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## PREFACE

The Four-Year Undergraduate Programme (FYUGP) in Zoology aligns with the objectives outlined in the National Education Policy (NEP), fostering holistic development and preparing students for the dynamic demands of the future.

The Curriculum and Syllabus of BSc (Honours) Zoology Programme offers a comprehensive curriculum and syllabi aimed to equip students with theoretical and practical knowledge across various disciplines of Biological Science. The programme is structured with Major and Minor courses (DSC, DCC, DCE, DSE etc), Multi-Disciplinary Courses (MDC), Skill Enhancement Courses (SEC), Value Added Courses (VAC), Internship and Research Projects.

Students pursuing the Bachelor of Science in Zoology have two exit options: B Sc Degree and B Sc Degree (Honours with Research), awarded after successful completion of three and four years respectively. The curriculum integrates traditional components of Zoology with modern advancements in Biochemistry, Molecular Biology, Biotechnology, Bio Informatics, Immunology and Microbiology.

The B Sc (Honours) Programme in Zoology offered by Mar Athanasius College (Autonomous), Kothamangalam is with Microbiology as specialisation. It enables the students to understand the fundamental and applied areas of Microbiology such as Bacteriology, virology, and mycology and Clinical Microbiology. The Zoology core courses in the syllabus consisted of Animal Taxonomy, Physiology, Cell Biology, Genetics, Comparative Anatomy, Developmental Biology, Environment and Conservation Biology. In addition, the syllabi incorporate courses like Research Methodology, Biostatistics, Computer Applications and Animal Ethics to pursue career in academic and applied research. The Curriculum also gives ample opportunities for the students to acquire skills in Apiculture, Sericulture, Poultry, Ornamental fish culture and Medical diagnostic techniques.

The Chairperson  
Board of Studies in Zoology  
Mar Athanasius College  
(Autonomous)  
Kothamangalam

<b>MAR ATHANASIVUS COLLEGE, KOTHAMANGALAM (AUTONOMOUS) Members of Board of Studies Subject: ZOOLOGY</b>	
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**Programme Outcomes (PO)**

**PO 1: Critical thinking and Analytical reasoning**

Capability to analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories to develop knowledge and understanding; critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society.

**PO 2: Scientific reasoning and Problem solving**

Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective; capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.

**PO 3: Multidisciplinary/interdisciplinary/transdisciplinary Approach**

Acquire interdisciplinary /multidisciplinary/transdisciplinary knowledge base as a consequence of the learning they engage with their programme of study; develop a collaborative-multidisciplinary/interdisciplinary/transdisciplinary- approach for formulate constructive arguments and rational analysis for achieving common goals and objectives.

**PO 4: Communication Skills**

Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.

**PO 5: Leadership and Entrepreneurship Skills**

Ability to work effectively and lead respectfully with diverse teams; setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. After inculcating all the necessary graduate qualities, a graduate can become an entrepreneur.

**PO 6: Social Consciousness and Responsibility**

Ability to contemplate the impact of research findings on conventional practices, and a clear understanding of responsibility towards societal needs and reaching the targets for attaining inclusive and sustainable development.

**PO 7: Equity, Inclusiveness and Sustainability**

Appreciate equity, inclusiveness and sustainability and diversity; acquire ethical and moral reasoning and values of unity, secularism and national integration to enable to act as dignified citizens; able to understand and appreciate diversity (caste, ethnicity, gender and marginalization), managing diversity and use of an inclusive approach to the extent possible.

**PO 8: Moral and Ethical Reasoning**

Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behaviour.

**PO 9: Networking and Collaboration**

Acquire skills to be able to collaborate and network with educational institutions, research organisations and industrial units in India and abroad.

**PO 10: Lifelong Learning**

Ability to acquire knowledge and skills, including "learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

### Programme Specific Outcomes (PSO)

PSO NO:	Upon completion of the Four Year BSc Zoology ( Honours) Undergraduate Programme the students will be able to :	PO No:
PSO-1	Understanding the fundamental concepts of Zoology including cell biology, genetics, taxonomy, animal physiology, ecology, evolution, enabling students to analyse and interpret the biological phenomena.	7, 10, 8, 6
PSO-2	Develop and apply scientific research skills such as hypothesis formulation, experimental design, data collection, statistical analysis, and interpretation to equip the students to carry out research.	6, 8
PSO-3	Acquire practical and technical skills through hands on laboratory work, modern biotechnological and microbiological techniques by laboratory visits and field studies essential for the understanding of biological science.	2, 5
PSO-4	Enhance critical thinking, problem solving effective communication skills to articulate scientific knowledge.	1, 2, 4
PSO-5	Prepare the students for professional careers and further academic pursuits in Zoology and its related fields by fostering a continuous learning, professional development and exposure to latest scientific advancements.	5, 9, 10
PSO-6	Cultivate an understanding of microbiology, biotechnology, health and fitness and related fields by providing a committed learning environment equipped with sophisticated instruments.	3,7, 10



### SCHEME OF INSTRUCTIONAL CREDITS AND HOURS

No	Semester	Course Title	Course Type	Credit	Hrs/Week	Total Hours
1	1	Complexity of Animal Cells and Life Processes	DSCA	4	5	90
2	1	Community Health and Nutrition	MDC	3	4	72
3	2	Advanced Cellular Processes and Specialised Functions in Animals	DSCA	4	5	90
4	2	Man and Nature	MDC	3	4	72
5	3	Animal diversity 1- Non Chordata	DSC	4	5	90
6	3	Biosystematics	DSC	4	5	90
7	3	Biophysics	Any 1	DSE	4	72
	3	Instrumentation and Biological Techniques				
8	3	Animal Diversity	DSC B	4	5	90
9	4	Cell Biology	DSC A	4	5	90
10	4	Animal Diversity 2 - Chordata	DSC A	4	5	90
11	4	General Microbiology	Any 1	DSE	4	72
		Biomedical Sciences				
12	4	Human Physiology and Immunology	DSC B	4	5	90
13	4	Medical Diagnostic Technology	SEC	3	3	54
14	4	Internship		2		-
15	5	Molecular Biology	DSC	4	5	90
16	5	Environmental Biology and Human rights	DSC	4	5	90
17	5	Genetics	DSC	4	4	72
18	5	Evolutionary Biology and Ethology	DSE	4	4	72
19	5	Clinical Microbiology	Any 1	DSE	4	72
	5	Animal Pathology				
20	5	Ornamental Fish Culture	SEC	3	3	54
21	6	Biochemistry	DSC	4	5	90
22	6	Human Physiology and Endocrinology	DSC	4	5	90
23	6	Reproductive and developmental Biology	DSE	4	5	90
24	6	Bacteriology, Virology and Mycology	Any 1	DSE	4	72
	6	Marine Microbiology				
25	6	Apiculture and Sericulture	SEC	3	3	54
26	6	Poultry Science	VAC	3	3	54
27	7	Biotechnology	DCC	4	5	90
28	7	Biostatistics	DCC	4	4	72
29	7	Computer Application and Bioinformatics	DCC	4	4	72
30	7	Animal Reproduction and Breeding	Any 1	DCE	4	72
	7	Biosafety, Bioethics and IPR				
31	7	Research Methodology	DCE	4	4	72
32	7	Biodiversity Conservation and Management	DCE	4	4	72
33	8	Immunology	DCC	4	5	90
34	8	Genetic Engineering	DCC	4	5	90
35	8	Genomics and Proteomics	Any 1	DCE	4	90
	8	Green Biotechnology				
36	8	Bioprocess technology	Any 1	DCE	4	90
	8	Comparative Anatomy of Vertebrates				
37	8	Environmental Management and Climatology	Any 1	DCE	4	90
	8	Environmental Pollution and Ecotoxicology				
38	8	Research Project		12/8	-	-

**Syllabus Index: Zoology Major**  
**Name of the Major Subject: Zoology (Specialisation: Microbiology)**

**Semester: 1**

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
M24ZY1DSC100	Complexity of Animal Cells and Life Process	DSC A	4	5	3	-	2	-
M24ZY1MDC100	Community Health and Nutrition	MDC	3	4	2		2	

L — Lecture, T — Tutorial, P — Practical/Practicum , O — Others

**Semester: 2**

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
M24ZY2DSC100	Advanced Cellular Processes and Specialised Functions in Animals	DSC A	4	5	3	-	2	-
M24ZY2MDC100	Man and Nature	MDC	3	4	2	-	2	-

L — Lecture, T — Tutorial, P — Practical/Practicum , O — Others

**Semester: 3**

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
M24ZY3DSC200	Animal diversity 1- Non Chordata	DSC A	4	5	3	-	2	-
M24ZY3DSC201	Biosystematics	DSC A	4	5	3	-	2	-
M24ZY3DSE200	Biophysics	Any One	4	4	4	-	-	-
M24ZY3DSE201	Instrumentation and Biological Techniques							
M24ZY3DSC202	Animal diversity	DSC B	4	5	3		2	

L — Lecture, T — Tutorial, P — Practical/Practicum , O — Others

**Semester: 4**

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
M24ZY4DSC200	Cell Biology	DSC A	4	5	3	-	2	-
M24ZY4DSC201	Animal Diversity 2 - Chordata	DSC A	4	5	3	-	2	-
M24ZY4DSE200	General Microbiology(S)	Any One	DSE	4	4	4	-	-
M24ZY4DSE201	Biomedical Sciences							
M24ZY4DSC202	Human Physiology and Immunology	DSC B	4	5	3	-	2	-
M24ZY4SEC200	Medical Diagnostic Technology	SEC	3	3	3	-	-	-
M24ZY4INT200	Internship		2					

L — Lecture, T — Tutorial, P — Practical/Practicum , O — Others, S-Specialisation

**Semester: 5**

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
M24ZY5DSC300	Molecular Biology	DSC	4	5	3	-	2	-
M24ZY5DSC301	Environmental Biology and Human rights	DSC	4	5	3	-	2	-
M24ZY5DSC302	Genetics	DSC	4	4	4	-	-	-
M24ZY5DSE300	Evolutionary Biology and Ethology	DSE	4	4	4	-	-	-
M24ZY5DSE301	Clinical Microbiology (S)	Any One	DSE	4	4	-	-	-
M24ZY5DSE302	Animal Pathology							
M24ZY5SEC300	Ornamental Fish Culture	SEC	3	3	3	-	-	-

L — Lecture, T — Tutorial, P — Practical/Practicum , O — Others, S-Specialisation

**Semester: 6**

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
M24ZY6DSC300	Biochemistry	DSC	4	5	3	-	2	-
M24ZY6DSC301	Human Physiology and Endocrinology	DSC	4	5	3	-	2	-
M24ZY6DSE300	Reproductive and developmental Biology	DSE	4	5	3	-	2	-
M24ZY6DSE301	Bacteriology, Virology and Mycology (S)	Any One	DSE	4	4	-	-	-
M24ZY6DSE302	Marine Microbiology							
M24ZY6SEC300	Apiculture and Sericulture	SEC	3	3	3	-	-	-
M24ZY6VAC300	Poultry Science	VAC	3	3	3	-	-	-

L — Lecture, T — Tutorial, P — Practical/Practicum , O — Others, S-Specialisation

**Semester: 7**



Course Code	Title of the Course		Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
						L	T	P	O
M24ZY7DCC400	Biotechnology		DCC	4	5	3	-	2	-
M24ZY7DCC401	Biostatistics		DCC	4	4	4	-	-	-
M24ZY7DCC402	Computer Application and Bioinformatics		DCC	4	4	4	-	-	-
M24ZY7DCE400	Animal Reproduction and Breeding	Any One	DCE	4	4	4	-	-	-
M24ZY7DCE401	Biosafety, Bioethics and IPR								
M24ZY7DCE402	Research Methodology		DCE	4	4	4	-	-	-
M24ZY7DCE403	Biodiversity Conservation and Management		DCE	4	4	3	-	-	-

L — Lecture, T — Tutorial, P — Practical/Practicum , O — Others

**Semester: 8**

Course Code	Title of the Course		Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
						L	T	P	O
M24ZY8DCC400	Immunology		DCC	4	5	3	-	2	-
M24ZY8DCC401	Genetic Engineering		DCC	4	5	3	-	2	-
M24ZY8DCE400	Genomics and Proteomics	Any One	DCE	4	5	3	-	2	-
M24ZY8DCE401	Green Biotechnology								
M24ZY8DCE402	Bioprocess technology	Any One	DCE	4	5	3	-	2	-
M24ZY8DCE403	Comparative Anatomy of Vertebrates								
M24ZY8DCE404	Environmental Management and Climatology	Any One	DCE	4	5	3	-	2	-
M24ZY8DCE405	Environmental Pollution and Ecotoxicology								
M24ZY8PRJ400	Research Project			12	Honours with Research - 2 DCC + Project				
				8	Honours – 2 DCC + 1 DSC/DCE + Project OR 2 DCE				

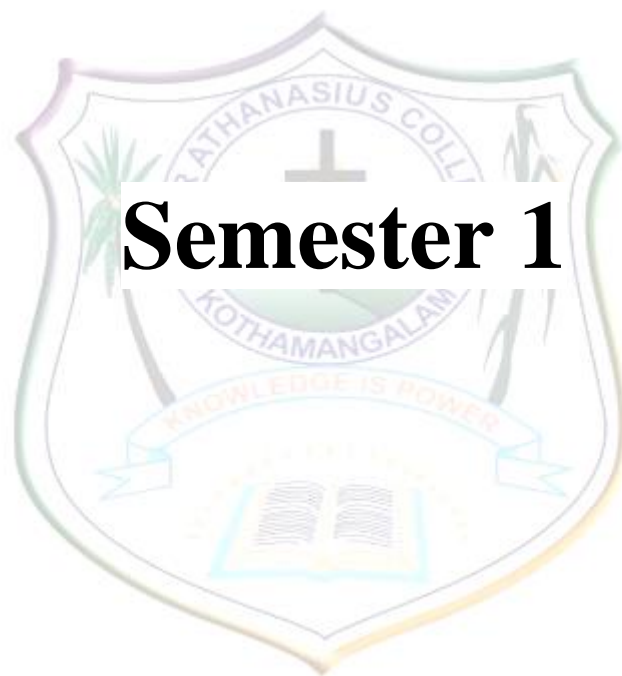
L — Lecture, T — Tutorial, P — Practical/Practicum , O — Others

**Courses which have study tour/ field visits/institution visit**

SI No	Semester	Course type	Name of Course	Activity
1	1	DSC	Complexity of Animal Cells and Life Processes	Field study (One Day)
2	1	MDC	Community Health and Nutrition	Community engagement (One day)
3	2	DSC	Advanced Cellular Processes and Specialised Functions in Animals	Field study (One day)
4	2	MDC	Ecology and Evolution	Field study (One day)
5	3	DSC	Animal diversity 1- Non Chordata	Institution visit (Two days) Field study/ Museum Visit (One day)
6	3	DSC	Biosystematics	
7	4	DSC	Animal Diversity Chordata 2	Field study (One day) Museum Visit
8	4	SEC	Medical Diagnostics	Visit a medical diagnostic laboratory (One day)
9	5	DSC	Environmental Biology and Human rights	Field study (Two days)
10	5	SEC	Ornamental Fish Culture	Visit a ornamental fish facility/museum (One day)
11	6	SEC	Apiculture and Sericulture	Visit an apiary and Sericulture (Two days)
12	7	DSE	Biodiversity Conservation and Management	Visit any two protected areas (Three days)
13	8	DCC	Biotechnology	Laboratory visit in reputed institutions (3 days) Industry visit (Two days)
14	8	DCE	Genetic Engineering	
15	8	DCE	Genomics and Proteomics	
16	8	DCE	Green Biotechnology	
17	8	DCE	Bioprocess technology	
18	8	DCE	Environmental Management and Climatology	Industrial visit (Two days)
19	8	DCE	Environmental Pollution and Ecotoxicology	

### Courses with Practical and Records

SI No	Semester	Course type	Course Title
1	1	DSC	Complexity of Animal Cells and Life Processes
2	1	MDC	Community Health and Nutrition
3	2	DSC	Advanced Cellular Processes and Specialised Functions in Animals
4	2	MDC	Ecology and Evolution
5	3	DSC	Animal diversity 1- Non Chordata
6	3	DSC	Biosystematics
7	3	DSCB	Animal diversity
8	4	DSC	Cell Biology
9	4	DSC	Animal Diversity Chordata 2
10	4	DSCB	Physiology and Immunology
11	5	DSC	Molecular Biology
12	5	DSC	Environmental Biology and Human rights
13	6	DSC	Biochemistry
14	6	DSC	Human Physiology and Endocrinology
15	7	DSE	Reproductive and Developmental Biology
16	8	DCC	Biotechnology
17	8	DCC	Immunology
18	8	DCE	Genetic Engineering
19	8	DCE	Genomics and Proteomics
20	8	DCE	Green Biotechnology
21	8	DCE	Bioprocess technology
22	8	DCE	Comparative Anatomy of Vertebrates
23	8	DCE	Environmental Management and Climatology
24	8	DCE	Environmental Pollution and Ecotoxicology



# Semester 1



**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology				
Course Name	Complexity of Animal Cells and Life Processes				
Type of Course	DSC				
Course Code	M24ZY1DSC100				
Course Level	100				
Course Summary	This course explores basic understanding of cell biology focus on animal cells, types of cells and tissues. Students can delve into the diversity of animal cells and their structure and functions, additionally students will learn about the organisation and functions of animal tissues- epithelial, muscular, nervous and connective tissue.				
Semester	1	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3	-	1	-
Pre-requisites, if any	Basic knowledge in science				

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Recall cell as the basic unit of life	K	1, 3
2	Compare and contrast various types of cells	An	1, 3
3	Analyse the structural organisation of cells	An	1, 3
4	Develop the skill to distinguish between various types of cells in animal body	S	1, 4
5	Analyse the various biomolecules in the cell	An	1, 3
6	Imagine the organisation of various cells and the Location of Biomolecules like nucleic acids	C	1, 3, 4

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**


Module	Units	Course Description	CO No.	Hours
1		The Cell	1, 2, 3, 4	15
	1.1	Cell as the machinery Life Prokaryotic and eukaryotic cells		
	1.2	Difference between plant and animal cells		
	1.3	Basic structure of animal cell		
	1.4	Plasma membrane, Protoplasm, Cytoplasm		
	1.5	Cell inclusions- nucleus, mitochondria, ER, Golgi apparatus and lysosomes, ribosomes, (Brief account of the structure and function)		
2		Types of Animal cells and Tissues	1, 2, 4	15
	2.1	Stem cells, Bone cells, Cartilage cells		
	2.2	Muscle cells - types		
	2.3	Epithelial cells - types, fat cells		

	2.4	Sex cells, Nerve cells - types		
	2.5	Animal Tissues types –Connective tissue (Blood and its composition), Epithelial tissue, Muscle tissue and Nervous tissue, Renal tissue		
3		Biomolecules in the cell	5, 6	15
	3.1	Water, Micro and macromolecules- vitamins, minerals, amino acids		
	3.2	Proteins, Carbohydrates, lipids		
	3.3	Enzymes		
	3.4	DNA and RNA		
4		Practical	1, 2, 3, 4	30
	4.1	Adequately use light microscopes to observe cells at a magnification up to 100X (oil immersion) The Steps in the tissue preparation for light microscopy		
	4.2	Identification and recognition of Blood cells using light microscope Microscopic observation of tissues- Muscle tissue-skeletal muscle and smooth muscle, skeletal tissue, epithelial tissue, adipose tissue, nervous tissue Cell organelles identification- Mitochondria, Golgi bodies, ER, Nucleus, Lysosomes, Ribosomes Structure of DNA, RNA and proteins (Models /Images)		
	4.3	Homogenisation and centrifugation- Separating of supernatant and pellet Paper chromatography		
	4.4	Preparation of whole mounts- 5 Mounting of cheek epithelium, Observe sperm and egg		
5		Teacher Specific Module		

<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

### Recommended Reading

1. Becker, W. M., Kleinsmith, L. J., Hardin. J. & Bertoni, G. P. (2009). *The World of the Cell* (7<sup>th</sup> ed.). Pearson Benjamin Cummings Publishing, San Francisco.
2. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith & Watson James (2008). *Molecular Biology of the Cell* (5<sup>th</sup> ed.). Garland publishing Inc. New York and London.
3. Cooper, G. M. & Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and Sunderland, Washington DC.
4. Janet Iwasa, Wallace Marshal ., (2021) *CARP'S Cell and molecular Biology*, 9<sup>th</sup> edition: Wiley Online publication Asia Edition
5. Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments* (6<sup>th</sup> ed.). John Wiley and Sons. Inc.
6. Veer Bala Rastogi., (2021) *Cell Biology* Med Tech Science press

	<b>Mar Athanasius College (Autonomous), Kothamangalam</b>  <b>FYUGP SYLLABUS</b>
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Programme	B Sc. (Honours) Zoology					
Course Name	Community Health and Nutrition					
Type of Course	MDC					
Course Code	M24ZY1MDC100					
Course Level	100					
Course Summary	This course provides an overview of health and sanitation. It covers fundamental principles of nutrition, importance of balanced diet at various life stages like pregnancy, lactation and healthy food practices, The course emphasises the importance of exercise and sleep, cardiac, mental health, and haematological parameters. The course also covers various life style diseases and the dangers of life style diseases.					
Semester	1	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	-	1	-	60
Pre-requisites, if any	Basic knowledge in health and nutrition					

### COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the various aspects of nutrition and health	U	1, 2, 3
2	Understand the importance of food safety	U	1, 2
3	Examine the concepts of health and lifestyle	E	1, 2
4	Discuss the methods of lifestyle managements	An	1, 6
5	Analyse the causes of lifestyle diseases	An	1,2,6
6	Create an action plan for the local needs such as prevention of food adulteration and importance of exercises	C	3,6

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

### COURSE CONTENT

#### Content for classroom transaction (Units)

Module	Units	Course Description	CO No.	Hours
1	1.1	Nutrition and health: Nutritional requirements of man, classification of major nutrients including protein, vitamins and minerals, water, role of fibre, biological value of food components, food groups and sources, balanced diet, RDA, BMI, BMR, Calorie intake and expenditure	1, 4, 6	15
	1.2	Healthy eating pyramid, nutrition in infancy, preschool, school, adolescent, pregnancy, lactation and old age. nutrition in diseases and special conditions. Food safety: nutrition education, food sanitation and hygiene, food adulteration and consumer protection.		
	1.2	Understanding of health: Define health, basic concepts, dimensions of health		
	1.3	Health Parameters: Individual normal standards, devices.1. Blood pressure, 2. Brain activities and sleep, 3.Focus or attention, 4.Pulse, 5. Body temperature, 6. Daily physical activities, 7. Electrocardiogram (ECG), 8.Cardiac fitness 9. Stress, 10. Haematological parameters,		

		11. BMI		
2	2.1	Common life style diseases: Alzheimer's disease and other neural disorders, asthma, cancer, cardio vascular diseases - including hypertension, Atherosclerosis and stroke, chronic obstructive pulmonary disease, Diabetes Mellitus or Type 2 Diabetes, kidney disorders and chronic renal failure, constipation, depression, gastro-intestinal disturbances including diarrhoea and peptic ulcer, liver cirrhosis and other liver diseases, obesity, osteoporosis, occupational lifestyle diseases.	3, 4, 5, 6	15
	2.2	Modern lifestyle disorders: sleeping habits, junk food, poor eating habits, anxiety, food poisoning		
	2.3	Causes of lifestyle diseases: Defects of modern food habits and unbalanced diet options, food adulteration, environmental pollution, poor life style choices, drug abuse, tobacco smoking, alcohol and drug consumption, lack of adequate exercise, wrong body posture, disturbed biological clock, stressful environmental conditions		
	2.4	Prevention and control of life style diseases: Healthy life style habits and practices, healthy eating habits, exercise and fitness, good sleep patterns, a strict no to alcohol, drugs, and other illegal drugs. Uncontrollable factors like age, gender, heredity and race. Healthy diet: disease prevention through appropriate diet and nutrition, avoiding foods that are high in fats, salt and refined products. Avoid junk food and replace by natural food/ organic food.		
3		Practical	1, 3, 4, 5, 6	30
	3.1	Preparation of balanced diet- healthy person, adult man, pregnant woman and lactating woman BMI calculation Monitoring of blood pressure ECG analysis Identification of RBC and WBC Test for the analysis of sugar in the Urine sample		
	3.2	Vector identification- anopheles and culex mosquitoes EEG interpretation of different brain waves- Alpha, Theta, Beta and Delta		
5		Teacher Specific Module		

