Lec	ST	4

Reference Books

1. G. Ganga and J. Sulochana Chetty. 2019. An introduction to sericulture, 2nd edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

2. M. Johnson and M. Kesary. 2019. Sericulture, Saras publication, Tamilnadu.

3. Singh, Amardev & Ravinder Kumar. 2013. Sericulture handbook Vol 1, Biotech.

4. M. Madan Mohan Rao. An Introduction to Sericulture, 2nd edition, BS Publications.

Recommended Websites

1. https://agritech.tnau.ac.in/sericulture/

2. https://csb.gov.in/