<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 15 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	<b>B. End Semester Examination</b> Theory Total = 35 marks, Duration 1 hrs Part A (Short answer) – 10 out of 12 x 1 = 10 marks Part B (Short essay) – 3 out of 6 x 5 = 15 marks Part C (Long essay) – 1 out of 2 x 10 = 10 marks Practical Total = 35 marks; Duration- 2 hrs



**Recommended Reading**

1. AAPERD (1980). *Health Related Physical Fitness Test Manual*. Published by Association drive Reston Virginia.
2. ACSM (2005). *Health Related Physical Fitness Assessment Manual* Lippincott Williams and Wilkins USA,
3. Begum, M.R. (2006). *A Text Book of Foods, Nutrition and Dietetics*. 2nd Edn. Sterling Low Price Edition. Sterling Publishers Private Ltd., New Delhi.
4. Charles B.C., et.al, C.A., (2004). *Concepts of Fitness and Wellness*. Boston: McGraw Hill. 6.
5. Delvin, T.M (1997). *Text Book of Biochemistry with clinical correlation*. 4th Edn. John Wiley and Sons Inc. Ltd. U.K.
6. Fahey, T. P. Insel, M, and W. Roth (2005) *Fit and Well* New York: McGraw Hill Inc.
7. Greenberg, and Dintiman B 1997. *Wellness Creating a life of Health and Fitness*, London Allyn and Bacon Inc.
8. Kumar, M and Kumar R. (2003) *Guide to Healthy Living: Role of food and exercise*. Deep and Deep Publications.
9. Les Snowdan. , (2002). *Maggie Humphrey's Fitness walking*, Maggie Humphery Orient Paper Backs 2002 New Delhi.
10. Puri, K., and Chandra. S. S., (2005). *Health and Physical Education*. New Delhi: Surjeet Publications
11. Rai, B.C., (2005). *Health Education and Hygiene* Published by Prakashan Kendra, Lucknow.
12. Ralph, S., Barger P., Jr. and Leolson E. (1999) *Life Fit*. Human Kinetics. USA





# Semester 2



**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology					
Course Name	Advanced Cellular Processes and Specialised Functions in Animals					
Type of Course	DSC					
Course Code	M24ZY2DSC100					
Course Level	100					
Course Summary	This course delves into intricacies of life, focusing on the key concepts such as cell division, cellular nutrition, including mitosis and meiosis. The course explains the nutritional requirements of cells functioning of specialised tissues such as cardiac and skeletal and nervous tissue. Special attention is given to the importance of contact inhibition and cancer. This course provides a basic understanding of the importance, development and future of Synthetic Biology.					
Semester	2	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
Pre-requisites, if any	Basic knowledge in science					

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Record the stages of cell cycle, identify the difference between mitosis and meiosis	K , U	1, 3
2	Perceive the role of cell division check points and development of cancer	A	1, 3
3	Analyse the metabolic process of various cells	An	1, 2, 3
4	Evaluate and assess the functioning of neurones and cardiac tissue and conducting systems of heart	E	1
5	Cultivate interest and curiosity in the organisation and functioning of sensory receptors	I	2, 4
6	Create innovative solutions and experiments in synthetic biology using the foundational knowledge of cell Biology	C	2, 4

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Introduction to cell cycle, Overview of G <sub>0</sub> Phase, G <sub>1</sub> Phase, S phase, G <sub>2</sub> phase and M phase	1, 2	15
	1.2	Cell division- Mitosis		
	1.3	Cell division-Meiosis		
	1.4	Concept of contact inhibition, Cancer and metastasis		
2	2.1	Cell metabolism- Metabolic activities in the cell- Anabolism and catabolism	3, 4	15
	2.2	Nutrition in brain cells mention the significance of Blood brain barrier		

	2.3	Basic understanding of primary energy source and secondary energy source for neurons, Cardiac muscle, skeletal muscle, liver cells and kidney cells		
	2.4	Working of cardiac muscle, neurogenic and myogenic heart, conducting system of heart, Working of neurons and generation of nerve impulses		
3	3.1	General understanding of Sensory cells -Photo-receptors, Rods and cones, Auditory receptors, Otolith organs, Olfactory and gustatory receptors, Bioluminescence, Echolocation in bats	5, 6	15
	3.2	Introduction to synthetic biology and examples of unique mechanisms and biological features used in synthetic biology – Biological sensors, regenerative medicine, Bioinspired designs		
4		Practical	1, 2, 4, 6	30
	4.1	Study of slides mitosis different stages Study of meiosis different stages		
	4.2	Neuro muscular junction and synapse comparison (Photographs/ images/ slides/ models) Recognise and identify the various items in the electron microscopic images of cell and cell organelles – parts of the organelles, macromolecular complexes		
	4.3	Study using photographs - Structure of photo receptor rods and cones, auditory and olfactory receptor		
	4.4	Effect of salivary amylase on starch		
	4.5	Principle and working of micro-photographic equipment, Flame photometer, magnetic stirrer, Spectrophotometer		
5		Teacher Specific Module		

#### MODE OF EVALUATION AND ASSESSMENT

<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks
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#### Recommended reading

1. Becker, W. M., Kleinsmith, L. J., Hardin. J. & Bertoni, G. P. (2009). *The World of the Cell* (7<sup>th</sup> ed.). Pearson Benjamin Cummings Publishing, San Francisco.
2. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith & Watson James (2008). *Molecular Biology of the Cell* (5<sup>th</sup> ed.). Garland publishing Inc. New York and London.
3. Cooper, G. M. & Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and Sunderland, Washington DC.
4. Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments* (6<sup>th</sup> ed.). John Wiley and Sons. Inc.



**Mar Athanasius College (Autonomous), Kothamangalam**  
**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology				
Course Name	Animal Diversity 1- Non - Chordata				
Type of Course	DSC				
Course Code	M24ZY2DSC101				
Course Level	200				
Course Summary	This course offers an in-depth exploration of the vast array of animal life excluding the phylum Chordata. It covers the morphology, taxonomy, evolutionary relationships, and ecological roles of non-chordate animals, providing a comprehensive understanding of their diversity and biological significance.				
Semester		Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3	-	1	-
Pre-requisites, if any	Basic knowledge in science				

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the evolutionary relationships among protistans and non-chordate animals	U	1
2	Describe the morphological and physiological adaptations that allow non-chordates to thrive in diverse environments	K, E	2
3	Discuss the economic and health impacts of non-chordate animals on human society	An	4
4	Identify and classify major non-chordate phyla based on their distinctive characteristics	K, U	1, 3, 6
5	Explain the ecological roles and significance of Protistans and Non-chordate animals in various ecosystems	U, E	1, 3
6	Recall and understand the characters of various invertebrate phyla along with their ecological and morphological significance	K	1, 3, 4

\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	General characters of Kingdom Protista ( <i>e.g., Amoeba, Noctiluca, Trychonympha, Trypanosoma, Leishmania, Euglena, Opalina, Diatoms, Volvox, Proterospongia, Paramecium, Balantidium coli, Plasmodium, Red Alga</i> )	1, 2, 4, 5	15
	1.2	Type: Paramecium		
	1.3	Parasitic protists (diseases mode of transmission and prophylactic measures: <i>Entamoeba, Trypanosoma, Plasmodium, Leishmania</i> ).		
	1.4	Outline classification of Kingdom Animalia Three branches - Mesozoa, Parazoa and Eumetazoa		

		Mesozoa: Phylum Orthonectida (e.g., <i>Rhopalura</i> ) Parazoa: Phylum Placozoa (e.g., <i>Trycoplax</i> )		
	1.5	General characters of Porifera (e.g., <i>Sycon</i> , <i>Euplectella</i> , <i>Cliona</i> ) Canal system in sponges		
	1.6	General characteristics of Cnidaria (e.g., <i>Hydra</i> , <i>Obelia</i> , <i>Rhizostoma</i> , <i>Metridium</i> ) Life cycle of <i>Obelia</i> Polymorphism in Coelenterates, Corals and coral reefs		
	1.7	General characteristics and affinities of Ctenophora (e.g., <i>Pleurobrachia</i> )		
2	2.1	General characters of Platyhelminthes (e.g., <i>Planaria</i> , <i>Fasciola</i> , <i>Taenia solium</i> , <i>Taenia saginata</i> ) Life cycle and pathogenicity of <i>Schistosoma</i> , <i>Taenia solium</i> and <i>Taenia saginata</i> Life cycle of <i>Fasciola hepatica</i> .	2, 3	15
	2.2	General characters of Nematelminthes (e.g., e.g., <i>Wuchereria bancrofti</i> , <i>Ascaris lubricoides</i> ) Concept of pseudocoelom Pathogenic nematodes in man (e.g., <i>Wuchereria bancrofti</i> , <i>Ascaris lubricoides</i> , <i>Ancylostoma duodenale</i> , <i>Trichinella</i> , <i>Enterobius</i> ).		
	2.3	General characteristics of Annelids (e.g., <i>Polygordius</i> , <i>Chaetopterus</i> , <i>Megascolex</i> , <i>Hirudinaria</i> ) Evolution of coelom and metamerism		
3	3.1	Characteristics and phylogenetic significance of Onychophora (e.g., <i>Peripatus</i> )	1, 5, 6	15
	3.2	General characters of Arthropoda (e.g., <i>Triarthrus</i> , <i>Limulus</i> , <i>Cyclops</i> , <i>Argulus</i> , <i>Sacculina</i> , <i>Scolopendra</i> , <i>Spirostreptus</i> , <i>Bombyx mori</i> ) Type : <i>Penaeus</i> Characteristics and phylogenetic significance of <i>Limulus</i>		
	3.3	General characters of Mollusca (e.g., <i>Chiton</i> , <i>Dentalium</i> , <i>Pinctada</i> , <i>Sepia</i> , <i>Pila</i> ) Respiration in Mollusca with reference to <i>Pila</i>		
	3.4	General characters of Echinodermata (e.g., <i>Astropecten</i> , <i>Ophiothrix</i> , <i>Echinus</i> , <i>Holothuria</i> , <i>Antedon</i> ) Water-vascular system in Echinoderms		
4		Practical	1, 2, 4, 5	30
	4.1	Identification and Classification of Representatives of: Phylum Protozoa – <i>Paramecium</i> , <i>Plasmodium</i> , <i>Euglena</i> , <i>Trypanosoma</i> , <i>Noctiluca</i> , <i>Entamoeba</i> (Amoeba). Porifera - <i>Sycon</i> , <i>Euplectella</i> , <i>Cliona</i> Coelenterata - <i>Hydra</i> , <i>Obelia</i> , <i>Rhizostoma</i> , <i>Metridium</i> , Physalia, Corals – <i>Fungia</i> , <i>Astrea</i> , <i>Gorgonia</i> , <i>Meandrina</i> (Brain coral), <i>Tubifora</i> (Slag horn coral), <i>Pennantula</i> (Sea pen). Platyhelminthes - <i>Planaria</i> , <i>Fasciola</i> , <i>Taenia solium</i> , <i>Taenia saginata</i> and <i>Schistosoma</i> Aschelminthes - <i>Wuchereria bancrofti</i> , <i>Ascaris lubricoides</i> , <i>Ancylostoma duodenale</i> , <i>Trichinella</i> , <i>Enterobius</i> Annelida - <i>Nereis</i> , <i>Polygordius</i> , <i>Chaetopterus</i> , <i>Megascolex</i> , <i>Leech</i> , <i>Sabella</i> . Arthropoda- <i>Triarthrus</i> , <i>Limulus</i> , <i>Cyclops</i> , <i>Argulus</i> , <i>Sacculina</i> , <i>Scolopendra</i> , <i>Spirostreptus</i> , <i>Bombyx mori</i> Mollusca - <i>Chiton</i> , <i>Dentalium</i> , <i>Pinctada</i> , <i>Sepia</i> , <i>Pila</i>		

		Echinodermata - <i>Astropecten</i> , <i>Ophiothrix</i> , <i>Echinus</i> , <i>Holothuria</i> , <i>Antedon</i>		
	4.2	Demonstration of Dissections – Reproductive, Digestive and Nervous system of male and female Cockroach/Silk moth. Earth worm – Nervous system and appendages of prawn		
	4.3	Mounting of Earthworm setae /mouth arts of cockroach/ Nereis parapodia		
	4.4	Field visits to Museums, Butterfly Park and natural habitats of invertebrates		
5		Teacher Specific Module		

<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

### Recommended Reading

1. Barnes, R.S.K., Calow, P., Olive, P. J. W., Golding, D.W. & Spicer, J. I. (2002). *The Invertebrates: A New Synthesis* (3 ed.). Blackwell Science.
2. Barrington, E. J. W. (1979). *Invertebrate Structure and Functions* (2 ed.). E.L.B.S. and Nelson.
3. Ganguly, Sinha & Adhikari. (1988). *Biology of Animals*. Vol. I. New Central Book Agency.
4. Jordan E. L., Verma P. S. (2009). *Invertebrate Zoology*. S. Chand Publishing.
5. Kotpal R. L. (2020). *Modern text book of Zoology: Invertebrates* (12 ed.). Rastogi Publications.
6. Parker & Haswell. *Textbook of Zoology Invertebrates*. (2021). Vol I (8 ed.). Veer Bala Rastogi.
7. Ruppert E. E., Fox R. S, & Barnes R. D. (2006). *Invertebrate Zoology: A functional evolutionary approach*. Cengage (7<sup>th</sup> ed.).



**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology					
Course Name	Man and Nature					
Type of Course	MDC					
Course Code	M24ZY2DSC101					
Course Level	100					
Course Summary	This course delves into the key themes such as biosphere, landscape, natural resources, biodiversity conservation and sustainable agricultural practices. This course explores concepts such as dominance of humans on earth, dressing both benefits and consequences of human intervention in natural process. The course also covers topics like eco spirituality, importance of biodiversity conservation and initiatives from local and global levels					
Semester	2	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
Pre-requisites, if any		2	-	1	-	60
	Basic knowledge in science					

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the intricate relationship between humanity and natural world	U	1
2	Examine the interplay between human activities and the environment	An	1, 4
3	Students can evaluate the impact of urbanisation, industrialisation, and resource exploitation on ecosystems and biodiversity	E	1, 2
4	Equip the students to plan strategies for biodiversity conservation the principles of modern agriculture and green revolution	S	2, 1, 3
5	Empower the students to appreciate the conservation efforts and initiatives	Ap	3, 1
6	Develop interest in students to involve with local and global stakeholders in addressing environmental challenges	I	4, 5

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	The Biosphere: Earth-continents and continental drift concept of landscapes and habitats, lithosphere- forest (Tropical and Temperate), grasslands, deserts and montane, the biomes of the world, hydrosphere- oceans, estuaries, freshwater, water the elixir of life, atmosphere- structure and stratification	1, 2, 3	15



	1.2	natural resources: renewable and non- renewable, biodiversity, importance of biodiversity -the six e's, hotspots of biodiversity, biotic richness of India, monoculture and loss of genetic diversity, extinction crisis, IUCN and red data book		
	1.3	Dominance of Man on earth: industrial revolution human population growth, resource utilization, environmental consequences modern agriculture and green revolution, environmental impacts, imperialism and its ecological root		
2	2.1	Deforestation, landscape alterations, soil erosion, flood and drought, desertification, overexploitation, pollution (air, water and soil- pollutants and consequences only), acid rain, ozone depletion, greenhouse effect and global warming, waste disposal ( biodegradable and non-degradable eg. plastic and e- waste), oil spill energy – production consumption and its impact on environment quality of the environment and human health	3, 4, 5, 6	15
	2.2	Man's perspective on nature: eco spirituality, eco-theology and eco-feminism, community initiatives Indigenous People's Perspective (tribal and traditional communities), Native American, Amazonian,. Australian, Aborigines, Bishnoi Contributions of -John Muir, Aldo Leopold, Thoreau, Rachel Carson Edward Abbey, Arne Ness, Carolyn Merchant, Vandana Shiva		
	2.3	Global Strategies for Conservation: UN conference on Man and Environment-1972 UNEP and its contributions The World Conservation Strategy-1980 World Commission on Environment and Development The Earth Summit -1992, The UNFCCC and IPCC Conservation Strategies in India-MoEF Legal System- Mention Major Conservation Acts People's Participation in Conservation: Chipko Movement and Narmada Bachao Andolan, Silent Valley		
3		Practical	1, 5, 4, 6	30
	3.1	Field study Biodiversity sampling methods Study on transect methods		
	3.2	Field study and documentation of data on species richness in various ecosystems		
	3.3	Prepare a report on human activities such as farming, waste disposal and recreation activities and their impact on the environment		
4		Teacher Specific Module		

MODE OF EVALUATION AND ASSESSMENT	
A. Continuous Comprehensive Assessment (CCA)	B. End Semester Examination Theory Total = 35 marks, Duration 1 hrs

Theory Total = 15 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 3 out of 6 x 5 = 15 marks Part C (Long essay) – 1 out of 2 x 10 = 10 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks
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### Recommended Reading

1. Andrew S. Pullin, (2002). *Conservation Biology*. Cambridge University Press, Cambridge, UK
2. Barnes, C.W. (1988). *Earth, Time and Life*. John Wiley & Sons, New York
3. Barry Commoner.(1990). *Making Peace with the Planet*. Pantheon Books, New York, USA.
4. Berry Thomas.(1988). *The Dream of the Earth*. Sierra Club Books, San Francisco.
5. Bickerton, D., (1995). *Language and Human Behaviour*. University of Washington Press, Seattle.
6. Chattopadhyay Sajib. (2002). *Life Origin, Evolution and Adaptation*. Books and Allied (P)
7. Conroy, G. C. (1997).*Reconstructing Human Evolution: A Modern Synthesis*. Norton, NY,USA.
8. Donella H. Meadows et al. (1992). *Beyond the Limits*. Chelsea Green Publishing Com. Vermont, USA.
9. Donella H. Meadows et al.(1972). *The Limits to Growth*. Universe Books Ny, USA.
10. Forman, R.T and M. Gordaon. (1986). *Landscape Ecology*. John Wiley & Sons, NY,USA.
11. Gore A.(1993). *Earth in Balance*. Penguin Books, NY,USA.
12. Hardin, Garrett. (1968). "The Tragedy of the Commons," *Science*, 162(1968): 1243-1248.
13. Harrison, Lawrence E. and Samuel P. Huntington. (2000). *Culture Matters: How Values Shape Human Progress*. Basic Books. Perseus.
14. Joy A. Plamer (Edn.). (2004). *Fifty Great Thinkers on the Environment*. Routledge, London and New Delhi
15. Khanna ,G.N.(1993). *Global Environmental Crisis and Management*. Ashish Publishing House, New Delhi
16. Lester R. Brown. (2001). *Eco-Economy Building an Economy for the Earth*. W. W. Norton & Company, NY, USA.
17. Primack, R. (2002). *Essentials of Conservation Biology*. Sinauer Associates, Inc.; 3<sup>rd</sup> edition
18. Ramesh, B.R and Rajan Gurukkal., (2007). *Forest Landscapes of the Southern Western Ghats, India Biodiversity, Human Ecology and management Strategies*. French Institute of Pondicherry, India
19. Richard T. Wright & Bernard J. Nebel. (2002). *Environmental Science-Toward a Sustainable Future*. Pearson Education Inc. NY, USA.
20. Sapru, K. K. (1987). *Environment Management in India*. Ashish Publishing House, New Delhi.
21. Sharma P. D. (1994). *Ecology and Environment*. Rastogi Publications, Meerut-2.
22. Wilson, E.O. (1975). *Sociobiology* Harvard University Press, Cambridge, Mass. USA.
23. World Commission on Environment and Development. (1987). *Our Common Future*. Oxford University, *World Development*, 29(10): 1649-1672.



# Semester 3



**Mar Athanasius College (Autonomous), Kothamangalam**  
**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology					
Course Name	Biosystematics					
Type of Course	DSC					
Course Code	M24ZY3DSC201					
Course Level	200					
Course Summary	This course focuses on the principles and methodologies of Biosystematics, the scientific discipline focused on the classification and naming of organisms in an evolutionary context. Students will explore the theories and practices used to identify, name, classify, and understand the relationships among different life forms, with an emphasis on both traditional and modern approaches including molecular techniques.					
Semester	3			Credits		Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	-	1	-	75
Pre-requisites, if any	Basic knowledge in science					

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand and apply the principles of taxonomy and classification	U	1
2	Construct and interpret phylogenetic trees to elucidate evolutionary relationships	C	1, 2
3	Utilize molecular tools and techniques in systematic studies	A	3, 4
4	Evaluate species concepts and approaches to species delimitation.	E	4
5.	Create an awareness on the identification of animals	C	5, 3
6	Familiarise the research opportunities in animal taxonomy	C, S	2, 4

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Biological Classification: Hierarchy of categories and higher taxa	1, 2	15
	1.2	Taxonomic Procedures-collection, preservation, curation and process of identification.		
	1.3	Process of typification, different zoological types and their significance.		
	1.4	Methods of Biosystematics: Classical and modern methods- Typological, Phenetics, Evolutionary, Phylogenetic, Cladistics and Molecular Taxonomy. Phylocode, Tree of Life and Bar-coding of Life		
2	2.1	Taxonomic key. Types: Single access key- Dichotomous (linked and nested) and Polytomous key, Multi access key, Computer aided Interactive Key, Advantages and Disadvantages.	1, 5, 6	15

	2.2	Zoological nomenclature International Code of Zoological Nomenclature (ICZN), Law of Priority, Homonymy and Synonymy.		
	2.3	Ethics in taxonomy- authorship, suppression of data, undesirable practices in taxonomy.		
3	3.1	Linnaean classification, Basis for Animal kingdom classification (levels of organization, symmetry, coelom),	1, 2, 3	15
	3.2	Three domain concept in systematics, two, five, six and eight kingdom classification		
	3.3	Concept of species-taxonomic diversity within species.		
	3.4	Molecular Phylogeny-use of Proteins, DNA and RNA, Phylogenetic trees		
4		Practical	1, 4, 5, 6	30
	4.1	Preparation of dichotomous key of 4 specimens each Identification of fishes up to the level of order. Identification of snakes up to family. Identification of insects		
	4.2	Larval forms – any 10 larvae from different taxa		
	4.3	Camera Lucida and Micrometer		
	4.4	Scientific drawing		
	4.5	Taxa, identification techniques, Bird body parts/Butterfly/ dragonfly body parts and venation		
	4.6	Insect collection and preservation techniques (Group Activity), Preparation of Cladogram based on the specimens provided (at least five museum specimen).		
5		Teacher Specific Module		

#### MODE OF EVALUATION AND ASSESSMENT

<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x 1 = 10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks
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#### Recommended Reading

1. Alfred, J. R. B., & Ramakrishna. (2004). *Collection, Preservation, and Identification of Animals*. Zoological Survey of India Publications, Calcutta.
2. Campbell, N. A & J. B. Reece. (2009). *Biology* (8 ed.). Benjamin Cummings Publ. NY, USA
3. Cleveland Hickman, Jr., Susan Keen, Allan Larson, David Eisenhour & Larry Roberts. (2020). *Animal Diversity*. McGraw-Hill Companies, Inc. NY.
4. David, M. H, Craig Moritz & K. M. Barbara. (1996). *Molecular Systematics*. Sinauer Associates.
5. Kapoor, V. C. (1991). *Theory and Practice of Animal Taxonomy*. Oxford and IBH Publishing Co., Pvt. Ltd. New Delhi.
6. Margulis, Lynn & M. J. Chapman 2001. *Kingdoms and Domains: An Illustrated Guide to the Phyla of Life on Earth*(4th edn.). W. H. Freeman & Company, USA
7. Mayr, E. (1969). *Principles of Systematic Zoology*. McGraw Hill Book Company, Inc., NY.
8. Mayr, E. (1997). *This is Biology: The Science of Living world*. Universities Press Ltd.
9. Narendran, T. C. (2008). *An introduction to Taxonomy*. Zoological survey of India.
10. Niles, E. (2000). *Life on earth: an Encyclopaedia of Biodiversity, Ecology and Evolution* (Vol.1&II). ABC-CLIO, Inc. CA, USA
11. Winston, J. E. (2000). *Describing species: Practical Taxonomic Procedures for Biologists*. Columbia University Press, Columbia, USA.





## Mar Athanasius College (Autonomous), Kothamangalam

### FYUGP SYLLABUS

Programme	B Sc. (Honours) Zoology				
Course Name	Animal Diversity				
Type of Course	DSC B				
Course Code	M24ZY3DSC202				
Course Level	100				
Course Summary	This course focuses on the study of animal taxonomy, morphology and evolutionary history. It covers the diversity of animal forms, functions, and ecological roles across different habitats and evolutionary lineages. This course provides a foundational understanding of animal diversity and the evolutionary processes that have shaped it				
Semester	3	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3	-	1	-
Pre-requisites, if any	Basic knowledge in Biology				

### COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Describe the diversity of animal forms and functions	U, An	1, 2
2	Recognize major animal taxa and their evolutionary relationships	Ap	2, 1
3	Explain the adaptations of animals to different environments	E	4
4	Analyse the ecological roles and interactions of animals in ecosystems	An	4, 1
5	Differentiate systematics and taxonomy	E	1, 4
6	Discuss the importance of conservation for preserving animal diversity	Ap	1, 2

\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

### COURSE CONTENT

#### Content for classroom transaction (Units)

Module	Units	Course Description	CO No.	Hours
1	1.1	General characters of Kingdom Protista (e.g., <i>Amoeba</i> , <i>Noctiluca</i> , <i>Trypanosoma</i> , <i>Leishmania</i> , <i>Euglena</i> , <i>Opalina</i> , <i>Paramecium</i> , <i>Plasmodium</i> ); Parasitic protists ( <i>Entamoeba</i> , <i>Trypanosoma</i> , <i>Plasmodium</i> , <i>Leishmania</i> ).	1, 2	15
	1.2	Outline classification of Kingdom Animalia; Three branches - Mesozoa, Parazoa and Eumetazoa; Mesozoa: Phylum Orthonectida (e.g., <i>Rhopalura</i> ); Parazoa: Phylum Placozoa (e.g., <i>Trycoplax</i> )		
	1.3	General characters of Porifera (e.g., <i>Sycon</i> , <i>Euplectella</i> , <i>Cliona</i> )		
	1.4	General characteristics of Cnidaria (e.g., <i>Hydra</i> , <i>Obelia</i> , <i>Rhizostoma</i> , <i>Metridium</i> )		
	1.5	General characteristics of Ctenophora (e.g., <i>Pleurobrachia</i> )		

	1.6	General characters of Platyhelminthes (e.g., <i>Planaria</i> , <i>Fasciola</i> , <i>Taenia solium</i> , <i>Taenia saginata</i> )		
	1.7	General characters of Nematelminthes (e.g., <i>Wuchereria bancrofti</i> , <i>Ascaris lumbricoides</i> )		
	1.8	General characteristics of Annelids (e.g., <i>Polygordius</i> , <i>Chaetopterus</i> , <i>Megascolex</i> , <i>Hirudinaria</i> )		
2	2.1	Characteristics and phylogenetic significance of Onychophora (e.g., <i>Peripatus</i> )	1, 6	15
	2.2	General characters of Arthropoda (e.g., <i>Triarthrus</i> , <i>Limulus</i> , <i>Cyclops</i> , <i>Argulus</i> , <i>Sacculina</i> , <i>Scolopendra</i> , <i>Spirostreptus</i> , <i>Bombyx mori</i> ).		
	2.3	General characters of Mollusca (e.g., <i>Chiton</i> , <i>Dentalium</i> , <i>Pinctada</i> , <i>Sepia</i> , <i>Pila</i> ).		
	2.4	General characters of Echinodermata (e.g., <i>Astropecten</i> , <i>Ophiothrix</i> , <i>Echinus</i> , <i>Holothuria</i> , <i>Antedon</i> ).		
3	3.1	General Characters and outline classification of Chordata up to class	1, 4, 5	15
	3.2	Protochordates: General characters and classification Sub phylum Urochordata: General characters (e.g., <i>Oikopleura</i> , <i>Ascidia</i> , <i>Doliolum</i> Sub phylum Cephalochordata: General characters (e.g., <i>Amphioxus</i> )		
	3.3	Sub phylum Vertebrata: General characters and Classification Division 1– Agnatha Class I Ostracodermi (e.g., <i>Cephalaspis</i> ) Class II Cyclostomata (e.g., <i>Petromyzon</i> )		
	3.4	Division 2 – Gnathostomata Super class Pisces General Characters (e.g., <i>Narcine</i> , <i>Chimaera</i> , <i>Latimeria</i> , <i>Lepidosiren</i> , <i>Protopterus</i> , <i>Neoceratodus</i> , <i>Acipenser</i> , <i>Amia</i> , <i>Sardine</i> )		
	3.5	General characteristics and classification of reptiles up to order with example each Difference between poisonous and non-poisonous snakes.		
	3.6	General characteristics and classification of Aves up to order, <i>Archaeopteryx</i> : general characteristics and phylogenetic importance; Migration in birds; Flying and perching mechanism in birds.		
	3.7	General characters and classification of mammals up to order with one example each Aquatic mammals		
4		Practical	1, 3, 5, 6	30
	4.1	Scientific drawing - 10 specimens		
	4.2	Simple identification – 10 invertebrates & 10 vertebrates (Out of which 10 by their scientific names)		
	4.3	T.S - Earthworm, T.S <i>Fasciola</i>		
	4.4	Mounting – Prawn Appendages, Cockroach Mouth parts, Mounting of placoid scales of shark		
	4.5	Osteology – Vertebrae and girdles of Frog		
	4.6	Snake identification - 3 poisonous and 3 non-poisonous with key		
	4.7	Dissections: Dissection - Prawn Nervous system Dissection - Cockroach Nervous system Frog: Photographs/Diagrams/one dissected & preserved specimen each/ models may be used for the study.		




		Frog – Viscera Frog – Digestive System Frog – Arterial System Frog – Sciatic plexus Frog – Brain		
5		Teacher Specific Module		

<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x 1 = 10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

### Recommended reading

- Barnes, R.S.K., Calow, P., Olive, P. J. W., Golding, D.W. & Spicer, J. I. (2002). *The Invertebrates: A New Synthesis* (3 ed.). Blackwell Science.
- Barrington, E. J. W. (1979). *Invertebrate Structure and Functions* (2 ed.). E.L.B.S. and Nelson.
- Ganguly, Sinha & Adhikari (2019). *Biology of Animals*. Vol II. New Central Book Agency.
- Ganguly, Sinha & Adhikari. (1988). *Biology of Animals*. Vol. I. New Central Book Agency.
- Jordan E. L. & Verma P. S. (2013). *Chordate Zoology*. S. Chand.
- Jordan E. L., Verma P. S. (2009). *Invertebrate Zoology*. S. Chand Publishing.
- Kapoor V. C. (2019). *Theory and Practice of Animal Taxonomy and Biodiversity* (8<sup>th</sup> ed.). Oxford & IBH Publishing; 8<sup>th</sup> Edition
- Kotpal R. L. (2007). *Modern text book of Zoology: Vertebrates*. 12<sup>th</sup> Edition. Rastogi Publications.
- Kotpal R. L. (2020). *Modern text book of Zoology: Invertebrates* (12 ed.). Rastogi Publications.
- Mayr E. (2015). *Principles of Systematic Zoology*. Scientific Publishers. Jodhpur
- Narendran T. C. (2009). *An introduction to taxonomy*. Zoological Survey of India.
- Parker & Haswell. (2024). *Textbook of Zoology Vertebrates*. Vol II. (8<sup>th</sup> ed.).
- Parker & Haswell. *Textbook of Zoology Invertebrates*. (2021). Vol I (8 ed.). Veer Bala Rastogi.
- Paul DN, Hebert T, Gregory R. (2005). *The Promise of DNA Barcoding for Taxonomy*. *Systematic Biology*. 54(5):852–859.
- Pough H. *Vertebrate life* (8<sup>th</sup> ed.). Pearson International.
- Ruppert E. E., Fox R. S, & Barnes R. D. (2006). *Invertebrate Zoology: A functional evolutionary approach*. Cengage (7<sup>th</sup> ed.).
- Young, J. Z. (2004). *The Life of Vertebrates* (3<sup>rd</sup> ed.). Oxford University press.

	<b>Mar Athanasius College (Autonomous), Kothamangalam</b> <b>FYUGP SYLLABUS</b>
Programme	B Sc. (Honours) Zoology
Course Name	Biophysics

Type of Course	DSE				
Course Code	M24ZY3DSE200				
Course Level	200				
Course Summary	This course provides an interdisciplinary approach to understanding biological systems through the principles and methods of physics. It emphasizes the physical mechanisms underlying biological processes at the molecular, cellular, and organismal levels. Students will gain insight into the quantitative analysis and modelling of biological phenomena, bridging the gap between biology and physics.				
Semester	3	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		4	-	-	-
Pre-requisites, if any	Basic knowledge in Physics and Biology				

### COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Apply physical principles to understand and analyse biological systems	A	2
2	Use various biophysical techniques to study the structure and function of biomolecules and cells	A	3
3	Understand the mechanical properties and dynamics of biological tissues and systems.	U	1, 2
4	Analyse the energy flow in living systems	A	4
5	Recall and relate the concept of radioactivity and its application	K	1, 2
6	Integrate knowledge from physics and biology to address complex problems in health and diseases	E, C	2, 4

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

### COURSE CONTENT

#### Content for classroom transaction (Units)

Module	Units	Course Description	CO No.	Hours
1	1.1	Diffusion and osmosis: Diffusion -Kinetics of diffusion, Fick's law of diffusion and diffusion coefficient	1, 3	15
	1.2	Biological significance in animals and plants, Gibbs-Donnan equilibrium.		
	1.3	Osmosis- osmotic concentration and osmotic pressure, Van't Hoff's laws Biological significance of osmosis in animals and plants		
2	2.1	Biophysics of Cell Membrane: Membrane Transport – endocytosis, exocytosis	2, 4	15
	2.2	Nutrient transport across membranes, porins facilitated diffusion, porter molecules		
	2.3	Facilitated transport: symport, antiport, uniport, anion porter, glucose porter		
	2.4	Active transport: proton pumps, Na <sup>+</sup> K <sup>+</sup> pumps and Ca <sup>++</sup> pumps, ionic channels. Artificial membranes.		
3	3.1	Bioenergetics: Thermodynamics- Laws of thermodynamics, Entropy, Enthalpy	1, 3, 6	15
	3.2	Free energy. Reversible thermodynamics and irreversible		

		thermodynamics		
	3.3	Systems – open, closed and isolated. Photo bioenergetics		
	3.4	Photosynthesis – light and dark reactions, Redox couple and redox potential		
4	4.1	Radiation Biophysics: Ionizing radiation, units of radioactivity, exposure and dose, dosimetry	2, 5, 6	15
	4.2	Interaction of radiation with matter – Photoelectric effect, ion pair production, absorption and scattering of electrons		
	4.3	Biological effects of radiation: effect on nucleic acids, proteins, enzymes and carbohydrates. Cellular effects of radiation: somatic and genetic		
	4.4	Nuclear medicine: Internally administered radioisotopes. Radiation protection and therapy		
5		Teacher Specific Module		

MODE OF EVALUATION AND ASSESSMENT	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 30 marks Quiz, Test Papers, seminar	<b>B. End Semester Examination</b> Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

### Recommended Reading

1. Ackerman, E. (1962). *Biophysical Science*. Prentice Hall Inc. NJ, USA
2. Alonso, A., & Arrondo, J.L.R. (2006). *Advanced Techniques in Biophysics*. Springer, UK
3. Arora, M. P. (2007). *Biophysics*. Himalaya Publishing House. New Delhi
4. Das, D. (1991). *Biophysics and Biophysical Chemistry*. Academic Publishers, Calcutta.
5. Edward, A. L. (1997). *Radiation Biophysics*. Academic Press, NY, USA.
6. Ernster, L. (Ed.). (1985). *Bioenergetics*. Elsevier, New York, USA.
7. Hoope, W. et.al. (1983). *Biophysics*. Springer Verlag. Berlin
8. Lehninger, A. L. (1971). *Bioenergetics*. W.A. Benjamin. London. UK.
9. Narayanan, P. (2000). *Essentials of Biophysics*. New Age International (P) Ltd. Publishers. New Delhi.
10. Pradeep T. (2007). *NANO: The Essentials. Understanding Nanoscience and Nanotechnology*. Tata McGraw Hill Education Pvt. Ltd., New Delhi.
11. Roy, R.N. (1996). *A Textbook of Biophysics*. New Central Book Agency (P) Ltd. Calcutta
12. Srivastava, P. K. (2006). *Elementary Biophysics. An Introduction*. Narosa Publishing House, New Delhi.
13. Varghese, T. & Balakrishna, K. M. (2012). *Nanotechnology-An Introduction to Synthesis,*



## Mar Athanasius College (Autonomous), Kothamangalam

### FYUGP SYLLABUS

Programme	B Sc. (Honours) Zoology				
Course Name	Instrumentation and Biological Techniques				
Type of Course	DSE				
Course Code	M24ZY3DSE201				
Course Level	200				
Course Summary	This course provides comprehensive training in the principles, applications, and hands-on use of various instruments and techniques essential for modern biological research. It covers a wide range of methodologies used to investigate biological systems, focusing on both theoretical knowledge and practical skills.				
Semester	3	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		4	-	-	-
Pre-requisites, if any	Basic knowledge in science				

### COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Identify the techniques available for studying biochemical and biophysical nature of life	An	2, 1
2	Understand the basic principles underlying the working of these instruments	U, A	1, 2, 3
3	Integrate theoretical knowledge with practical skills to design and conduct experiments	S	2, 3, 4
4	Apply appropriate techniques to investigate specific biological questions.	A	3
5	Operate a variety of biological instruments and perform standard techniques with competence.	S	3, 4, 5
6	Analyse and interpret data generated from different biological techniques.	A	2

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

### COURSE CONTENT

#### Content for classroom transaction (Units)

Module	Units	Course Description	CO No.	Hours
1	1.1	Microscopy: Light microscope and dark field microscope; Phase contrast microscope	1, 2, 4, 5	15
	1.2	Polarizing microscope; birefringence fluorescence microscope; Micro imaging techniques TEM, SEM		
	1.3	Differential Interference contrast (Nomarsky) microscopy; Confocal microscope		
	1.4	Electron microscope –Scanning Tunnelling and Atomic Force Microscopes		
	1.5	Specimen preparation for TEM, SEM, shadow casting, freeze fracturing, freeze etching, negative staining.		
2	2.1	Chromatography: Paper chromatography	1, 2	15
	2.2	Thin layer chromatography; Ion exchange chromatography		

	2.3	Gel permeation chromatography; Affinity chromatography; Gas chromatography		
	2.4	High pressure liquid chromatography (HPLC); High pressure thin layer chromatography (HPTLC).		
3	3.1	Electrophoresis: Paper electrophoresis; Gel electrophoresis; Polyacrylamide gel electrophoresis (PAGE); Agarose gel electrophoresis; immuno-electrophoresis.	2, 3	15
	3.2	Principle and applications of colorimetry		
	3.3	Spectroscopy: Flame emission spectroscopy; atomic absorption spectroscopy; Nuclear Magnetic-resonance spectroscopy (NMR); Circular dichroism spectroscopy; ESR spectroscopy; Mass spectroscopy		
4	4.1	Homogenisation and Centrifugation	1, 5, 6	15
	4.2	Cell separation techniques - homogenisation and types of homogenisers		
	4.3	Centrifugation: Basic principles of sedimentation; Types of centrifuges; Analytical and Preparative centrifugation; Differential and density gradient centrifugation.		
	4.4	Assayas: Radio Immuno Assay; Enzyme Linked Immuno Sorbant Assay (ELISA); ELIFA.		
	4.5	pH meter: Principle and working; Types of pH meters.		
5		Teacher Specific Module		

<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 30 marks Quiz, Test Papers, seminar	<b>B. End Semester Examination</b> Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

### Recommended Reading

- Ghatak K. L. (2011). *Techniques and Methods in Biology*. PHI Learning Pvt. Ltd. New Delhi
- Gupta A. (2009). *Instrumentation and Bio-Analytical Techniques*. Pragati Prakashan, Meerut.
- Pearse, A. G. E. (1980). *Histochemistry*. Vol. & Vol. II. Churchill Livingstone. NY. USA.
- Pradeep T. (2007). *NANO: The Essentials. Understanding Nanoscience and Nanotechnology*. Tata McGraw Hill Education Pvt. Ltd. New Delhi.
- Roy, R. N. (1996). *A Textbook of Biophysics*. New Central Book Agency (P) Ltd. Calcutta
- Sandhu, G. S. (1990). *Research Techniques in Biological Sciences*. Anmol Publications, New Delhi
- Srivastava, P. K. (2006). *Elementary Biophysics. An Introduction*. Narosa Publishing House, New Delhi.
- Varghese, T. & Balakrishna, K. M. (2012). *Nanotechnology-An Introduction to Synthesis*,
- Weesner, F. M. (1960). *General Zoological Microtechniques*. The Williams & Wilkins Co. Baltimore. USA



## Mar Athanasius College (Autonomous), Kothamangalam

### FYUGP SYLLABUS

Programme	B Sc. (Honours) Zoology					
Course Name	Cell Biology					
Type of Course	DSC					
Course Code	M24ZY4DSC200					
Course Level	200					
Course Summary	This course provides a basic understanding of the structure, function, and processes of cells, the fundamental units of life. It covers the molecular and biochemical mechanisms that govern cell behaviour, the organization of cellular components, and the interactions between cells and their environments. The course emphasizes both the theoretical knowledge and practical techniques used to study cells					
Semester	4	Credits			Total Hours	
Course Details	Learning Approach	Lecture	Tutorial	Practical		Others
		3	-	1	-	75
Pre-requisites, if any	Basic knowledge in science					

### COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Describe the structure and function of cellular components and organelles	K, U	1
2	Understand the molecular mechanisms underlying cell processes such as metabolism, signalling, and divisions	U	1, 2
3	Explain how cells interact with their environment and contribute to the function of tissues and organs	K, U	1, 3
4	Analyse the Cell transport and cell communication	A	4
5.	Develop the knowledge of common and advanced laboratory practices in cell biology	S	3
6	Create critical thinking, skill and research aptitudes in basic and applied biology	C, E, C	3, 4

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

### COURSE CONTENT

#### Content for classroom transaction (Units)

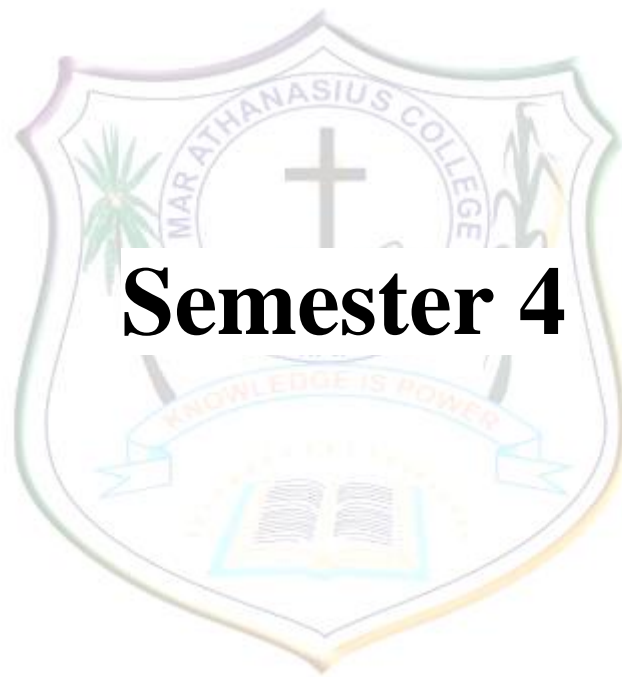
Module	Units	Course Description	CO No.	Hours
1	1.1	Cell theory, Various models of plasma membrane structure - Fluid mosaic model and unit membrane concept	2, 4	15
	1.2	Transport across membranes: Active and Passive transport, Facilitated transport		
	1.3	Cell junctions: Tight junctions, Desmosomes, Gap junctions		
2	2.1	Structure and functions of Endoplasmic reticulum, Golgi apparatus and Lysosomes	1, 3	15
	2.2	Mitochondria: Structure and function		
	2.3	Electron transport chain and Krebs's cycle, Semi-autonomous nature, Peroxisomes: Structure and function		
	2.4	Structure and function of Nucleus, Nucleolus		
	2.5	Structure and Functions: Microtubules, Microfilaments and		

		Intermediate filaments,		
	2.6	Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome)		
	2.7	Role of microtubules in Cell cycle and its regulation		
3	3.1	Cell to cell adhesion and recognition Role of glycocalyx in cell communication	4, 2	15
	3.2	Introduction to cell signalling, Intra cellular and extra cellular receptors.		
	3.3	Apoptosis, Programmed cell death.		
4		Practical	1, 6	30
	4.1	Mounting of polytene chromosome (Drosophila/Chironomous.) Demonstration Models (DNA, DNA replication, RNA – Different types)		
	4.2	Squash preparation of onion root tip for mitotic stages Squash preparation of grasshopper testis to study meiotic stages (Demonstration)		
	4.3	Effect of drugs on cell division (Colchicine or any other inhibitor)		
	4.4	Preparation of permanent whole mount (demonstration) Preparation of Microtome section, spreading and staining		
5		Teacher Specific Module		

<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x 1 = 10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

**Recommended readings:**

1. Becker, W. M., Kleinsmith, L. J., Hardin. J. & Bertoni, G. P. (2009). *The World of the Cell* (7<sup>th</sup> ed.). Pearson Benjamin Cummings Publishing, San Francisco.
2. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith & Watson James (2008). *Molecular Biology of the Cell* (5<sup>th</sup> ed.). Garland publishing Inc. New York and London.
3. Cooper, G. M. & Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and Sunderland, Washington DC.
4. Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments* (6<sup>th</sup> ed.). John Wiley and Sons. Inc.



# Semester 4





**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology					
Course Name	Animal Diversity 2 - Chordata					
Type of Course	DSC					
Course Code	M24ZY4DSC201					
Course Level	200					
Course Summary	This course provides an extensive overview of the phylum Chordata, which includes some of the most complex and diverse organisms on Earth. The course explores the morphology, taxonomy, evolution, and ecological roles of chordates, ranging from primitive chordates to the highly evolved vertebrates. It emphasizes comparative anatomy, physiological adaptations, and the evolutionary relationships among chordate groups					
Semester	4	Credits				Total Hours
Course Details	Learning Approach	Lecture 3	Tutorial -	Practical 1	Others -	
Pre-requisites, if any	Basic knowledge in science					

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Describe the anatomy, physiology, and adaptations of various chordates.	K, U	1, 3
2	Recall the common features non Chordata and compare it with Chordata	K	1
3	Apply it in the transformation level and make a set up approach to evolution	A	3, 4
4	Examine the local chordate diversity	An	1, 2
5	Predict the classification category of given chordates based on morphological features	A	1, 4
6	Understand the evolutionary relationships among chordate groups	U, An	1

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**  
**Content for classroom transaction (Units)**

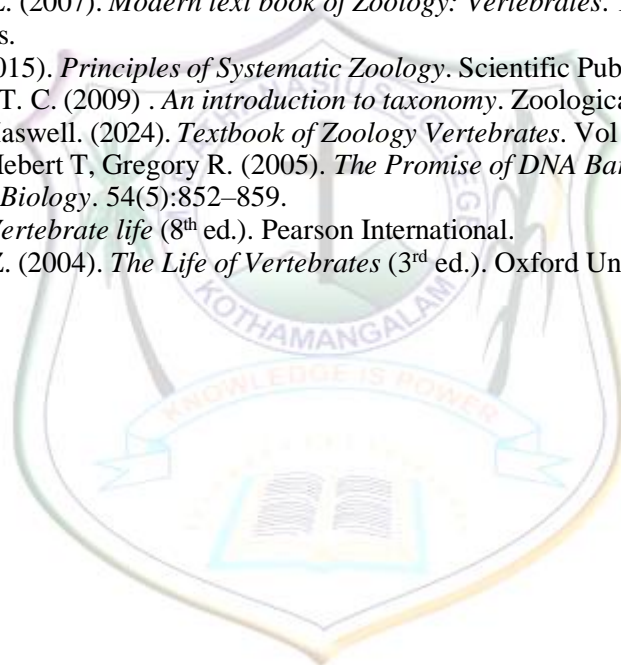
Module	Units	Course Description	CO No.	Hours
1	1.1	General Characters and outline classification of Chordata up to class Origin of Chordates – mention theories in brief	2, 4, 5	15
	1.2	Protochordates: General characters and classification Sub phylum Urochordata: General characters (e.g., <i>Oikopleura, Ascidia, Doliolum</i> ) Retrogressive metamorphosis in Urochordata.		
	1.3	Sub phylum Cephalochordata: General characters (e.g., <i>Amphioxus</i> ) Structure and affinities of Amphioxus		
	1.4	Sub phylum Vertebrata: General characters and Classification;		

		Advanced features of vertebrates over Protochordata		
2	2.1	Division 1– Agnatha Class I Ostracodermi (e.g., Cephalaspis) Class II Cyclostomata (e.g., Petromyzon)	4, 6	
	2.2	Division 2 – Gnathostomata Super class Pisces General Characters and Classification		
	2.3	Class Chondrichthyes: General Characters Sub class ElasmobranchI (e.g., Narcine) Sub class Holocephali (e.g., Chimaera) Class: Osteichthyes: General Characters		
	2.4	Sub class Choanichthyes: Order 1 Crossopterigii (e.g., Latimeria) Order 2 Dipnoi (e.g., Lepidosiren, Protopterus, Neoceratodus - Distribution, affinities and systematic position of lung fishes).		
	2.5	Sub class: - Actinopterygii: Super order 1. Chondrostei (e.g., Acipenser) Super order 2. Holostei (e.g., Amia) Super order 3. Teleostei (e.g., Sardine)		
	2.6	Migration; Osmoregulation; Accessory respiration; and Parental care in fishes		
3	3.1	General characteristics and classification of Amphibians up to order; Type: Frog	2, 3, 5, 6	
	3.2	General characteristics, distribution and affinities of <i>Sphenodon</i> Poison apparatus and Biting mechanism in snakes Difference between poisonous and non-poisonous snakes.		
	3.3	General characteristics and classification of Aves up to order <i>Archaeopteryx</i> : general characteristics and phylogenetic importance Migration in birds Flying and perching mechanism in birds.		
	3.4	General characters and classification of mammals up to order; Echolocation of Bats		
4		Practical	1, 5, 4, 6	30
	4.1	Dissections- Demonstration Frog: Photographs/diagrams/one dissected & preserved specimen each/models may be used for study. (Frog Viscera, Frog Digestive System, Frog Arterial System, Frog 9th& 1st Spinal nerve, Frog Sciatic Plexus, Frog Brain		
	4.2	Mounting of placoid scales; study of cycloid and ctenoid scales		
	4.3	Osteology Frog vertebrae - typical, atlas, 8th and 9th Rabbit – Atlas, Axis and typical vertebra Pectoral and pelvic girdles of Frog and Rabbit Bird - Keel and Synsacrum Turtle/Tortoise - plastron and carapace		
	4.4	Study of sections <i>Amphioxus</i> T. S. through pharynx/T.S. through intestine		
	4.5	Identification General identification- Identify, classify and describe the following animals by their generic names and 30 % of them by their scientific names. Protochordata-1, Pisces-5, Amphibia-5, Reptilia- 5, Aves-2, Mammalia-2		
	4.6	Visit to Biological National Parks, Zoo, Sanctuaries and report		
5		Teacher Specific Module		

<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x 1 = 10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

### Recommended reading

1. Ganguly, Sinha & Adhikari (2019). *Biology of Animals*. Vol II. New Central Book Agency.
2. Jordan E. L. & Verma P. S. (2013). *Chordate Zoology*. S. Chand.
3. Kapoor V. C. (2019). *Theory and Practice of Animal Taxonomy and Biodiversity* (8<sup>th</sup> ed.). Oxford & IBH Publishing; 8<sup>th</sup> Edition
4. Kotpal R. L. (2007). *Modern text book of Zoology: Vertebrates*. 12<sup>th</sup> Edition. Rastogi Publications.
5. Mayr E. (2015). *Principles of Systematic Zoology*. Scientific Publishers. Jodhpur
6. Narendran T. C. (2009). *An introduction to taxonomy*. Zoological Survey of India.
7. Parker & Haswell. (2024). *Textbook of Zoology Vertebrates*. Vol II. (8<sup>th</sup> ed.).
8. Paul DN, Hebert T, Gregory R. (2005). *The Promise of DNA Barcoding for Taxonomy*. *Systematic Biology*. 54(5):852–859.
9. Pough H. *Vertebrate life* (8<sup>th</sup> ed.). Pearson International.
10. Young, J. Z. (2004). *The Life of Vertebrates* (3<sup>rd</sup> ed.). Oxford University press.





**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology					
Course Name	General Microbiology					
Type of Course	DSE					
Course Code	M24ZY4DSE200					
Course Level	200					
Course Summary	This course provides an introduction to the world of microorganisms, covering the fundamental principles of microbiology. It explores the diversity, structure, function, and physiology bacteria. The course also examines growth and cultivation of bacteria, sterilisation methods, evaluation of antimicrobial agent effectiveness, staining methods, epidemiology of bacterial infections, and microbiology of water, milk and food substances etc.					
Semester	4	Credits				Total Hours
Course Details	Learning Approach	Lecture 4	Tutorial -	Practical -	Others -	
Pre-requisites, if any	Basic knowledge about microbes					

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Record the history and classification of microbiology	R, U	1, 2
2	Examine the use of culture, staining and preservation techniques in microbiology	An, E	2, 4
3	Illustrate the structure and reproduction of bacteria	C	5
4	Explain the role of microorganisms in disease and immunity	U	4
5	Analyse the applications of microbiology in industry, biotechnology, and medicine	An	2, 4
6	Apply microbiological techniques for the cultivation, identification, and analysis of microorganisms.	A	4, 5

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	History, scope, relevance and future of microbiology.	1, 2	15
	1.2	Classification of bacteria and salient features according to Bergey's manual of determinative Bacteriology.		
	1.3	Microbial diversity in different ecosystems (halophiles, mesophiles, thermophiles, acidophiles, alkalophiles, barophiles and other extremophiles).		
	1.4	Sterilization and Control of Microbial Growth: Control of microorganisms by physical methods: heat, filtration and radiation.		
	1.5	Sterilization Techniques: Hot air oven and Pasteurization; Tyndallization; Autoclaves- principles, precautions and applications; Filtration. Sterilization by radiation.		
	1.6	Chemical methods: phenolics, alcohols, halogens, heavy metals, quaternary ammonium		

		compounds, aldehydes and sterilizing gases Disinfectants and their mechanisms of action		
	1.7	Evaluation of antimicrobial agent effectiveness. Antibiotics- types, mechanism of action. Antibiotic sensitivity tests. Antimicrobial agents (bacterial, viral and fungal).		
2	2.1	Microbial Growth and Cultivation of Bacteria: Growth and nutritional requirements of bacteria. Autotrophs, heterotrophs - enrichment culture - growth curve.	2, 3, 6	15
	2.2	Morphology and arrangement of bacteria, ultrastructure of bacteria. Cellular components of bacteria - sporulation and its mechanics.		
	2.3	Staining: Principle and Methods. Simple Staining and Differential staining- Gram staining, Acid-fast staining (Ziehl-Neelson Method) and Staining of Specific Structures- Spore staining (Schaeffer-Fulton Method), Capsule staining, staining of volutin granules, Negative staining.		
3	3.1	Epidemiology of bacterial infections	4, 5, 6	15
	3.2	Microbiology of Water, Milk and Food Substances: Microbial contamination of water- types, sources, threats. Microbial contamination of milk		
	3.3	Food poisoning, Major food borne diseases. Methods of detection of microbial contamination of food, water and milk Microbial standards of drinking water		
4		Activity	2,6	
		Sterilization, disinfection and safety in microbiological laboratory. Preparation of culture media (a) liquid media – nutrient broth, peptone water (b) Solid media – Nutrient Agar, MacConkey' Agar. Identification of microorganisms- Staining techniques- gram staining Determination of Bacterial motility Bacteriological analysis of milk- methylene blue reductase test.		
5		Teacher Specific Module		

#### MODE OF EVALUATION AND ASSESSMENT

<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 30 marks Quiz, Test Papers, seminar	<b>B. End Semester Examination</b> Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks
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#### Recommended Readings

1. Carpenter P. L. (1967). *Microbiology*. W B Saunder & Co. Philadelphia.
2. Dube H. C. (2008). *Fungi, Bacteria and Viruses*. Agrobios.
3. Dubey R. C. Maheswari D. K. (2004). *Microbiology*. S Chand.
4. F. H Kayser, K. A. Bienz, J Eckert, R M Zinkernagel. (2004). *Medical Microbiology*. Thieme Publishers.
5. Kanika Sharma. (2005). *Manual of Microbiology: Tools and Techniques*. Ane Books.
6. Kumar H. D. (1990). *Modern concepts of Microbiology*. Vikas public. Delhi.
7. L R Haahelm, J R Pattison, R J Whitley. (2002). *A practical guide to Clinical virology*. John Wiley and Sons.
8. Lansing M. Prescott, Harley & Klein (1999). *Microbiology*. McGraw-Hill.
9. Michael J. Pelczar Jr., & E.C.S. Chan Noel R. Krieg. (1990). *Microbiology*. McGraw-Hill Education. Europe.
10. Pelczar Michael J, Adams M. R, Chan E. C. S. & Krieg Noel R. (2000). *Microbiology*. Tata

- McGraw Hill.
11. Powar C. B. & Daginawala H. F. (1991). *General Microbiology*. Vol II. Himalaya Publishing House.
  12. Purohit S. S. (1997). *Microbiology: Fundamentals and application*. Agrobotanical.
  13. Salle A. J (1978). *Fundamentals of Bacteriology*. Asia TMH
  14. Sharma P. D. (2003). *Microbiology*. Rastogi Publications.
  15. Sinha L. Bilgrani, Bilgrami K. S. Rajan. S. & Selvi Christy. R. (2019). *Essentials of Microbiology*. CBS Publishers & Distributors





**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology				
Course Name	Biomedical Sciences				
Type of Course	DSC				
Course Code	M24ZY4DSE201				
Course Level	200				
Course Summary	This course offers an in-depth exploration of the fundamental concepts in biomedical science. The course covers the stem cells, regenerative biology, human cytogenetics, cancer biology, mode of infection, symptoms, epidemiology and control of common viral and bacterial diseases, neural disorders, and modern diagnostic techniques, preparing students for careers in medical research, clinical practice, and healthcare innovation.				
Semester	4	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		4	-	-	-
Pre-requisites, if any	Basic knowledge in Biology				

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Develop a basic understanding of stem cells and types	R, U	
2	Understand the alternative animal models in the study of diseases and development of therapeutics	U, R	
3	Illustrate the basic concepts in cytogenetics	An	
4	Create an awareness about various type of cancer, diagnosis and treatment and epidemiology human diseases	C	
5	Assess the importance of haematology in biomedical diagnosis	An, E	
6	Inspect various biomedical diagnostic techniques	An	

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Stem Cells: Definition and characteristics, classification of stem cells (embryonic stem cells and adult stem cells), stem cell niche, stem cell division and its control, induced pluripotent stem cell generation & application, hemopoietic stem cell disorders: classification and manifestations, principle and procedure of bone marrow transplantation.	1, 2	15
	1.2	Regenerative biology - Tissue regenerative capacity, Regeneration in planaria, zebrafish, axolotl, and mammals, Facultative stem cells, Trans differentiation, De-Differentiation and plasticity.		
2	2.1	Human Cytogenetics: Human chromosomes and karyotypes, sex determination, X and Y chromosomes, evolution of human	3, 4, 6	15

		chromosomes, fragile sites mutagenesis studies, causes of chromosome breakage, SCE/MN, In-situ Hybridization, chromosome and cancer, studies of prenatal chromosomes, Somatic cell hybrids in gene mapping, chromosomal disorders/syndromes, Chromosome banding techniques — G, C, R, Q, T. FISH,		
	2.2	Cancer Biology: Different types of tumors, factors and mechanism involved in tumor formation, oncogenes, tumor suppressor genes, methods of detection of cancer, tumor markers, treatment- chemotherapy, radio therapy, immunotherapy and gene therapy for cancer.		
3	3.1	Mode of infection, symptoms, epidemiology and control of AIDS, Hepatitis B, Rabies, Tetanus, Typhoid, STD, TB, Cholera, Aspergillosis, Histoplasmosis, Cryptococcosis, Leprosy, H5N1 and H1N1; Arboviral diseases: yellow fever, Dengue, Japanese Encephalitis, Chickungunia, Kyasanur forest disease- epidemiology and management.	3, 4, 5, 6	
	3.2	Structure, function and production of blood cells, platelet structure and function haemostasis, fibrinolysis, thrombosis. Types of anaemias, haemoglobinopathies and thalassaemias, Haematological malignancy. Transfusion science, Genetics, inheritance, structure and role of red cell antigens, the preparation, storage and use of blood components, the selection of appropriate blood components for transfusion and possible adverse effects, immune mediated destruction of blood cells, health and safety aspects of handling blood.		
4	4.1	Nervous system, perspective and behaviour, Neural disorders and repair. DNA finger printing in Forensic science- Fundamental principles of fingerprinting, classification of fingerprints, development of fingerprint as science for personal identification, Principle of DNA fingerprinting, application of DNA profiling in forensic medicine. Cyber Forensic Investigation	5, 6	15
	4.2	Disease diagnosis. Enzymes in diagnosis of human diseases and Health care. Acetylcholinesterase, angiotensin converting enzyme (ACE), Pseudocholinesterase, 5'- nucleotidase (5NT), Glucose-6-phosphate dehydrogenase (GPD) and other red cell enzymes; CK isoforms, Immunoreactive trypsinogen (IRT) and Chymotrypsin; Amylase isoenzymes, Macro amylases, Isoenzymes (CK, LD, ALP). SGOT and SGPT. Diagnosis of Diabetes mellitus and Glucosoria.		
5		Teacher Specific Module		

#### MODE OF EVALUATION AND ASSESSMENT

<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 30 marks Quiz, Test Papers, seminar	<b>B. End Semester Examination</b> Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks
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#### Recommended Reading

1. A. V. Hoffbrand, P. A. H. Moss, J. E. Pettit. (2006). *Essential haematology*. Medical.
2. Atul B. Mehta, A. V. Hoffbrand (2005). *Haematology at a glance*. Medical.
3. Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, & James D. Watson. (1994). *Molecular Biology of the Cell* (3<sup>rd</sup> ed.).



4. Caul. E. (1992). *Immuno-flourescent–antigen detection techniques in diagnostic microbiology*, PubHealth Lab services.
5. Cruickshank, R. (1975). *Medical Microbiology: A Guide to Diagnosis and Control of Infection*. E and S Livingston Ltd., Edinburgh and London.
6. Goding, M. J. W. (1983). *Monoclonal Antibodies: principles and practice*. Academic press.
- Kuby. J. (1992). *Immunology* (4th ed.). Richard A. Goldsby Kindt & Oshome Eds W.H. Feeman & Co. NY
7. Herbert A Kirst, Wu- Kuang Yeh, & Milton J.(2001). *Enzyme Technologies for pharmaceutical and biotechnological applications*. CRC Press.
8. Scott F. Gilbert. (2000). *Developmental Biology* (6th ed.). Sinauer Associates.
9. William J. Williams, Ernest Beutler, Allan JU. Erslev, Marshall A. & Lichtman. (1989). *Haematology* (4<sup>th</sup> ed.). McGraw-Hill Professional.
10. Zaiko, G. E (2004). *Biotechnology and agriculture & Food industry*. Nova publishers





**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology				
Course Name	Human Physiology and Immunology				
Type of Course	DSC B				
Course Code	M24ZY4DSC202				
Course Level	200				
Course Summary	This course focuses on human physiology and immunology. It gives a detailed account on the structure of human organs and systems like digestive, respiratory excretory, circulatory, nervous and endocrine system and their functions. Special emphasis is given to the immune system, innate and adaptive immunity, structure and types of antigens and antibodies and immune functions.				
Semester	4	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3	-	1	-
Pre-requisites, if any	Basic knowledge in Human physiology				

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Remember the basic structural organisation of various organs and organ systems.	K	1, 3
2	Understand the function of major organ systems in the human body.	U	1, 3
3	Examine the role of immune system in defending the body against pathogens.	An	3, 4
4	Evaluate the interplay between various organ systems in maintaining the homeostatic mechanisms	E	3, 4, 5
5	Analyse the environmental factors and modern lifestyle practices affecting human health	An	4, 5
6	Apply the interventions in human physiology and immunology in the development of medicine therapy and research methodologies	A	5, 6

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Malnutrition disorders, Vitamin deficiencies, and mineral deficiencies (Iron, Calcium and Iodine)	1, 2, 4, 5	15
	1.2	Transport of O <sub>2</sub> and CO <sub>2</sub> in blood, respiratory disorders – Dyspnoea, Hypoxia, Asphyxia, Hypo and Hypercapnia, CO poisoning, smoking and its physiological effects.		
	1.3	Blood – Composition and function, Brief account of mechanism of blood clotting; Disorders of blood clotting – Haemophilia, cerebral and pulmonary thrombosis, Cerebral haemorrhage, Blood pressure and factors controlling it; electrocardiogram, Cardiovascular disorders – Arteriosclerosis, Myocardial infraction, Angiogram and Angioplasty		

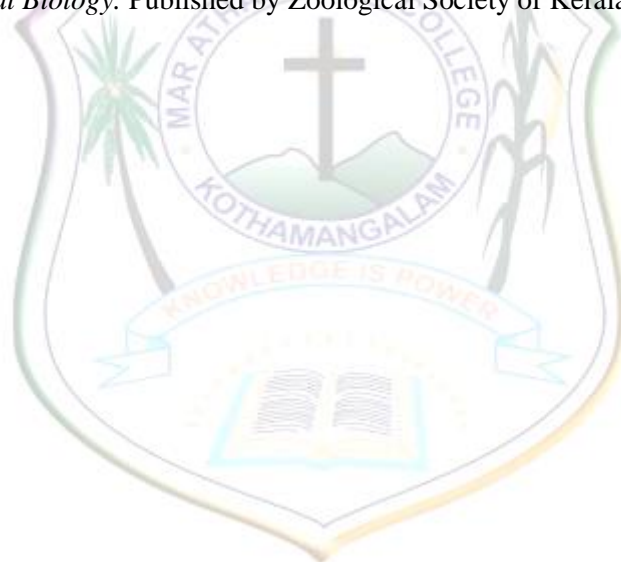
	1.4	Structure of human nephron, composition of urine – normal and abnormal constituents, urine formation (ultra filtration , selective reabsorption, tubular secretion and counter current mechanism); Hormonal control of renal function, Kidney disorders – pyelonephritis, glomerular nephritis, nephrotic syndrome, Dialysis		
2	2.1	Structure of typical neuron, myelinated and non-myelinated nerve fibres; Nerve impulse – initiation and propagation of nerve impulse, All or none law, Saltatory conduction, Synaptic transmission, Neurotransmitters, Brian waves, Electroencephalogram, Neural disorders – Parkinson’s disease, Epilepsy, Alzheimer’s syndrome, Dyslexia.	1, 2, 4	15
	2.2	Striated, Non striated and Cardiac muscle, Ultra structure of striated muscle fibre, Mechanism of muscle contraction, Threshold and spike potential, Fatigue, O <sub>2</sub> dept, Rigor mortis.		
	2.3	Endocrine glands and their hormones, mode of action (in brief) , Hypothalamus, Pituitary , Thyroid, Parathyroid, Thymus , Islets of Langerhans, Adrenal, Testis and ovary , Hormonal disorders.		
3	3.1	Introduction to immunology Types of immunity, innate immunity , acquired, passive , active Mechanism of innate immunity (e.g. Barriers , phagocytosis , inflammation ) Complement System, biological effects of complements.	3, 6	15
	3.2	Antigens and antibodies Types of antigens , haptens, antigenic determinants. Basic structure of immunoglobulins , Different classes of immunoglobulins and functions.		
	3.3	Antigen antibody reactions Precipitation test, agglutination test , Clinical applications of antigen antibody reaction, Widal, VDRL, HIV test (ELISA), Complement Fixation Test, and Coombs test.		
	3.4	(Brief accounts of the followings) Immune response system Primary and secondary lymphoid organs, Cells of Immune system – Leucocytes, lymphocytes, T&B cells, Macrophages, Plasma cells , Memory cells, MHC, Antibody synthesis, Monoclonal antibodies, Hybridoma technology Immune disorders – hypersensitivity, Auto immunity & Immunodeficiency, AIDS, Vaccines - Major types of vaccines (BCG, DPT, Polio vaccine and TAB vaccines). Recent trends in vaccine preparation.		
4		Practical	3, 6	30
	4.1	Preparation of Human Blood smear & identification of leucocytes		
	4.2	Qualitative analysis of Reducing Sugar, Protein and Lipid		
	4.3	Action of Salivary amylase on Starch		
	4.4	Estimation of Haemoglobin		
	4.5	Identification of human blood groups, A, AB, B and O, Rh factor		
	4.6	Instruments (Principle & use)– Sphygmomanometer , Stethoscope, Measurement of blood pressure using Sphygmomanometer (demonstration)		

5	Teacher Specific Module		
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MODE OF EVALUATION AND ASSESSMENT	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

### Recommended Reading

1. Guyton (2002). *Text Book of Medical Physiology*. Saunders pp.718-833
2. Ivan Roitt (2002). *Essentials of Immunology ELBS*
3. Michael J. Pelczar ECS, Chan & Noel. R. Kreig (1996). *Microbiology*. Tata McGraw Hill 5<sup>th</sup> edn
4. Monica Cheesbrough (1986). *Laboratory Manual for Tropical Countries*. Vol. II
5. Prosser & Brown (2006). *Comparative Animal Physiology*
6. Sobha & Sharma (2008). *Essentials of Modern Biology One's Student edition* PP 463-468
7. Zoological Society of Kerala, Study material (2002). *Biochemistry, Physiology and Developmental Biology*. Published by Zoological Society of Kerala





**Mar Athanasius College (Autonomous), Kothamangalam**  
**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology					
Course Name	Medical Diagnostic Technology					
Type of Course	SEC					
Course Code	M24ZY4SEC200					
Course Level	100					
Course Summary	It is an introductory course designed to provide students with foundational knowledge and practical skills in medical diagnostics. The course covers essential concepts, techniques, and instruments used in diagnosing diseases and health conditions. Through a combination of theoretical learning and hands-on laboratory sessions, students gain proficiency in conducting basic diagnostic tests, interpreting results, and understanding their clinical significance.					
Semester	4	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	-	-	-	45
Pre-requisites, if any	Basic knowledge in Biomedical Science					

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the principles and techniques of basic medical diagnostics	U	1, 4
2	Demonstrate common diagnostic tests and examinations	A, An	4, 5
3	Understand the non-infectious and infectious diseases	U	3, 4
4	Apply medical imaging techniques	A	3, 5
5.	Adhere to ethical principles, safety protocols, and quality standards in diagnostic practice	Ap, S	5

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Introduction and Haematology Importance of medical diagnostics	1, 2	15
	1.2	Blood composition, Preparation of blood smear and Differential Leucocyte Count (DLC) using Leishman's stain Platelet count using haemocytometer Erythrocyte Sedimentary Rate (ESR), Packed Cell Volume (PCV)		
	1.3	Diagnostic Methods used for Sputum, Urine and Stool Analysis Sputum analysis: Physical characteristics and abnormal constituents		

		Urine Analysis: Physical characteristics and abnormal constituents		
	1.4	Histopathological analysis- Normal and diseased histopathological slides and comparison of any two		
2	2.1	Non-infectious Diseases Diabetes (Type I and Type II): Causes, types, symptoms, complications, diagnosis and prevention Hypertension (Primary and secondary): Causes, types, symptoms, complications, diagnosis and prevention Cancer: Basics, benign and malignant tumour, metastasis, Detection	3	15
	2.2	Infectious Diseases Tuberculosis: Causes, types, symptoms, diagnosis and prevention Hepatitis: Causes, types, symptoms, diagnosis and prevention		
3	3.1	Medical Imaging Techniques X-Ray: Basic principle and applications CT Scan: Basic principle, types and applications MRI: Basic principle, types and applications Sonography: Basic principle and applications	2, 4, 5	15
	3.2	Activity Preparation of blood smear Haematocrit Haemocytometer Study of haematological slides		
4		Teacher Specific Module		

<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x 1 = 10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

#### **Recommended reading**

1. Kumar V, Abul K. Abbas AK, Jon C. Aster JC, Singh MK (2020). Robbins and Cortan, Pathologic Basis of Disease, X Edition, Elsevier Health Science; South ASIA edition.
2. Park, K. (2007), Preventive and Social Medicine, B.B. Publishers
3. Prakash, G. (2012), Lab Manual on Blood Analysis and Medical Diagnostics, S. Chand and Co. Ltd.



# Semester 5



**Mar Athanasius College (Autonomous), Kothamangalam**  
**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology				
Course Name	Molecular Biology				
Type of Course	DSC				
Course Code	M24ZY5DSC300				
Course Level	300				
Course Summary	This course provides a basic understanding of the molecular mechanisms underlying biological processes at the cellular level. It covers fundamental principles, techniques, and applications in molecular genetics, gene expression, DNA replication, and protein synthesis.				
Semester	5	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3	-	1	-
Pre-requisites, if any	Basic knowledge in Cell Biology				

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Recall the structural and functional details of the basic unit of life at the molecular level	K	1,5
2	Understand in detail the structure of Genetic material and its function	U	1
3	Illustrate the DNA replication, repair transcription and post transcriptional modification	C	1,3
4	Examine the mechanism in gene expression and gene regulation	An	3,5
5	Analyse the characters and features of genetic code	An	3,5
6	Discover the new developments in molecular biology and its implications in human welfare	C	5,6

\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

**COURSE CONTENT**  
**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Organization of chromosomes in prokaryotic and eukaryotic cells, model organisms in the study of molecular biology	1,2,3	15
	1.2	Nucleic acids: Structure and function of DNA (DNA as a storehouse of information; genes are mutable units; DNA as the genetic material)		
	1.3	The structure of eukaryotic chromosomes (chromatin and nucleosome organization, DNA packing, interphase chromosomal architecture)		
	1.4	Structure, function and biogenesis of different types of DNA.		
2	2.1	Replication: The replicon- Module of replication, replicon in bacterial vs eukaryotic genome, Replisomes (apparatus for DNA replication, DNA polymerases, Okazaki fragments, Leading and Lagging strand synthesis, common events in priming replication at origin, methylation regulating initiation		15



		at origin)		
	2.2	DNA repair mechanisms (Brief account), recombination (breakage and reunion involves heteroduplex DNA, Holliday junction)		
	2.3	Transcription and post-transcriptional modifications: Transcription complex (promoters, factors, RNA polymerases), initiation-elongation-termination of transcription, mono-cistronic and poly-cistronic RNAs, Post transcriptional modifications of m-RNA, t-RNA and r-RNA		
3	3.1	Translation: Genetic code- General features of Genetic code. Mechanism of protein synthesis: initiation, elongation and termination in Prokaryotes and eukaryotes. Inhibitors of protein synthesis post-translational modifications. Protein sorting and targeting.	4, 5, 6	15
	3.2	Gene regulation in prokaryotes: operons (Lactose and Tryptophan operon)		
4		Practical	2, 6	30
	4.1	Types of chromosomes, and Nucleosome model understanding via photographs Identification and comment on the models or photographs- DNA replication, Various types of RNA, DNA double helix		
	4.2	Isolation of DNA Protein estimation using Biuret or Lowery's method		
	4.3	Agarose gel electrophoresis Polyacrylamide gel electrophoresis		
5		Teacher Specific Module		

<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

**Recommended reading:**

1. Albert, B., Johnson, A., Raff, M., Robert, K., & Walter, P. *Molecular biology of the cell* (5<sup>th</sup> ed.). Garland Sciences. NY.
2. Benjamin Lewin. (1995). *Genes V*. Oxford University Press
3. Cooper, G. M. (2000). *The Cell –A molecular approach*. Princeton Publishers, NY, 2000.
4. Cooper, G.M. (2009). *The Cell : A molecular approach* (5<sup>th</sup> ed.). ASM Press, USA
5. De Robertis, E. D. P., De Robertis, E. M. F. (1987). *Cell and molecular biology*. Hong Kong: Lippincott Williams & Wilkins.
6. Karp G. (2010). *Cell Biology* (6<sup>th</sup> ed.). McGraw Hill book comp. New York.
7. Lodish H. F., Berk A., Zipursky s. L., Matsudaira P., Baltimore D. & Darnell. J. E. (2000). *Molecular Biology* (4<sup>th</sup> ed.). Freeman Press.
8. Pollard. J. P. & Earnshow. (2002). *Cell Biology*. W.C. Saunders.



**Mar Athanasius College (Autonomous), Kothamangalam**  
**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology				
Course Name	Environmental Biology and Human Rights				
Type of Course	DSC				
Course Code	M24ZY5DSC301				
Course Level	300				
Course Summary	This course examines the principles of ecology, the structure and function of ecosystems. Through the theoretical concepts students gain insight into the complexities of environmental systems and the importance of sustainable practices for maintaining ecological balance. The Human Rights module provides a comprehensive examination of the theory, history, principles, and contemporary issues surrounding human rights. It explores the philosophical foundations of human rights, the development of international human rights law, and the challenges and opportunities in promoting and protecting human rights globally.				
Semester	5	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3	-	1	-
Pre-requisites, if any	Basic knowledge in Biology				

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the principles of ecology and ecosystem dynamics	U	1
2	Examine the multidisciplinary nature, important theories and concepts of environmental science, ecosystems, natural resources and conservation	An	1, 2
3	Apply ecological principles to address global environmental challenges	A	1, 3
4	Analyse and apply international human rights law and principles to real-world situations.	An	3, 5
5	Recognize and address human rights violations and challenges in diverse contexts.	Ap	5
6	Develop strategies for advocating for and promoting human rights in their communities and beyond.	S	4, 5, 6

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**  
**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Basic concepts and Components of ecosystem: Abiotic (Sunlight, temperature, soil, water, atmosphere) and Biotic components (Producers, consumers, decomposers)	1,3	15
	1.2	Ecological pyramid- number, biomass, energy, Functions of ecosystem: Productivity-Food Chain-Food web-Energy flow-Laws of Thermodynamics.		
	1.3	Types of Ecosystems: Terrestrial-Forest- Grassland-Desert, Aquatic-Marine, Fresh water, Wetland & Biome		
	1.4	Concept of limiting factors: Liebig's and Shelford's laws of limiting factors.		
	1.5	Biogeochemical cycles: Concept, gaseous and sedimentary cycles, Carbon cycle, Nitrogen cycle.		
	1.6	Renewable resources (solar, wind, hydroelectric, biomass and geothermal) and Non-renewable resources (mineral and metal ore, fossil fuels).		
2	2.1	Concept of population: Population attributes- Population growth forms, Basic concepts of growth rates, density, natality, mortality, growth curves Animal interactions: Positive-Commensalism- Mutualism- Proto co-operation, Negative Predation-Parasitism-Competition- Antibiosis	2,3,4	15
	2.2	Characteristics of a community: Species diversity- richness, evenness, stratification, dominance, ecological indicators, Ecotone and Edge effect, Keystone species, Concepts of Ecological Niche and Guild, Ecological succession, community evolution- climax.		
3	3.1	An Introduction to Human Rights, Meaning, concept and development. History of Human Rights Different Generations of Human Rights Universality of Human Rights Basic International Human Rights Documents: UDHR, ICCPR, ICESCR Value dimensions of Human Rights	5,6	15
	3.2	Human Rights and United Nations Human Rights co-ordination within UN system Role of UN secretariat The Economic and Social Council The Commission Human Rights The Security Council and Human rights The Committee on the Elimination of Racial Discrimination The Committee on the Elimination of Discrimination Against Women The Committee on Economic, Social and Cultural Rights The Human Rights Committee- Critical Appraisal of UN Human Rights Regime		
	3.3	Human Rights National Perspective Human Rights in Indian Constitution, Fundamental Rights The Constitutional Context of Human Rights: directive Principles of State Policy and Human Rights Human Rights of Women, children, minorities, and Prisoners Science Technology and Human Rights National Human Rights Commission State Human Rights Commission		

		Human Rights Awareness in Education		
4		Practical	2, 6	
	4.1	Determination of soil organic carbon and chlorides. Estimation of dissolved oxygen Estimation of Carbon dioxide Estimation of primary productivity (Gross and Net)		
	4.2	Separation and identification of soil arthropods using Berlese funnel. Qualitative and Quantitative study of marine planktons		
	4.3	Principles and application of the following instruments: Rain Guage, Plankton Net, Secchi Disc, GPS.		
	4.4	Study of Pond/ wetland/ River/ forests ecosystem- Food web and food chain and pyramid (no museum specimen). Record the date, time, methodology, and observations in the record book.		
	4.5	Field Study Report: Field study covering River/ Wetland/ Marine and forests/ grassland.		
5		Teacher Specific Module		

MODE OF EVALUATION AND ASSESSMENT	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

#### Recommended readings:

1. Alan Beeby (2006). *Anne-Maria Brennan First Ecology, Ecological principles and Environmental issues*. International student's edition Sec. edition Oxford University Press.
2. Arunkumar Palai. (1999). *National Human Rights Commission of India*, Atlantic publishers
3. Erach Bharucha. (2008). *Textbook of Environmental Studies of Undergraduate Course*, UGC, University Press.
4. J. B Sharma. (2009). *Environmental studies* (3<sup>rd</sup> ed.). University science Press
5. Landis, Wayne and Hing-hoYu, & Baca Raton (1995). *Introduction to Environmental Toxicology: Impacts of chemicals upon Ecological systems*. Lewis Publishers.
6. Meera Asthana and Astana D.K. (1990). *Environmental pollution and Toxicology* Alkaprinters.
7. Misra S. P., & Pandey S. N. (2009). *Essential Environmental Students*, Ane books Pvt. Ltd.
8. Odum, E. P. (1971). *Fundamentals of Ecology*, W.B. Saunders College Publishing, Philadelphia
9. P.D Sharma. (2012). *Ecology and Environment* (11<sup>th</sup> ed.). Rastogi Publications
10. Paul R. C. (2000). *Situations of Human Rights in India*. Efficient offset printers.
11. R.B Singh & Suresh Mishra Paulami Maiti. (1996). *Biodiversity - Perception, Peril and Preservation*, PHI Learning, Environmental Law in India: Issues and Responses
12. Rajagopalan, R. (2005). *Environmental Studies from Crisis to Cure*. Oxford University Press, New Delhi.
13. Robert Ricklefs (2001). *The Ecology of Nature*. Fifth Edition. W.H. Freeman and Company.
14. Sharma P. D. (2005). *Environmental biology and Toxicology*, Rastogi publication
15. Stiling Peter (2002). *Ecology: Theories and applications*. Prentice Hall of India pvt. Ltd. New Delhi.



**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology				
Course Name	Genetics				
Type of Course	DSE				
Course Code	M24ZY5DSC302				
Course Level	300				
Course Summary	This is a course to study the principles and mechanisms governing the inheritance and variation of traits in living organisms. It covers various aspects of Mendelian genetics, linkage, crossing over, mutation, recombination and human genetics.				
Semester	5	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		4	-	-	-
Pre-requisites, if any	Basic knowledge in Cell Biology				

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Describe principles and mechanism of inheritance	K,U	1,3
2	Understand the applications and techniques of modern genetic technology as well as select the correct techniques to solve genetic problems	U	4
3	Able to learn the importance of inheritance in man and role of genetic mechanisms in evolution	An	3
4	Compare the nature of heritable traits in families and populations to provide insight in to cellular and molecular mechanisms	A	3,5
5	Examine how genetic concepts affect broad social issues including health and disease, food and natural resources, environmental sustainability etc.	E	5,6

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Mendelism and its Extension: Principles of inheritance, Incomplete dominance and co-dominance	1	15
	1.2	Allele concept – multiple alleles, pseudo allele and lethal allele, Epistasis, hypostasis and pleiotropy		
	1.3	Linkage – types of linkage, linkage groups and significance		
	1.4	Crossing over – types of crossing over, mechanism and significance		
	1.5	Mutation – Gene and chromosome mutations.		
2	2.1	Recombination in bacteria- transformation, transduction, conjugation, and sex-duction	2, 3	15
	2.2	Chromosome theory of heredity, Linkage, and recombination of genes in a chromosome, crossing over as the physical basis of recombination		
	2.3	Stern's Experiment; molecular mechanisms of recombination		

		(Holliday model), Gene conversion		
	2.4	Recombination mapping with two-point and three –point test cross in <i>Drosophila</i> , Coincidence and Interference		
	2.5	Genetic mapping by tetrad analysis in <i>Neurospora</i> . Mitotic recombination		
3	3.1	Human Genetics: Karyotype, pedigree analysis, genetic analysis of complex traits - complex pattern of inheritance, quantitative traits, threshold traits; human genome and mapping. QTL mapping, genotype-environment interactions.	3, 4, 5	15
	3.2	Sex determination. Sex linkage, sex limited, and sex influenced characters in man		
	3.3	Inheritance of mitochondrial, maternal inheritance.		
	3.4	Epigenetics - from phenomenon to field, chromatin modifications and their mechanism of action, concept of 'histone-code' hypothesis, epigenetics in <i>Saccharomyces cerevisiae</i> , position effect variegation, heterochromatin formation and gene silencing in <i>Drosophila</i> .		
4		Activity	1, 2, 3	
		Prepare a report on Culture, sexing and etherisation of <i>Drosophila</i> performed in the laboratory Study of life cycle of <i>Drosophila</i> (Plot graph) Observation of Mutants in <i>Drosophila</i>		
		Study of sex chromatin in buccal smear (Human) Squash preparation and identification of salivary gland chromosomes in drosophila/Chironomus larva (group activity) Abnormal human karyotypes (any five). Pedigree analysis		
5		Teacher Specific Module		


#### MODE OF EVALUATION AND ASSESSMENT

<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 30 marks Quiz, Test Papers, seminar	<b>B. End Semester Examination</b> Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks
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#### Recommended readings:

1. Becker, W.M., Kleinsmith, L.J., Hardin, J. & Bertoni, G. P. (2009). *The World of the Cell*. (7<sup>th</sup> ed.). Pearson Benjamin Cummings Publishing, San Francisco.
2. Cooper, G.M. & Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and Sunderland, Washington, D.C.
3. Gardner, E.J., Simmons, M.J., & Snustad, D.P. (2008). *Principles of Genetics*. (8<sup>th</sup> ed.). Wiley India
4. Griffiths, A. J. (2008). *Introduction to Genetic Analysis*. United Kingdom: W. H. Freeman.
5. Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments* (6<sup>th</sup> ed.). John Wiley and Sons. Inc.
6. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics* (10<sup>th</sup> ed.). Benjamin Cummings
7. M. A. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith & Watson James. (2008). *Molecular Biology of the Cell* (5<sup>th</sup> ed.). Garland publishing Inc. New York and London.
8. Russel P. J. (2016). *iGenetics A molecular Approach* (3<sup>rd</sup> ed.). Pearson Education India
9. Strickberger M. W. (2015). *Genetics* (3<sup>rd</sup> ed.). Pearson Education India
10. Wilson, J., Hunt, T. (2014). *Molecular Biology of the Cell* (6<sup>th</sup> ed.). The Problems Book. United States: W.W. Norton.



	<b>Mar Athanasius College (Autonomous), Kothamangalam</b> <b>FYUGP SYLLABUS</b>
Programme	B Sc. (Honours) Zoology
Course Name	Evolutionary Biology and Ethology
Type of Course	DSE
Course Code	M24ZY5DSE300

Course Level	300				
Course Summary	This course provides a comprehensive examination of the principles and processes that drive the diversity of life on Earth. This course also aimed to understand the mechanisms of evolution, the history of life, and the application of evolutionary theory to modern biological problems. The Ethology module delves into the scientific study of animal behaviour. It explores the mechanisms, ecological significance, and evolution of behaviour across a variety of animal species.				
Semester	5	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		4	-	-	-
Pre-requisites, if any	Basic knowledge in Evolution				

### COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand and explain the fundamental mechanisms of evolution	K	1,3
2	Analyze genetic variation and evolutionary processes in populations	An	4
3	Discuss the evolutionary origins and adaptations of various life forms	E.An	3,4
4	Interpret the fossil record and understand major evolutionary transitions	C	3,5
5	Understand and explain the biological and ecological foundations of animal behaviour	U	1
6	Evaluate the interplay between genetics, neurobiology, and environment in shaping behaviour	E	4,5

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

### COURSE CONTENT

#### Content for classroom transaction (Units)

Module	Units	Course Description	CO No.	Hours
1	1.1	Introduction to Evolution: Molecules to Organisms: The first ten billion years (universe and earth arise, the atmosphere, rocks and continents)	1	15
	1.2	Evidence for evolution		
	1.3	Origin of life (origin of the molecules of life- molecules, membranes, protocells, the first cells, eukaryotic organelles and organisms)		
	1.4	Theories of Evolution: Theories of Evolution (Lamarckism, Darwinism, Neo-Darwinian Synthesis)		
	1.5	Natural selection: Survival of the fittest Types of Natural selection		
2	2.1	Basic population genetics: Hardy-Weinberg genetic equilibrium; basic one-locus models of mutation, migration and selection; genetic polymorphism; average effect of an allele, breeding value for fitness; breeding value; random genetic drift and inbreeding.	2, 3, 4	15
	2.2	Species concepts; reproductive isolation mechanisms and patterns; different models of speciation; phyletic gradualism,		



		punctuated equilibrium; neutral theory of molecular evolution		
	2.3	Primate evolution, Chimpanzees and Humans, Earliest Hominids, Australopithecines: the southern apes of Africa, Bipedalism and brain size, origins of Homo, Out of Africa.		
3	3.1	Historical background, Scope of ethology. Stimulus-Response	5, 6	15
	3.2	Reflex action, Kinesis, Taxes, Fixed action patterns. Sherrington's neuro-physiological concepts in behaviour– Latency, summation, fatigue.		
	3.3	Goal oriented drive, internal causal factor, Homeostatic and Non-homeostatic drives. Hormones and behaviour, Psycho-hydrologic model of motivation		
	3.4	Short- and long-term memory, Habituation, Classical conditioning, Instrumental conditioning, Latent learning, Trial and error learning, Instinct, Imprinting		
	3.5	Sensory mechanisms: Electrical, Chemical, Olfactory, Auditory and Visual. Dance language of honey bees Pheromonal communication (Ants and mammals).		
4	4.1	Reproductive strategies, Mating systems, Courtship, Sexual selection- patterns Parental care and investment	5, 6	
	4.2	Orientation, Navigation, Navigation cues. Biological rhythms – Circadian, Circannual, Lunar periodicity, Tidal rhythms.		
	4.3	Sociobiology (Brief account only) Aggregations – schooling in fishes, herding in mammals, Group selection, Kin selection, altruism, reciprocal altruism, inclusive fitness, co-operation, territoriality, alarm call, social organization in insects and primates.		
		Activity	1, 2, 5	
		Mapping of geological time scale of the listed organisms based on their evolutionary history		
		Study of animal behaviour in the field		
		Understanding the evolution of horse and man using photographs		
	Construction of an Evolutionary tree			
5		Teacher Specific Module		

MODE OF EVALUATION AND ASSESSMENT	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 30 marks Quiz, Test Papers, seminar	<b>B. End Semester Examination</b> Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

**Recommended readings:**

1. Daniel Hartal & Andrew Clark. Population genetics, 3rd edition.
2. Futuyma, D. (1998). *Evolutionary Biology* (3<sup>rd</sup> ed.). Sinauer Assoc. Inc
3. Jobling et al. (2004). *Human Evolutionary Genetics*. Garland
4. Monroe W. Strickberger. (2005). *Evolution*. Jones and Barlett Learning.

5. Ridley, M. (2004). *Evolution* (3<sup>rd</sup> ed.). Blackwell.
6. Terence A. Brown.(1999). *Genomes*, Bios Scientific Publisher Press , Oxford





**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology				
Course Name	Clinical Microbiology				
Type of Course	DSE				
Course Code	M24ZY5DSE301				
Course Level	300				
Course Summary	Clinical Microbiology is a specialized course focusing on the study of microorganisms relevant to human health and disease diagnosis. It covers the principles and practices of microbiological techniques used in specimen collection, isolation, and identification. The course also explores the epidemiology, pathogenesis, and laboratory diagnosis of infectious diseases caused by bacteria, viruses, and fungi.				
Semester	5	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		4	-	-	-
Pre-requisites, if any	Basic knowledge on Microbiology				

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Record the history of medical microbiology	K,U	1,4
2	Practice the importance of safe microbial handling, Appreciate the development of various safety level measures	S	2,5
3	Analyse the source of microbial infections and mode of transfer	An	4,5
4	Schedule Practices in the collection transport and processing of microbial samples	A	5
5	Examine the dangers and safety measures while handling of viral samples and virus culture	E	4,5
6	Develop an understanding on the diagnosis of Fungal infections	U	5

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	History of development of Medical Microbiology, Contributions made by eminent scientists	1, 2	15
	1.2	Safety in Clinical Microbiology laboratory		
	1.3	Good laboratory practices Microbiological safety cabinets- types		
	1.4	WHO safe code of practice for a clinical microbiology laboratory.		
2	2.1	Factors predisposing to microbial pathogenicity Infections Sources of infections	3	15
	2.2	Mode of transmission of infections, nosocomial infections,		

		opportunistic infections		
	2.3	Normal microflora of human body		
	2.4	Identification of pathogens- cultural, biochemical, serological and molecular methods		
3	3.1	Collection, transport, processing and microbiological examination of Blood, Sputum, stool, urine, cerebrospinal fluid, genital specimens, throat and mouth specimens, nasopharyngeal swabs and aspirates, ear discharges, eye specimens, pus from wounds, abscesses, burns and sinuses, and effusions	2, 4, 5	15
4	4.1	Specimens for viral diagnosis, Viral isolation and growth, Cell culture for viral detection Detection of viral proteins, Detection of viral genetic material, Viral serology	5, 6	15
	4.2	Laboratory diagnosis of fungal diseases Diagnostic procedures, Superficial, Cutaneous and Systemic mycosis.		
		Activity	4, 5, 6	
		Study of motility of bacteria hanging drop experiment		
		Antibiotic sensitivity test and preparation of anti-bio gram (demonstration) Microscopic identification of any 10 blood pathogens (slides/ images/ photos)		
		Identification of fungi Identification of 5 intestinal protozoans/ helminths( Slides/ Spotters or photographs)		
		Visit to a Biomedical laboratory/ Vaccine producing lab/ And prepare a report on various steps in vaccine production		
5		Teacher Specific Module		

#### MODE OF EVALUATION AND ASSESSMENT

<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 30 marks Quiz, Test Papers, seminar	<b>B. End Semester Examination</b> Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks
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#### Recommended readings:

1. Baron E. J, L. R. Peterson & S. M. Finegold. (1994). *Bailey and Scott's Diagnostic Microbiology*. ASM, Washington, DC
2. Cowan, S. T. & K. J. Steel. (1985). *Manual for the Identification of Medical Bacteria*. Cambridge University Press, London.
3. D.C. Kloss, W.E., & T.L. Bannermann. (1995). *Manual of Clinical Microbiology* (6th ed.), American Society for Microbiology, Washington, USA
4. Goodman and Guilman's. (2000). *Pharmacological Basis of Therapeutics* (10<sup>th</sup> ed.).
5. Gradwohl's. (1981). *Clinical laboratory methods*. Vol I. Academic Books, London.
6. Howard B. J, J. F. Keiser. T. F. Smith, A. S. Weissfeld, & R. C. Tolton. (2002). *Clinical and Pathogenic Microbiology*.
7. Koneman E.W. D. Stephen, & William A, Janda. (2008). *Color Atlas and Textbook of Diagnostic Microbiology*. Tata McGraw Hill, NY.
8. Mackie & McCartney. (2008). *Practical Medical Microbiology* (14th edn). Churchill Livingstone, UK.
9. Monica Cheesbrough. (1991). *Medical Laboratory Manual for Tropical Countries*. Vol. I. Microbiology. ELBS.

10. P. R. Murray, E. J. Baron, M, Patrick R. M, K. S. Rosenthal, G.S. Koayashi & M. A. Ptaller. (1997). *Medical Microbiology*.
11. Sherris Jc., 1990. *Medical Microbiology, An Introduction to Infectious Diseases* (2<sup>nd</sup> ed.). New York





**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology				
Course Name	Animal Pathology				
Type of Course	DSE				
Course Code	M24ZY5DSE302				
Course Level	300				
Course Summary	This course offers a comprehensive study of diseases in animals, focusing on the causes, mechanisms, and effects of pathological conditions. This course also focuses on diagnostic techniques, disease prevention, and treatment strategies.				
Semester	5	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		4	-	-	-
Pre-requisites, if any	Basic knowledge on Pathogens				

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the fundamental principles of animal pathology	U	1, 2
2	Identify and describe pathological conditions in various organ systems	K, U	2, 4
3	Perceive the importance of mineral metabolism and development of diseases	A	4
4	Understand animal Pathological disorders and disturbances in detail	U	4
5	Make use of the learned strategies to prevent the spread control of zoonotic diseases.	E	4, 5, 6
6	Apply the knowledge of vaccination and immunisation in disease management	Ap, I	4, 5

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Introduction of Pathology: scope and branches	1	15
	1.2	Diseases of fishes (Dropsy, Fin rot, Argularis, Anchor worm)		
	1.3	Diseases of fowls. (Fowl pox, Newcastle disease, Avian influenza, Mereks disease).		
	1.4	Diseases of cattle's (Anthrax, Foot and mouth disease, Mastitis, Milk fever)		
2	2.1	Human diseases: Communicable diseases in humans. Pathogen, aetiology, pathogenesis of - Hepatitis, Tuberculosis, AIDS.	1, 5	15
	2.2	Zoonotic diseases: Bacterial disease - Leptospirosis Fungal disease - Histoplasmosis Viral disease - Rabies		

		Protozoan disease- Toxoplasmosis		
3	3.1	Common pathological processes: Retrogressive changes: Cloudy swelling, Degeneration - fatty degeneration, mucoid degeneration and amyloid degeneration Necrosis: Nuclear and cytoplasm changes, Types of necrosis Gangrene: Definition and causes, Types of gangrene - dry, moist and gas gangrene	1, 2, 3, 4, 6	15
	3.2	Pathological disturbances and disorders: Circulatory disturbances- Hyperaemia: active and passive (causes and effects) Ischaemia: causes and effects Haemorrhage: causes, effects and haemorrhagic effects Thrombosis: thrombus formation, its causes, and effects Embolism: Definition, sources, types, and effects		
	3.3	Disorders of pigmentations: Causes and effects of pigmentation, melanises		
	3.4	Disorders of mineral metabolism: Mechanism of calcification, pathological calcification (dystrophic and metastatic) Causes and its effects. Gout aetiology and pathogenesis. Diagnostic tests, Immunization, vaccines.		
		Activity		15
		Identification of any 10 animal pathogens (slides/ Photos) Etiology of any 5 animal pathogens Identification of any five pathological specimens / Images or slides Identification of Histological slides of Liver, Kidney, muscles under microscope Identify behavioral changes associated with various pathological conditions in Cattles, Poultry and prepare a report.		
5		Teacher Specific Module		

<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 30 marks Quiz, Test Papers, seminar	<b>B. End Semester Examination</b> Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) –10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

### Recommended reading

1. Bhende Y. M. and Deodhar S.G. (2008). *General pathology and pathology of systems*, 2008, 6th Edn. Popular Prakashan Ltd., India.
2. C. R. Maiti. (2005). *Concise Book On Medical Laboratory Technology*, reprint, 1st Edn. New Central Book Agency (p) Ltd, Kolkata, India.
3. Dey N. C. and Dey T. K. Sinha Debashish. (2009). *A textbook of Pathology*, 2009, 15th Rev Edn. New central book agency, Kolkata.
4. Harsh Mohan (2014). *Textbook of Pathology*, 2014, 7th Edn. Jaypee Brothers Medical Publishers (P) Ltd.
5. Ramadas Nayak, Sharada Rai, and Astha Gupta. (2012). *Essentials in Haematology & Clinical Pathology*. 1st Edition.
6. Vinay Kumar, Abul K. Abbas, Jon C. Aster. (2012). *Robins Basic Pathology*. 9th Edn. Saunders, Philadelphia.



**Mar Athanasius College (Autonomous), Kothamangalam**  
**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology					
Course Name	Ornamental Fish Culture					
Type of Course	SEC					
Course Code	M24ZY5SEC300					
Course Level	300					
Course Summary	Ornamental Fish Culture is a specialized field focused on the breeding, rearing, and management of ornamental fish species used in home aquariums, public aquariums, and water gardens. This course provides an in-depth understanding of the principles and practices essential for successful ornamental fish culture.					
Semester	5	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	45
		3	-	-	-	
Pre-requisites, if any	Basic knowledge in Fishes					

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Design aesthetically pleasing and functional aquarium displays	1, 3	
2	Understand the role of plants, substrates, and decorative elements in creating balanced aquatic environments	2, 3, 4	
3	Explain the reproductive processes and development stages of ornamental fishes	3	
4	Implement and maintain water quality management practices to ensure optimal conditions for fish health and growth.	3, 5	
5	Develop breeding skill to produce high-quality ornamental fish	3, 5	
6	Identify indigenous/exotic ornamental fishes	3	

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Importance and history of aquarium fish keeping. Design and construction of aquaria: aquarium fabrication- shape, size, volume, type of glass tank, cutting of glass. preparation of glass tank, strengthening and supporting of tank. fitting of tanks into room settings: aquarium floor setting type and size of pebbles, gravels, granites used for bed setting and its advantages. Filters- biological, chemical and mechanical. Aquarium accessories like aerators. decorative, lighting, heating and feeding trays.	1, 2, 6	15
	1.2	Water quality management in aquarium systems - sources of water, containers, storage, temperature, pH dissolve carbon dioxide, ammonia, hardness, turbidity and ozone in aquarium.		
	1.3	Aquarium plants: Uses of aquarium plants - different varieties of plants like submerged plants (tubers, rooted plants. cutting plants) and emerged plants		



2	2.1	Fresh water ornamental fishes: Common ornamental fishes indigenous and exotic species; Identification of the common ornamental fishes. <i>Cyprinus carpio</i> (koi carp). <i>Molliensia sphenops</i> (black molly lyre tail), <i>Poecilia reticulata</i> (guppy). <i>Poecilia latipinna</i> , <i>Xiphophorous helleri</i> (red sword tail) <i>Xiphophorous maculatus</i> (red platy), <i>Pterophyllum scalare altum</i> (angel fish <i>Carassius auratus</i> (red oranda), <i>Betta splendens</i> (Siamese fighting fish), <i>Trichogaster leeri</i> (pearl gourami).	3, 4, 5, 6	15
	2.3	Live bearers and egg layers. Sexual dimorphism in ornamental fishes. Breeding and rearing of common ornamental fishes. Conditions for breeding- pH, temperature and - sex ratio. Brood stock management- selection of brooders, maintenance and management of brood stocks. Selective breeding and hybridization techniques. Induced -breeding. Colour enhancement techniques		
	2.4	Aquarium maintenance- Setting up of a freshwater community tank and its maintenance. Food and feeding .- live feed and formulated feed. Preparation and culture of live feed (Artemia, Infusoria, Spirulina). Control of algal growth, snails and other predators Common disease of. ornamental aquarium fishes - their causative agents - virus, bacteria, fungi, protozoa and nematode; symptoms, treatment and prophylactic measures		
3	3.1	Indigenous ornamental fishes - Common indigenous ornamental fishes. Identification of the common ornamental fishes. <i>Puntius denisonii</i> (red line torpedo fish ), <i>Puntius fasciatus</i> (melan barb), <i>Puntius filamentosus</i> (Indian tiger barb), <i>Puntius curmuca</i> (red tailed silver shark), <i>Danio malabaricus</i> (Malabar danio); <i>Nemacheilus triangularis</i> (Zodiac loach). <i>Lepidocephalus thermalis</i> (Malabar loach); <i>Etroplus maculatus</i> (yellow and orange chromides), <i>E. suratensis</i> (pearl spot); <i>Anabas testudineus</i> (climbing-'perch) and <i>Horabagrus brachysoma</i> (Yellowish catfish). <i>H. nigricollaris</i> (White collared imperial catfish)	1, 2, 4, 6	15
		Activity		
		Preparation and maintenance of aquarium		
		Visit fresh water and marine aquariums		
4		Teacher Specific Module		

MODE OF EVALUATION AND ASSESSMENT	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

#### Recommended reading

1. Arumugam. N. (2008). Aqua culture, Saras publications, Tamil Nadu, India.
2. Axelord, H.R. (1967). Breeding aquarium fishes, T F H Publications.
3. Dick Mills (1981). Aquarium Fishes, Arco publishing.
4. Dick Mills and Gwynne Ververs, (1982). The Practical encyclopedia of fresh water
5. Tropical Aquarium fishes, Salamander Books limited, London.
6. Gahlawat, S.K., et.al. (2007). Manual of experimental Ichthyology, Daya publishing Hipuse, Delhi.
7. Gerhard Brunner, (1973). Aquarium plants, T F H Publications. Inc. Ltd.. Hongkong.
8. Harishankari. A & A..Bij Kumar, (1997). Aquarium Fishes, B. R. publishing Corporation, Delhi.

9. Jorgen Hansen, (1979). Making your Own aquarium, Bell and Hyman Ltd., London.
10. Ramachandran. A. (2002). Breeding, Farming and management of ornamental fishes. School.of Industrial Fisheries, Cochin .University of Science. And Technology, Cochin-16.
11. Saroj. K. Swain, (2003). Aquarium care and maintenance, Publ. CIFA, ICAR. Orissa, India.
12. Tom Lovell (1998). Nutrition and feeding of fish second Ed. Kluwer Academic publishers.
13. Talwar. P.K., and Thingran.A.G..(1991). Inland fishes Oxford and IBH Publishing Co PVT LTD, New Delhi





# Semester 6



## Mar Athanasius College (Autonomous), Kothamangalam

### FYUGP SYLLABUS

Programme	B Sc. (Honours) Zoology				
Course Name	Biochemistry				
Type of Course	DSC				
Course Code	M24ZY6DSC300				
Course Level	300				
Course Summary	Biochemistry is the study of the chemical processes and molecular mechanisms that occur within living organisms. This foundational course provides students with an in-depth understanding of the structure, function, and regulation of biomolecules, including proteins, nucleic acids, carbohydrates, and lipids.				
Semester	6	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3	-	1	-
Pre-requisites, if any	Basic knowledge in Organic Chemistry				

### COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Describe the structure, function, and regulation of biomolecules in living organisms	K, U	3
2	Compare and contrast the relationship of organic compounds and homeostasis in biological organism	An, E	3, 5
3	Build the ability to understand and distinguish the chemical nature and Structure of various Biomolecules.	S	3
4	Understand the enzyme kinetics and its application in Industry	U	3, 5
5	Experiment with the properties and functions of Biomolecules	S	3
6	Generate an interest in the subject and help students explore the new developments in biochemistry	I	3, 4, 5

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

### COURSE CONTENT

#### Content for classroom transaction (Units)

Module	Units	Course Description	CO No.	Hours
1	1.1	Monosaccharides: Classification and nomenclature, Biological importance of Glucose, fructose, galactose, mannose and ribose. Glycosidic bond.	1, 3	15
	1.2	Disaccharides: Sucrose, Lactose, Maltose, Isomaltose, Cellobiose and Trehalose		
	1.3	Polysaccharides: Homopolysaccharides- Starch, Glycogen, Cellulose, Chitin, Dextran, Inulin, Pectin Heteropolysaccharides- Hyaluronic acid, Heparin, Chondroitin sulphate, Keratan sulphate, Dermatan sulphate and Agar-agar		
	1.4	Glycoproteins and Mucoproteins		
2	2.1	Proteins: Structure, classification, and properties of amino acids. Amphoteric properties of amino acids, pK value and iso-electric point of amino acids. Peptide bond formation and peptides.	3, 5, 6	15
	2.2	Primary structure of protein ( <i>e.g.</i> insulin)		

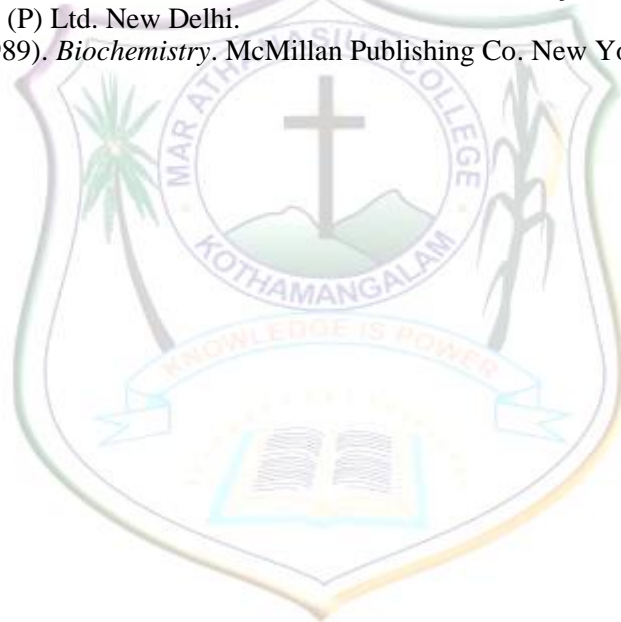
		Classification and properties of proteins Conformation of proteins- chemical bonds involved		
	2.3	Secondary structure- Alpha helix, Collagen helix, Beta pleated sheet Ramachandran angles and Ramachandran map Fibrous proteins- examples (Keratin, Collagen, Elastin, Resilin, Fibrous muscle proteins) Chaperons.		
	2.4	Tertiary structure- <i>e.g.</i> Myoglobin. Quaternary structure – <i>e.g.</i> Haemoglobin.		
3	3.1	Lipids: Classification of lipids: simple, compound and derived lipids. Biological importance of lipids.	2, 4	15
	3.2	Fatty acids: classification, nomenclature. Simple fats: Triacylglycerol (Triglycerides) - Physical properties. Reactions-Hydrolysis, Saponification, Rancidity		
	3.3	Compound lipids: Phospholipids- Lecithin, Phosphatidyl inositol, Cephalins, Plasmalogens. Glycolipids, Sphingolipids. Derived Lipids		
	3.4	Steroids: Biologically important steroids-cholesterol, Vitamin D, Bile acids, Ergosterol, Terpenes, Lipoproteins		
	3.5	Prostaglandins- structure, types, synthesis and functions		
	3.6	Enzymes: Classification- (I. U. B. system), co-enzymes, iso-enzymes, ribozyme. Enzyme specificity. Mode of action of enzymes. Formation of enzyme substrate complex. Lowering of activation energy, Various theories, Active site.		
	3.7	Enzyme kinetics: Michaelis-Menten equation. Km value and its significance. Enzyme velocity and factors influencing enzyme velocity. Kinetics of enzyme inhibition, suicide inhibition and feedback inhibition. Enzyme regulation: Allosteric regulations		
4		Practical	1, 5, 6	30
	4.1	Preparation of Molar solution and Normal solutions Determination of Ph using Ph meter and paper/solution		
	4.2	Paper Chromatography Thin layer chromatography		
	4.3	Test for non-reducing and reducing sugars Qualitative test of carbohydrates/ protein and / Lipid/ starch		
	4.4	Comparing the primary secondary and tertiary levels of proteins (Any one software)		
5		Teacher Specific Module		

<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

### Recommended Reading

1. Elliott, W. H. & C. Elliott. (2003). *Biochemistry and Molecular Biology*. Oxford University Press, Oxford. UK.
2. Eric E. Conn, Paul K. Stumpf, George Bruening, & Roy H. Doi. (2007). *Outlines of Biochemistry*. (5th ed.). John Wiley & Sons Inc. NY.
3. Garret, R.H. & C.M. Grisham. (1995). *Biochemistry*. Saunders College Publishers, USA.

4. Hanes, B. D. & N.M. Hoopar. (1998). *Instant notes: Biochemistry*. University of Leeds, Leeds, UK.
5. Horton, H.R., Morsan, L.A., Scrimgeour, K. G., Perry, M.D & J. D. Rawn. (2006). *Principles of Biochemistry*. Pearson Education International. New Delhi.
6. Keith Wilson and John Walker. (2008). *Principles and Techniques of Biochemistry and Molecular biology* (6<sup>th</sup> ed.). Cambridge University Press, UK.
7. Lenhninger, A. L. (2008). *Principles of Biochemistry*. (5th ed.). CBS Publishers and Distributors. New Delhi.
8. Murray, K., Granner, D.K., Maynes, P. A & V. W. Rodwell. (2006). *Harper's Biochemistry* (25th ed.). McGraw Hill. New York, USA.
9. Oser, B. L. (1965). *Hawk's Physiological Biochemistry*. Mc Graw Hill Book Co. New Delhi.
10. Palmer Trevor. (2001). *Enzymes: Biochemistry, Biotechnology & Clinical chemistry*. Horwood Publ.Com. England.
11. Rama Rao, A.V. S. S. (1986). *Textbook of Biochemistry*. L. K. & S Publishers, New Delhi.
12. Stayer, L. (2011). *Biochemistry*. (7th ed.). W.H. Freeman & Co. NY.
13. Vasudevan, D.M. & S. Sreekumar. (2000). *Text of Biochemistry for Medical Students*. Jaypee Brothers, Medical Publishers (P) Ltd. New Delhi
14. Voet, D. & J. G. Voet. (2004). *Biochemistry*. John Wiley & Sons. NY.
15. W.H. Freeman & Co, NY. Deb, A.C. (2004). *Fundamentals of Biochemistry*. New Central Book Agency (P) Ltd. New Delhi.
16. Zubay, G. (1989). *Biochemistry*. McMillan Publishing Co. New York.





**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology					
Course Name	Human Physiology and Endocrinology					
Type of Course	DSC					
Course Code	M24ZY6DSC301					
Course Level	300					
Course Summary	Human Physiology is an in-depth course that explores the functions and mechanisms of the human body's systems. This course provides students with a comprehensive understanding of how the body's organs and systems work both independently and together to maintain homeostasis.					
Semester	6	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	75
		3	-	1	-	
Pre-requisites, if any	Basic knowledge in Physiology					

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the basic principles and concepts of human physiology	U	1,3
2	Explain the physiological mechanisms underlying homeostasis	R, U	1, 4
3	Describe the structure and function of major organ systems	R, U	1
4	Analyse how different organ systems interact to maintain health	An	1, 2, 4
5.	Apply physiological knowledge to understand human health and disease	A	1, 4
6	Analyse the physiological roles of hormones in maintaining homeostasis and regulating bodily functions	An	4, 5

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Digestion: Brief description of digestive glands (liver, pancreas, salivary, gastric and intestinal)	1, 2	15
	1.2	Digestion and absorption of carbohydrates, proteins and fats		
	1.3	Nervous and hormonal control of digestion		
	1.4	Respiration: Phases of respiration (external respiration, gas transport and internal respiration).		
	1.5	Respiratory pigments: Haemoglobin, Myoglobin (Structure and Function).		
	1.6	Transport of respiratory gases - transport of oxygen, oxyhaemoglobin curve, factors affecting oxyhaemoglobin curve, transport of carbon dioxide, chloride shift		
	1.7	Control of respiration. Respiratory disturbances (Hypoxia, Hypercapnia, Asphyxia). Carbon monoxide poisoning		

2	2.1	Circulation: Systemic and pulmonary circulation, blood pressure, ECG	2	15
	2.2	Blood coagulation– clotting factors, intrinsic and extrinsic pathways, anticoagulants .		
	2.3	Cardiovascular diseases: Atherosclerosis, Myocardial infarction		
	2.4	Excretion: Histology of Bowman’s capsule and tubular part		
	2.5	Urine formation – glomerular filtration, tubular reabsorption, tubular secretion. Urine concentration – counter current mechanism. Acid – base balance,		
	2.6	Hormonal regulation of kidney function. Renal disorders (kidney stone, acute and chronic renal failure, and dialysis).		
3	3.1	Nerve physiology: Ultra structure of neuron.	3, 4, 5, 6	15
	3.2	Nerve impulse production, transmission of impulse along the nerve fibre, interneuron (synaptic) transmission, neuromuscular junction and transmission of impulses.		
	3.3	Neurotransmitters: acetyl choline, adrenalin, dopamine; EEG; Memory		
	3.4	Neural disorders: brief account on Dyslexia, Parkinson’s disease, Alzheimer’s disease, Epilepsy		
	3.5	Muscle physiology: Ultra structure of striated muscle, muscle proteins (myosin, actin, tropomyosin, troponin)		
	3.6	Muscle contraction and relaxation-Sliding Filament Theory, cross bridge cycle, biochemical changes and ATP production in muscle, Brief description of Cori cycle		
	3.7	Kymograph, Simple muscle twitch, muscle fatigue, tetanus, rigor mortis		
	3.8	Endocrine physiology: Hormones – classification and mechanism of hormone action		
	3.9	Major endocrine glands (Histology is not included) their hormones, functions and disorders (hypothalamus, pituitary gland, pineal gland, thyroid gland, parathyroid gland, islets of Langerhans, adrenal gland)		
	3.10	Homeostasis and feedback mechanism		
4		Practical	2, 3	30
	4.1	Virtual Practical's in Physiology (Use of PhysioEX 9.0 : <i>Laboratory Simulations in Physiology</i> by P.Zao.,T.Stabler., L.A.Smith and E.Griff. 2011.is suggested) for muscle and nerve physiology practical for classroom training and for practical examination in order to replace Frog as per UGC guidelines). Simple Muscle Twitch, Tetanus, Fatigue		
	4.2	Effect of drugs on the heartbeat of human being (using Physio EX 9.0)		
	4.3	Kymograph: working principle and applications		
	4.4	Haemoglobin estimation Using haemocytometer count the RBC and WBC Haematocrit and ESR of Human blood		
	4.5	Identification of various endocrine disorders / photographs		
5		Teacher Specific Module		

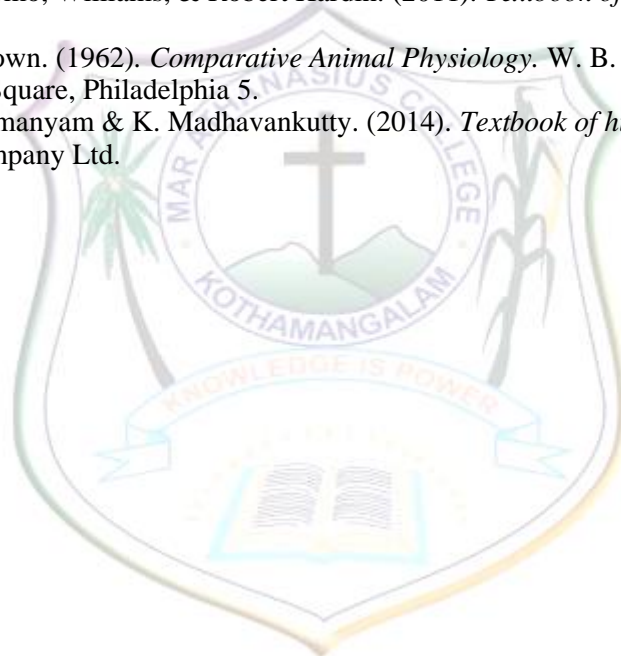
**MODE OF EVALUATION AND ASSESSMENT**



<p><b>A. Continuous Comprehensive Assessment (CCA)</b>  Theory Total = 25 marks  Quiz, Test Papers, seminar  Practical Total = 15 marks  Lab performance, record, field report etc.</p>	<p><b>B. End Semester Examination</b>  Theory Total = 50 marks, Duration 1.5 hrs  Part A (Short answer) – 10 out of 12 x1 = 10 marks  Part B (Short essay) – 4 out of 6 x 5 = 20 marks  Part C (Long essay) – 2 out of 4 x 10 = 20 marks  Practical Total = 35 marks; Duration- 2 hrs  Record 10 marks, Examination 25 marks</p>
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### Recommended reading

1. Arthur C. Guyton & John E. Hall. (2016). *Text Book of Medical Physiology* (13<sup>th</sup> ed.). Guyton. Elsevier
2. Barrington, E. J. W. (1975). *General and Comparative Endocrinology*: Oxford, Clarendon Press.
3. Geetha N. (2014). *Textbook of Medical Physiology* (3<sup>rd</sup> ed.). Paras Medical Publishers.
4. Jain, A K. (2016). *Textbook of Physiology*, Avichal Publishing Company
5. Martin, C. R. (1985). *Endocrine Physiology: Oxford University Press*.
6. Melmed, Shlomo, Williams, & Robert Hardin. (2011). *Textbook of Endocrinology* (12<sup>th</sup> ed.). Elsevier
7. Prosser & Brown. (1962). *Comparative Animal Physiology*. W. B. Saunders Co., West Washington Square, Philadelphia 5.
8. Sarada Subramanyam & K. Madhavankutty. (2014). *Textbook of human physiology.*, S. Chand & Company Ltd.





**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology				
Course Name	Reproductive and Developmental Biology				
Type of Course	DSE				
Course Code	M24ZY6DSE300				
Course Level	300				
Course Summary	This course explores the processes underlying the growth, differentiation, and morphogenesis of organisms from fertilization to adulthood. It covers fundamental principles of embryology, cellular differentiation, and organogenesis across various animal groups.				
Semester	6	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3	-	1	-
Pre-requisites, if any	Basic knowledge in Embryology				

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the fundamental principles of developmental biology from fertilization to organogenesis	U,R	3
2	Understand reproductive organs, gametogenesis and fertilization	U	5
3	Illustrate cleavage, blastulation and gastrulation	C	1, 5
4	Differentiate the embryology of chick, frog and humans	A, An	5
5	State the techniques on experimental embryology, prenatal diagnostic procedures and different types of placentation in mammals	A,U	4, 5
6	Analyse experimental approaches and model systems used in developmental biology	An	5

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Introduction: Definition, Scope of developmental biology, subdivisions (descriptive, comparative, experimental and chemical), historical perspectives, basic concepts and theories.	1, 2	15
	1.2	Structure of mammalian sperm and egg; Egg types: Classification of eggs based on the amount, distribution and position of yolk. Mosaic and regulative, cleidoic and non-cleidoic eggs. Polarity and symmetry of egg.		
	1.3	Fertilization: Mechanism of fertilization-(Encounter of spermatozoa and Ova, Approach of the Spermatozoon to the Egg, Acrosome Reaction and Contact of Sperm and Ovum, Activation of Ovum, Migration of Pronuclei and Amphimixis Significance of fertilization, Polyspermy.		
2	2.1	Cleavage: Types, planes and patterns of cleavage, Cell lineage of Planaria. Influence of yolk on cleavage.	3	15

	2.2	Blastulation: Morula, blastula formation, types of blastula with examples.		
	2.3	Fate maps: Concept of fate maps, construction of fate maps (artificial and natural), structure of a typical chordate fate map. Significance of fate map.		
	2.4	Gastrulation: Major events in gastrulation. Morphogenetic cell movements. Influence of yolk on gastrulation. Exogastrulation. Concept of germ layers and derivatives.		
	2.5	Gene action during development with reference to Drosophila (maternal effect genes), Zygotic genes.		
3	3.1	Embryology of Frog: Gametes, fertilization, cleavage, blastulation, fate map, gastrulation, neurulation, notogenesis. Differentiation of Mesoderm and Endoderm, Development of eye. Metamorphosis of frog Hormonal and environmental control.	4, 5	15
	3.2	Embryology of chick: Structure of egg, fertilization, cleavage, blastulation, fate map, gastrulation. Development and role of Primitive streak Salient features of 18 hour, 24 hour, 33 hour & 48 hour chick embryo. Extra embryonic membranes in chick.		
	3.3	Experimental embryology: Spemann's constriction experiments, Organizers and embryonic induction.		
4		Practical	3, 4, 6	30
	4.1	Identification of different developmental stages of frog (egg, blastula, gastrula, neurula, tadpole, with external gill and internal gill). Morphological and histological studies of different types of placentae in mammals. Study of serial sections of embryo-tadpole/chick		
	4.2	Vital staining of early gastrula of chick – window method Blastoderm mounting of chick embryo using vital stains		
	4.3	Influence of temperature and teratogens on animal development		
5		Teacher Specific Module		

<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x 1 = 10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

**Recommended readings:**

1. Anthony S. Fauci, Eugene Braunwald, Dennis L. Kasper, Stephen L. Hauser, Dan L. Longo, J. Larry Jameson & Joseph Loscalzo (2008). *Principles of Internal Medicine* (17<sup>th</sup> ed.). Churuch Livingston.
2. Balnisky B.I. (1981). *An Introduction to Embryology*, W.B. Saunders and Co.
3. Berril, N.J., & Kars, G. (1986). *Developmental biology*, Mc Graw Hills
4. Dutta. (2007). *Obstrestics* (17<sup>th</sup> ed.). Church Livingston
5. Majumdar N. N. (1985). *Vetebrate embryology*, Tata McGraw-Hill, New Delhi
6. Melissa A & Gibbs. (2006). *A practical Guide to Developmental Biology*, Oxford university press.
7. Scott F. Gilbert. (2003). *Developmental biology* (7<sup>th</sup> ed.). Sinauer Associates Inc., U.S.
8. Taylor D J, Green NPO & G W Stout. (2008). *Biological Science* (3<sup>rd</sup> ed.). Cambridge University Press.
9. Vijayakumarn Nair, K. & George, P. V. (2002). *A manual of developmental biology*, Continental publications, Trivandrum





**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology				
Course Name	Bacteriology, Virology, and Mycology				
Type of Course	DSE				
Course Code	M24ZY6DSE301				
Course Level	300				
Course Summary	This is an integrated course that delves into the study of bacteria, viruses, and fungi. The course provides a comprehensive understanding of the diversity, infections, pathogenesis, and prevention and control of these diverse microorganisms.				
Semester	6	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		4	-	-	-
Pre-requisites, if any	Basic knowledge in Microbiology				

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Recall the diversity of microbial world	K	1, 2
2	Understand the Major human pathogens – Bacteria, virus, fungi and protozoans in detail	U	2, 4
3	Compare the pathogenicity of bacterial, fungal and viral infections and diseases	An, E	2, 4
4	Illustrate an outline of vaccination	C	4
5	Discuss various tools and techniques in the study of microbes and to manage a microbial laboratory	E, An	5
6	Create skills and competency in the field of clinical microbiology	S	5, 6

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Study of important properties, pathogenicity, and laboratory identification of: <i>Staphylococci, Streptococci, Pneumococcus, Corynebacterium diphtheriae, Bacillus anthracis, Clostridium Neisseria, E. coli, Proteus, Klebsiella, Shigella</i> and <i>Salmonella. Vibrio, Pseudomonas, Haemophilus, Brucella.</i>	1, 2, 3	15
	1.2	Study of important properties, pathogenicity and laboratory identification of: <i>Mycobacterium, Treponema, Leptospira, Yersinia, Bordetella, Mycoplasma, Actinomycetes, Rickettsiae</i> and <i>Chlamydiae</i>		
	1.3	A brief study of bacteria viz. <i>Borrelia, Listeria, Campylobacter, Helicobacter</i> and <i>Legionella.</i>		
2	2.1	Bacterial infections of respiratory tract, Bacterial infections	2, 3	15

		of gastrointestinal tract and food poisoning		
	2.2	Bacterial urinary tract infections, Bacterial infections of genital tract and reproductive organs		
	2.3	Bacterial infections of central nervous system, Skin and soft tissue infections, Bone and joint infections, Eye ear and sinus infections, Cardiovascular infections		
3	3.1	Study of properties of viruses viz., Alpha virus, Pox, Herpes Virus, Adeno, Orthomyxo virus, Paramyxo virus and Papova. Pathogenesis and laboratory diagnosis of diseases caused by these viruses.	2, 3, 4	15
	3.2	Study of properties of Viruses viz. Polio, Influenza, Rabies, and Rubella viruses, Hepatitis viruses		
	3.2	HIV and AIDS, Pathogenesis of these viral diseases, Immunology of viral infections		
	3.3	Oncogenic viruses, Slow viruses and Prion		
	3.4	Control of viral infections through vaccines, interferons and chemotherapeutic agents. Emerging viruses.		
4	4.1	Introduction, Classification of fungi, General techniques used in mycology. Cultivation of fungi, Staining of fungi.	2, 3, 5	15
	4.2	Mycosis in man-Classification, pathogenesis and clinical findings in various superficial, cutaneous and systemic fungal infections. Opportunistic mycoses; Immuno compromised situation and mycological infections; emerging diseases. Antifungal agents and their susceptibility test (one e.g.,)		
		Activity	5, 6	
		Cultivation and microscopic examination of fungi Preparation of fungal smear and staining to see the fruiting body/ spore		
		Streak plating technique Microscopic identification of any 10 microbial pathogens (Bacteria/ Fungus)		
		Study of Virus organization using photographs- Animal, Plant and Bacteriophage		
		Visit to a microbiology lab to understand the various safety measures- prepare a report		
5		Teacher Specific Module		

MODE OF EVALUATION AND ASSESSMENT	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 30 marks Quiz, Test Papers, seminar	<b>B. End Semester Examination</b> Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) –10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

**Recommended readings:**

1. Ananthanarayan & Jayaram Panicker. (2002). *Textbook of Microbiology*. Orient Longman.
2. Belsche, R.B. (1991). *Textbook of Human Virology* (2nd edn.). Mosby, St.Louis.
3. Dimock, N & L. Primrose (1987). *Introduction to Modern Virology* (3<sup>rd</sup> ed.). Oxford Blackwell.

4. Duerdon, D. L. & Dresser, B.S. (eds). (1991). *Anaerobes in Human Disease*. London Arnold.
5. Emmons *et al.* (1997). *Medical Mycology*. Lea and Febiger, Philadelphia.
6. Goodfellow, M & R.G. Board (ed). (1989). *Microbiological Classification and Identification*.
7. Grady F.O, H.P. Lambert, R.G. Finch, & G. Greenwood. (1997). *Antibiotic and Chemotherapy; Anti-infective Agents and their Use in Therapy* (7<sup>th</sup> ed.). Churchil Livingstone, NY.
8. Kwon-Chung, K. J & J.E. Bennet. (1992). *Medical Mycology*. Lea & Febiger, Philadelphia,
9. Larone, D. H.1980. *Laboratory Handbook of Medical Mycology*. Academic press New York.
10. Mims C. A. & D. O. White. (1994). *Viral Pathogenesis and Immunology*. Oxford. Blackwell.
11. Monica Cheesbrough. (1991). *Medical Laboratory Manual for Tropical Countries*.  
Vol.2.ELBS
12. Panicker, C. K. J. (1998). *Textbook of Medical Parasitology*. Jaypee. New Delhi.
13. Plenum, NY. Topley W.W.C. & G. Wilson. (2002). *Principles of Bacteriology, Virology and Immunity. Systematic Bacteriology* (8th ed.). BWW Publishers.
14. Szanislo, P. J. (edn) (1985). *Fungal Dimorphism; with Emphasis on Fungi Pathogenic for Humans*.
15. White, D.C. and F.J. Fenner. (2004). *Medical Virology* (4<sup>th</sup> ed.) Academic Press, New York.





**Mar Athanasius College (Autonomous), Kothamangalam**  
**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology				
Course Name	Marine Microbiology				
Type of Course	DSE				
Course Code	M24ZY6DSE302				
Course Level	300				
Course Summary	Marine Microbiology explores the diverse and complex world of microorganisms in marine environments. This course provides students with a comprehensive understanding of the oceanography, marine microbial habitats, microbes and their physiology, and the roles of microbes in oceanic ecosystems. This course also addresses tools and technologies used in marine microbiology, including the study of microbial interactions.				
Semester	6	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		4	-	-	-
Pre-requisites, if any	Basic knowledge in Marine habitat and Microorganisms				

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Explain the various aspects of Oceanography	K, U	2
2	Compare the Physico-chemical parameters favouring the life of marine microbes	E, C	2
3	Create an awareness on various phenomena happening in the marine ecosystems	C	5
4	Understand the biogeochemical processes mediated by marine microbes	U	2, 5
5	Apply modern techniques to study marine microbial communities and their functions	A	4, 5
6	Understand the use of Molecular approaches in marine microbial assays	U	4

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**  
**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Introduction to oceanography: the world's oceans and seas, properties of seawater, physico-chemical factors in the marine environment such as temperature, density, nutrients, salinity, dissolved gases, waves, tides, oceanic currents, Ekman transport and upwelling	1, 2, 3	15
	1.2	Oceanic phenomena such as Coriolis effect, eddies, gyres, El Nino Southern Ocean (ENSO), El Nino, La Nina		
		Marine microbial habitats: estuaries, mangroves, salt marshes, beach and coastal ecosystems, reef and coral reefs,		



		water column, sediments.		
2	2.1	Marine microbes: Modes of microbial growth: viable but non-culturable (VBNC) microorganisms, biofilms, microbial mats, epibiosis.	4, 5	15
	2.2	Physiology of marine microbes: metabolic diversity and energy- yielding processes: microbial loop; marine snow; phototrophy and primary productivity		
	2.3	Fermentation, aerobic respiration, anaerobic respiration (denitrification, sulphate reduction, methanogenesis), nitrification, annamox, sulphur oxidation, methanotrophy		
	2.4	Carbon dioxide fixation in autotrophs		
	2.5	The role of microorganisms in biogeochemical cycling: carbon, nitrogen, phosphorous, sulphur, iron, manganese		
3	3.1	Methods in marine microbiology: Sampling equipment: water samplers such as Niskin sampler, Hydro-Bios sampler, Rosette samplers; sediment samplers such as van Veen grabs and corers	5, 6	15
	3.2	Analysis of primary productivity: the radiocarbon method Analysis of bacterial productivity: the thymidine uptake method Measurement of respiration rates: light-dark bottle method		
	3.3	Tools to study marine microbial diversity: flow cytometry (bacteria, picoplankton, picoeukaryotes, viruses) Molecular approaches such as metagenomics, community fingerprinting and Fluorescence in situ hybridization (FISH)		
4		Activity	2, 4, 5	15
	4.1	Write a report on the methods used in marine microbiology		
	4.2	Document any 10 marine microbes in estuary and mangroves/ sediments or salt marshes Identify 5 marine micro fauna and 5 marine microflora using diagrams		
	4.3	Visit to any two marine microbial habits- estuary, marshes, mangroves Visit to a marine microbiology lab		
5		Teacher Specific Module		

#### MODE OF EVALUATION AND ASSESSMENT

<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 30 marks Quiz, Test Papers, seminar	<b>B. End Semester Examination</b> Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks
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#### Recommended readings:

1. Belkin, S. and Colwell, R. R., *Ocean & health: Pathogens in the Marine Environment*, Springer.
2. Hunter-Cevera, J., Karl, D. and Buckley, M., *Marine Microbial Diversity: the key to Earth's habitability*, American Academy of Microbiology.
3. Meller, C. B. and Wheeler, P. A., *Biological Oceanography*, Wiley-Blackwell Publishers
4. Mitchell, R. and Kirchman, D. L. *Microbial Ecology of the Oceans*, Wiley-Blackwell Publishers.
5. Munn, C. *Marine Microbiology: ecology and applications*, Garland Science, Taylor and Francis group, N.Y.
6. Oliver, J. D. (1982) *Taxonomic scheme for the identification of marine bacteria by Deep Sea Research Part A*. *Oceanographic Research Papers*, 29 (6): 795 -798.





**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc. (Honours) Zoology				
Course Name	Apiculture and Sericulture				
Type of Course	SEC				
Course Code	M24ZY6SEC300				
Course Level	300				
Course Summary	This course provides an in-depth knowledge on the techniques, and practices involved in beekeeping (apiculture) and silk production (sericulture). It covers the biology and behaviour of bees and silkworms, the management of bee colonies and silk farms, and the processing and utilization of bee products and silk.				
Semester	6	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3	-	-	-
Pre-requisites, if any	Basic knowledge on Honey bees and Silkworm				

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the biology, behaviour, and lifecycle of bees and silkworms	U	1, 4
2	Demonstrate proficiency in beekeeping and silk production techniques	U, An	1, 4
3	Apply sustainable practices and ethical principles in apiculture and sericulture	A	1, 4
4	Analyse the economic, environmental, and social implications of beekeeping and silk production	A	3, 4, 5
5.	Develop entrepreneurial skills and innovative approaches to bee and silk-based enterprises	S	4, 5

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	History, Classification and Biology of Honey Bees, Social Organization of Bee Colony, Artificial Bee	1, 2, 3	15
	1.2	Rearing (Apiary), Beehives – Newton and Langstroth, Bee Pasturage, Selection of Bee Species for Apiculture, Bee Keeping Equipment, Methods of Extraction of Honey (Indigenous and Modern)		15
	1.3	Bee Diseases and Enemies, Control and Preventive measures		
	1.4	Bee Economy: Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen		
	1.5	Entrepreneurship in Apiculture: Bee Keeping Industry – Govt initiatives and recent efforts, Modern methods in employing artificial Beehives for cross pollination in horticultural gardens		
2	2.1	Sericulture: Definition, history and present status; Silk	2, 4, 5	15


		route, Types of silkworms, Distribution and Races, Exotic and indigenous races; Mulberry and non-mulberry Sericulture		
	2.2	Life cycle of <i>Bombyx mori</i> , Structure of silk gland and secretion of silk, Selection of mulberry variety and establishment of mulberry garden Rearing house and rearing appliances, Disinfectants: Formalin, bleaching powder, RKO, Silkworm rearing technology: Early age and Late age rearing Types of mountages; Spinning, harvesting and storage of cocoons, Pests of silkworm: Uzi fly, dermestid beetles and vertebrates, Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial Control and prevention of pests and diseases		
	2.3	Entrepreneurship in Sericulture Prospectus of Sericulture in India: Sericulture industry in different states, employment Potential in mulberry and non-mulberry sericulture.		
3		Activity	2, 5	15
	3.1	Document different tools used in honey extraction and bee hive maintenance		
	3.2	Visit to Aquaculture unit and document the culture fishes		
	3.3	Visit to a sericulture unit and prepare a report on different steps in the production of silk		
	3.4	Visit to an apiary and observe the composition of the honey comb and write a report on the types of honey bees and the steps in apiculture		
4		Teacher Specific Module		

#### MODE OF EVALUATION AND ASSESSMENT

<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks
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#### **Recommended reading**

1. Bisht D.S., Apiculture, ICAR Publication.
2. Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore
3. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan1972.
4. Improved Method of Rearing Young age silkworm; S. Krishnaswamy, reprinted CSB, Bangalore, 1986.
5. Manual of Silkworm Egg Production; M. N. Narasimhanna, CSB, Bangalore 1988.
6. Manual on Sericulture; Food and Agriculture Organisation, Rome 1976
7. Prost, P. J. Apiculture. Oxford and IBH, New Delhi.
8. Selby C. Beekeeping: A Beginner's Guide To Backyard Beekeeping. 2<sup>nd</sup> Edition
9. Silkworm Rearing and Disease of Silkworm, 1956, Ptd. By Director of Ptg., Stn. & Pub. Govt. Press, Bangalore
10. Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi.

	<b>Mar Athanasius College (Autonomous), Kothamangalam</b>
	<b>FYUGP SYLLABUS</b>
Programme	B Sc. (Honours) Zoology
Course Name	Poultry Science

Type of Course	VAC				
Course Code	M24ZY6VAC300				
Course Level	300				
Course Summary	Poultry Science is an interdisciplinary field that explores the biology, management, and production of poultry. This course provides an understanding of the principles and practices involved in the efficient and ethical production of poultry products. Students will learn about poultry prod and health management.				
Semester	6	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3	-	-	-
Pre-requisites, if any	Basic knowledge in Animal Science				

### COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Demonstrate comprehensive knowledge of the poultry	U, An	1, 3
2	Identify the nutrient requirements of poultry and develop balanced feed formulations to optimize poultry health and productivity	A, An	3
3	Recognize common poultry diseases and understand their prevention and control measures	An	1, 3
4	Analyse and practice various poultry product technologies	A	5, 6
5	Understand the quality standards of poultry products	U	3, 5, 6

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

### COURSE CONTENT Content for classroom transaction (Units)

Module	Units	Course Description	CO No.	Hours
1	1.1	Essential amino acids, proteins, fatty acids, vitamins and minerals their inter-relationships. Functional regulation of digestion, absorption and metabolism of nutrients.	1, 2	15
	1.2	Feed formulation for different species and groups Different systems of feeding wet mash, dry mash, crumble and pellet feeding. Feed Passage rate in G.I. tract in relation to digestion and absorption efficiency;		
	1.3	Characteristics features of endocrine glands. Endocrine control and variable factors influencing growth process		
2		Poultry Products technology: Structure, chemical composition and nutritive value of egg. Various measures of egg quality. Shell, albumen and yolk quality assessment. Factors influencing egg quality traits. Mechanism of deterioration of egg quality.	4, 5	15
		Different methods of preservation of table eggs and their relative merits and demerits.		
		Physical, chemicals, microbial and organoleptic evaluation of meat quality		
3	3.1	Poultry Health Management: Common diseases of poultry – bacterial, viral, fungal, protozoan, parasitic and other emerging diseases of poultry, their prevention, control and treatment.	2, 3, 5	15

	3.2	Metabolic and nutrient deficiency diseases and disorders.		
	3.3	Vaccination programmes and deworming programmes. Control of coccidiosis, worms, ectoparasites and flies. Medication procedures. Cleaning and disinfection of poultry houses. Drinking water sanitation		
		Activity		
		Estimation of amino acids/proteins/fatty acids in feed Estimation of albumen/yolk quantity in eggs Estimation of calcium in egg shell. Estimation of carotenes/cholesterol/peroxides in meat of chicken.	5	
		Poultry farm visit		
4		Teacher Specific Module		

<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x 1 = 10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

#### **Recommended reading**

1. Aggrey, S. E., & Muir, W. M. (2003). *Poultry genetics, breeding and biotechnology*. CABI.
2. Barrow, P. A. (2021). *Poultry health: A guide for professionals*. CABI.
3. Crawford RD. 1990. Poultry Breeding and Genetics. Elsevier.
4. Einsminger ME. 1992. Poultry Science. Poultry International Book Distributing Co.
5. Guerrero-Legarreta, I. (2010). *Handbook of poultry science and technology*. John Wiley.
6. Mac O' North & Bell D. 1990. Commercial Chicken Production Manual. 4th Ed. Avi Publ. Co. Inc., Westport, Connecticut.
7. Mountney GJ & Parkhairst CR. 1995. Poultry Products Technology. 3rd Ed. AVI publ.
8. Nollet, L. M. L. (2012). *Handbook of meat, poultry and seafood quality* (2nd ed.). Wiley.
9. Poultry Science Symposium & Hocking, P. M. (2009). *Biology of breeding poultry*. CABI.
10. ScienceDirect (Online service) & Van Alfen, N. K. (2014). *Encyclopedia of agriculture and food systems* (Second edition.). Elsevier.
11. Singh RA & Panda B. 1992. Poultry Production. Kalyani Publishers.
12. Singh RP & Kumar J. 1994. Biometrical Methods in Poultry Breeding. Kalyani.



# Semester 7



**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc (Honours) Zoology					
Course Name	Biotechnology					
Type of Course	DCC					
Course Code	M24ZY7DCC400					
Course Level	400					
Course Summary	This course provides an introductory exploration of the basic principles, techniques, and applications of biotechnology across various fields. It covers essential topics in molecular biology and genetic engineering, offering students a foundational understanding of biotechnological concepts and their practical applications.					
Semester	7	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	-	1	-	75
Pre-requisites, if any	Basic knowledge in Biotechnology					

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Recall the basic concepts of techniques in biotechnology	K	3
2	Understand the properties and types of cloning vectors	U	3
3	Assess the methods used in the screening of transformants and non-transformants	An	3, 5
4	Appreciate the tools and techniques in animal cell culture	Ap	3, 4, 5
5	Discover the latest trends in Biotechnology and its applications	An, C	4,5
6	Apply the techniques in biotechnology for environment & human welfare	A	5,6

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Historical aspects, definitions, and scope of Biotechnology.	1, 2	15
	1.2	Tools and Techniques in Recombinant DNA Technology: Vectors: cloning and expression vectors - Plasmids, Ti and Ri plasmids, cosmids, phasmids, phagemids, bacteriophage, SV40, vectors with combination features; PUC19 and Blue script vectors, shuttle vectors, viral vectors, BAC and YAC vectors. Restriction enzymes and DNA modifying enzymes		
	1.3	Polymerase chain Reaction- different types and applications		
	1.4	Molecular Markers and Probes-SNP, VNTR, RAPD, RFLP, SSR, STMS, FISH and GISH.		
2	2.1	DNA Sequencing: DNA sequencing methods- Maxam and Gilberts chemical degradation method, Sanger and Coulson method Automated DNA sequencers Site directed mutagenesis, molecular chimeras	5, 6	15
	2.2	Cloning Methodologies		



		Genome libraries, cDNA libraries		
	2.3	Splicing and integration of isolated gene- cohesive end ligation, homopolymer tailing, extending linkers. Methods of rDNA transfer to host cells- CaCl <sub>2</sub> treatment, Virus delivery		
	2.4	Selection and screening of the transformed cells, Blue-white screening, Colony hybridization methods, Reporter genes, Fusion proteins.		
	2.5	Blotting techniques- Southern, Northern, Western, Dot Blot, DNA finger printing		
3	3.1	Cell and Tissue culture: Basic techniques of mammalian cell culture, disaggregation of tissue and primary culture, maintenance of cell culture.	4	15
	3.2	Growth media: Physicochemical properties, natural and artificial media, Balanced salt solutions, Complete Media, Serum, Serum-Free Media and protein free media and their applications.		
	3.3	Biology and characterization of cultured cells, measurement of viability and cytotoxicity.		
	3.4	Stem cell culture: General and historical aspects, properties and types of stem cells, advantages and disadvantages, stem cell niche, application of stem cell technology in medicine.		
	3.5	Source of contamination, Type of microbial contamination, Monitoring, Eradication of contamination, Cross-Contamination. Cryopreservation - importance and process of cryopreservation.		
4		Practical	5, 6	30
	4.1	Blotting techniques (Any one)		
	4.2	Steps in Cloning (Videos/ images / Photographs) Comparison Cloning vector and expression vector (Anyone) using photographs or images/ Animated videos DNA fingerprinting steps and comparison (Photographs or image) Blue and white screening photographs and its significance		
	4.3	Isolation of plasmid DNA from Bacteria, PCR		
	4.4	Visit to a cell culture lab and prepare a report on various cell lines		
5		Teacher Specific Module		


<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

**Recommended readings:**

1. Dale, Jeremy W and Schantz, Malcom V. (2002). *From Gene to Genomes*. John Wiley and Sons Ltd, NY. USA
2. Das, H. K. (2007). *Textbook of Biotechnology*. Wiley India Pvt. Ltd. New Delhi

3. Doyle, Alan & Griffith Bryan J. (1999). *Cell and Tissue Culture- Laboratory Procedures in Biotechnology*. Wiley International. NY.
4. Freshney, Ian, R. (2006). *Culture of Animal Cell* (5th ed.). Wiley- Liss publications.
5. Pandian, T. T. & Kandavel, D. (2008). *Textbook of Biotechnology*. I. K International Publishing House. New Delhi.
6. Primrose, S. B., Twyman, R.M., & Old, R.W. (2001). *Principle of Gene Manipulation* (6th ed.). Blackwell Science Ltd, London.
7. Singh. B. D. (2006). *Biotechnology*. Kalyani Publishers, New Delhi.
8. Sobti, R. C. & Pachauri, Suparna S. (2009). *Essentials of Biotechnology*. Ane Books Pvt. Ltd. New Delhi.
9. Thakur, I. S. (2011). *Environmental biotechnology-Basic concepts and applications*. (2nd ed.). I. K. International Pvt. Ltd.



	<b>Mar Athanasius College (Autonomous), Kothamangalam</b>				
<b>FYUGP SYLLABUS</b>					
Programme	B Sc (Honours) Zoology				
Course Name	Biostatistics				
Type of Course	DCC				
Course Code	M24ZY7DCC401				
Course Level	400				
Course Summary	This is a fundamental course that introduces students to the application of statistical methods and principles in the field of biological sciences. This course provides an in-depth understanding of how to design biological experiments, analyse data, and interpret results using statistical techniques.				
Semester	7	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		4	-	-	-
Pre-requisites, if any	Basic knowledge in Mathematics				

### COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the scope, significance, and steps in statistical analysis	U	5
2	Create enthusiasm and awareness about various statistical tools, techniques, and accessories in biological process	C	5
3	Equip the students how to make use of various statistical methods to analyse different types of data in research	S	4, 5
4	Practice analytical and critical thinking through problem solving	An, E	5
5	Equip the students to interpret any data using the statistical methods studied	An, S	5
6	Discover various mathematical and statistical tools in the analysis of biological data	C	5

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

### COURSE CONTENT Content for classroom transaction (Units)

Module	Units	Course Description	CO No.	Hours
1	1.1	Characteristics of scientific research: Qualitative studies, quantitative studies, longitudinal studies, experimental studies and survey studies. Stating hypothesis or research question, concepts and constructs, units of analysis and characteristics of interest, independent and dependent	1, 2, 3	15

		variables, extraneous or confounding variables. Primary and secondary data, different types of data: quantitative and qualitative data, continuous and discrete data, time series and cross-sectional data, methods of collection of primary data, sources of secondary data. Designing a questionnaire. Levels of measurement: Nominal, ordinal, interval and ratio.		
	1.2	Concepts of statistical population and sample, complete enumeration and sampling, probability and non-probability sampling, simple random sampling and stratified random sampling (Outline only). Determination of sample size.		
	1.3	Design of Experiments: Planning of experiments: Basic principles of experimental design, uniformity trials. Completely Randomised Design (CRD), Randomised Block Design (RBD), Latin Square Design (LSD), Factorial experiments, Split plot experiments.(Only the concepts and outline of the designs are needed)		
2	2.1	Measures of central tendency: Arithmetic Mean (AM), median, mode and partition values. Measures of dispersion: Range, Quartile Deviation (QD), Mean Deviation (MD) and Standard Deviation (SD), Coefficient of Variation (CV). Diagrams and Graphs: Pictogram, Bar diagrams, pie diagram, Box Plot, Stem and Leaf plot and frequency graphs.	2, 4	15
	2.2	Introduction to Bivariate data. Correlation, scatter diagram, Karl Pearson's correlation coefficient, Spearman's rank correlation coefficient.		
3	3.1	Simple linear regression. Method of least squares. Curve fitting. Exponential and power curves. Coefficient of determination.	1, 3	15
	3.2	Probability and Distributions: Sample space. Events. Probability and conditional probability. Addition and multiplication theorems of probability. Probability distributions- Binomial, Poisson and normal distributions. Illustrations.		
4	4.1	Introduction to Statistical Inference: Parameter vs statistic. Estimation vs testing. Point estimation vs interval estimation. Hypothesis and types, Methods and Errors. Tests of significance (For large and small samples – Critical Ratio and P value). Z Test (Problem for small samples) Chi- Square Test – test of independence and goodness of fit (Problem for 2×2 table only). Student's t test (Problem for small samples comparing mean of two variable). F-test, Analysis of Variance (ANOVA - One way) Kruskal Wallis test. , Mc Nemar and Mann Whitney U test Test of Significance: Statistical hypothesis. Type-1 and Type-2 errors, level of significance, size and power of a test. Definition of Chi-square, t and F distributions. Central limit theorem. Tests for the mean, equality of two means, variance (for large and small samples). Large samples tests for proportions.	5, 6	15
	4.2	Chi-square test for goodness of fit and for independence of attributes in contingency tables. Confidence interval		
5		Teacher Specific Module		

**MODE OF EVALUATION AND ASSESSMENT**

<b>A. Continuous Comprehensive Assessment (CCA)</b>	<b>B. End Semester Examination</b> Theory Total = 70 marks, Duration 2 hrs
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Theory Total = 30 marks  
Quiz, Test Papers, seminar

Part A (Short answer) – 10 out of 12 x 2 = 20 marks

Part B (Short essay) – 6 out of 9 x 5 = 30 marks

Part C (Long essay) – 2 out of 4 x 10 = 20 marks

### Recommended reading

1. Cambell. R.C. (1967). *Statistics for Biologists*. Cambridge University Press. UK
2. Daniel, W. W., Cross, C. L. (2013). *Biostatistics: A Foundation for Analysis in the Health Sciences*. Singapore: Wiley.
3. Fry J.C. (1993). *Biological data analysis, a practical approach*. IRL Press, Oxford, U.K
4. Glantz, S. (2011). *Primer of Biostatistics* (7<sup>th</sup> ed.). United States: McGraw-Hill Education.
5. Snedecor P.S. (2000). *Statistical Methods*. Affiliated East-West press. New Delhi.
6. Zar, J. H. (2014). *Biostatistical Analysis*. United Kingdom: Pearson Education Limited.





**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc (Honours) Zoology					
Course Name	Computer Applications and Bioinformatics					
Type of Course	DCC					
Course Code	M24ZY7DCC402					
Course Level	400					
Course Summary	This course is designed to introduce the essential computer skills and applications commonly used in various professional and personal contexts. It covers fundamental concepts, software tools, and practical techniques to enhance digital literacy and productivity. In addition, the Bioinformatics module provides an interdisciplinary approach to the analysis and interpretation of biological data using computational tools and techniques.					
Semester	7		Credits			Total Hours
Course Details	Learning Approach	Lecture 4	Tutorial -	Practical -	Others -	
Pre-requisites, if any	Basic knowledge in science					

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Analyse the advantages of using computers in the statistical analysis of data generated by studies and experiments	An	5
2	Create enthusiasm and awareness about Computational tools, techniques and accessories in biological research	C	4, 5
3	Familiarise with the biological data bases	U	4, 5
4	Create an awareness on DNA sequence analysis	C	5
5	Discover the latest computer applications in Biological science and daily life computational tools to	An, A	4, 5
6	Motivate the students to understand the trends in genomics and proteomics	I	5, 6

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1		Computer Applications	1, 2, 3	15
	1.1	Basics of Computers: Types of Computers. Binary Number System, Digital and Analog systems. Hardware/Software/Firmware.		
	1.2	Hardware Basics: Memory -Classification and Types of memory; memory devices; Units. Input Devices -Types, working and functions. Output Devices –Types, working and functions.		
	1.3	CPU components - Processors, Mother boards, SMPS, Accessory Cards – Graphic /Sound/ Networking/ Bluetooth/Wi-fi (Brief account only).		
	1.4	New Generation Computers - Servers, Laptop; Palmtop; Cyborgs; Robotics, Zoobotics (Brief account only).		

2	2.1	Software Basics: System Software/Operating System - System Files; Working of OS; DOS, Widows, Linux and UNIX (Brief account only). Application Software -Programs and Packages, Calculator, MS Paint, MS Word, MS Excel, MS PowerPoint, Publisher, Acrobat Reader, E Book Reader, Explorer, Photoshop. Virus and Antivirus (Brief account only). Statistical Software (MS Excel, PH Stat, SPSS). MS Access and R programming (Brief account only).	2, 3, 5	15
	2.2	Networking, Internet and Information Technology: Computer Communication -Network Topology, Media of networking, Networking Protocols, PAN, LAN, WAN, MAN, INFLIBNET, Modem and Gateway.		
	2.3	Internet and Internet Services -World Wide Web, Uploading, Downloading, Hosting, Portal, Search Engines, Firewall. Cyber Crime and Cyber Laws, Cyber security (Brief account only).		
3	3.1	Computer applications in biological science and daily life: Global Information System -BIOSIS, Medline and Medlars, AGRIS; E Journals and E Books Publishing.	3, 6	15
	3.2	Mobile applications in biology- Complete biology, Biology dictionary,		
4		Bioinformatics	4, 5, 6	15
	4.1	Introduction to Bioinformatics: Computation biology, Bioinformatics, applications of bioinformatics and scope of bioinformatics.		
	4.2	Biological Databases: Primary databases - Nucleotide sequence databases: GenBank, EMBL, DDBJ; Protein sequence databases: SWISSPROT, PIR; Structure databases: PDB, NDB; Secondary databases: PROSITE, Pfam, CATH; Composite databases: OWL; Literature database: PubMed; Database searching – Entrez; Database sequence submission – BankIt.		
	4.3	Sequence Analysis: Types of sequence alignment, methods of sequence alignment, scoring schemes, gaps and gap penalties, construction of phylogenetic trees.		
	4.4	Genomics and Proteomics: Structural genomics, functional genomics, comparative genomics, data mining in proteomics		
		Activity Use of excel sheet for data processing Use of search engines like Scopus, Science direct for reference material collection and management. Nucleic acid and protein sequence databases Data mining for sequence analysis. Web– based tools for sequence searches and homology screening. Annotations: ORF finder, Use of ARTEMIS or any other suitable software. Construction of phylogenetic trees for DNA and proteins. Identification of peptide fingerprint by nano LC- MS/MS and database search using MASCOT and OMSSA Primer designing for gene amplification and gene cloning	2, 3	
5		Teacher Specific Module		

**MODE OF EVALUATION AND ASSESSMENT**

<p><b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 30 marks Quiz, Test Papers, seminar</p>	<p><b>B. End Semester Examination</b> Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks</p>
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### Recommended Readings

1. Alberghina, L & H.V. Westerhoff (Eds). (2008). *Systems Biology-Definitions & Perspectives*. Springer-Verlag, Berlin.
2. Anitha Goel. (2010). *Computer Fundamentals*. Pearson Education India.
3. Attwood T.K. & Parry Smith, D. (2006). *Introduction to Bioinformatics*. Pearson Education.
4. Bourne P. E. & Weissig H. (2003). *Structural Bioinformatics*. Wiley -Liss. USA
5. David W. M. (2004). *Bioinformatics, Sequence and Genome Analysis* (2nd edn). CSHP, New York
6. Krane, D. E & M. L. Raymer. (2006). *Fundamental concepts of Bioinformatics*. Pearson Education, New Delhi
7. Lesk A. M. (2005). *Introduction to Bioinformatics*. Oxford Press, New Delhi
8. Masaru Tomita and Takaai Nishioka. (2005). *Metabolomics. The Frontier of Systems Biology*. Springer Japan.
9. Pengcheng Fu and Sven Panke, (Eds.). (2009). *Systems Biology and Synthetic Biology*. John Wiley & Sons, Inc. NJ, USA
10. Pradeep Sinha & Priti Sinha. (2010). *Computer Fundamentals*. BPB Publications., New Delhi.
11. Rajathi A. & P. Chandran. (2010). *SPSS for You*. MJP Publishers, Chennai.
12. Shane Torbert. (2011). *Applied Computer Science*. Springer-verlag, New York.
13. Sudipto Das. (2010). *A Complete Guide to Computer Fundamentals*. Lakshmi Publishers (P) Ltd. New Delhi
14. Tisdall J. D. (2001). *Beginning Perl for Bioinformatics*. O'Reilly Media Inc. CA, USA
15. Vikram Singh and Pawan. K. Dhar. (2015). *Systems and Synthetic biology*. Springer Publications. New York.





**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc (Honours) Zoology					
Course Name	Animal Reproduction and Breeding					
Type of Course	DCE					
Course Code	M24ZY7DCE400					
Course Level	400					
Course Summary	This course explores the physiological, biochemical, and molecular mechanisms governing reproduction in animals. This course focuses on the structural diversity of reproductive systems across a wide range of animal species, fertilization in mammals and animal breeding.					
Semester	7	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	-	-	-	60
Pre-requisites, if any	Basic knowledge in science					

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the fundamental principles of comparative reproductive anatomy	U	1, 3
2	Identify and describe the reproductive structures in various animal species	U, An, E	1, 3, 5
3	Analyse the evolutionary adaptations of reproductive systems	An	2
4	Apply comparative anatomical knowledge to practical and research contexts	A	1, 3, 5
5	Explain the hormonal regulation and physiological processes involved in reproduction	K, U	1, 3
6	Equip the students to Practice the animal breeding techniques and make use of lessons from genetics for breeding efficiency	I, S	1, 3, 5

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Invertebrates: Reproduction in Coelenterates, Annelida and Arthropoda with special reference to insects, male and female reproductive systems, hormones, pheromones and their role in sex differentiation and gonadal activity.	1, 2, 3	15
	1.2	Mollusca and Echinodermata: Male and female reproductive systems, Gamete diversity		
	1.3	Vertebrates: Reproduction in vertebrates: Fishes, Amphibians, Reptiles and Birds: Male and female reproductive systems, Reproductive patterns - Ovipary, Ovo-vivipary and vivipary.		
2	2.1	The Female Reproductive System in mammals: Comparative anatomy and physiology of the mammalian ovary and ductal system. Follicular growth, Ovarian	4, 5	15

		hormones, two cell theory of Estrogen biosynthesis. Autocrine, Paracrine, Endocrine regulation of Ovarian functions.		
	2.2	The Male Reproductive System in mammals: Comparative anatomy and physiology of the Mammalian testis and sex accessory glands: Function and organization of Testis, Spermatogenic cycle, Testicular androgens, Autocrine, Paracrine, Endocrine regulation of Testicular function, semen and its biochemical nature.		
3	3.1	Fertilization in Mammals: Pre-fertilization events, biochemistry of fertilization and post- fertilization events. Implantation and its hormonal regulation, delayed implantation. Placenta as an endocrine tissue; foeto-placental Module. Gestation and its hormonal regulation.	2, 5	15
	3.2	Regulation of mammalian reproduction: The Pituitary gonadal axis, The hypothalamus and its neuro secretory centers. The phenomenon of neuro-endocrine integration and the hypothalamus hypophyseal gonadal axis, mammary gland, endocrinology of lactation.		
4	4.1	Animal Breeding: Concepts, development and applications breeds and breed structure, basic breeding methods; Silkworm, sheep and poultry and cattle	6	15
	4.2	Genetic principles in animal breeding, heredity and environment, Heritability, repeatability, methods of their estimations; genotypic, phenotypic and environmental correlations. Traits for selection, breeding efficiency and inbreeding, out breeding, top crossing, grading, cross breeding, criss- crossing, triple crossing system		
	4.3	Artificial insemination, infertility and assisted reproduction		
		Activity Visit of Animal farm / Fish breeding station and record the species- breeds- herd strength and characteristics, Visit to Veterinary university and study the steps in animal breeding (Sheep or Cattle/ Poultry): Prepare a report on common tools used in breeding Compare the permanent slides of testis and ovary of Frog and Human Prepare a sperm smear of testis of fish and observe under microscope Sperm counting using counting chamber – Use sperm smear of fish	1, 6	
5		Teacher Specific Module		

<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 30 marks Quiz, Test Papers, seminar	<b>B. End Semester Examination</b> Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

**Recommended readings:**

1. Balinsky, B. I. (1981). *An Introduction to Embryology* (5th ed.). W. B. Saunders Co. West Washington Square, Philadelphia.

2. Bodemer, C. W. (1968). *Modern Embryology*. Holt, Reinhart Winston Inc. NY. Chicago.
3. Dalton, D. C. (1987). *An Introduction to Practical Animal Breeding*. English Language Book Society Collins.
4. Enerjee, G. C. (1987). *A text Book of Animal Husbandry* (6<sup>th</sup> ed.). Oxford and IBH Pub. Co. NY. Delhi, Calcutta & Mumbai.
5. Gordon I. (1983). *Controlled Breeding in Farm Animals*. Paragon Press, Oxford, NY & Sydney
6. Hafez, E. S. E. (1987). *Reproduction in Farm Animals* (5th ed.) Lea & Febigar, Philadelphia.





**Mar Athanasius College (Autonomous), Kothamangalam**  
**FYUGP SYLLABUS**

Programme	B Sc (Honours) Zoology					
Course Name	Biosafety, Bioethics, and IPR					
Type of Course	DCE					
Course Code	M24ZY7DCE401					
Course Level	400					
Course Summary	Biosafety, Bioethics, and Intellectual Property Rights (IPR) is a comprehensive course that explores the ethical, legal, and practical considerations surrounding the conduct of biological research and innovation. The course covers principles and practices related to biosafety and biosecurity, bio-ethical considerations in biological research and applications, and the protection and management of intellectual property rights in the life sciences.					
Semester	7	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
Pre-requisites, if any		4	-	-	-	60
	Basic knowledge in Science					

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the principles and practices of biosafety and biosecurity in biological research	U	3, 5
2	Develop skill in the management biological wastes	S	5
3	Make use of Biosafety regulations, manuals and the Biosafety protocols in India	A	3, 6
4	Identify and analyse ethical issues and dilemmas in the life sciences.	K, U	5, 6
5	Recognize the importance of intellectual property rights in promoting innovation and technology transfer in the life sciences	U, Ap	6
6	Apply ethical, legal, and regulatory frameworks to address biosafety, bioethics, and IPR challenges in biological research and innovation	A, An	5, 6

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Introduction and development of biosafety practices, Definitions and biosafety levels	1, 2, 3	15
	1.2	General lab requirements Good Laboratory Practice (GLP) and Good Manufacturing Practice (GMP), Application of GMP in biosafety, especially in pharmaceuticals.		
	1.3	Biological safety cabinets: function and use		
	1.4	Shipment of biological specimens		
	1.5	Biological waste management, decontamination		

	1.6	Biosafety manuals, medical surveillance, emergency response, biosafety protocol 2000 Bio safety regulation: handling of recombinant DNA products and process in industry and in institutions (Indian context) Biosafety assessment procedures in India and abroad Role of Public and Non-Governmental Organizations (NGOs)		
	1.7	Guidelines for research in transgenic plants and animals.		
2	2.1	What is Bioethics? Principles of bioethics: autonomy, beneficence, justice, non- maleficence, legality, morality and ethics, autonomy, human rights etc. Ethical conflicts in biotechnology - interference with nature, unequal distribution of risk and benefits of biotechnology Legal and Socio- economic Impacts of Biotechnology.	4, 5	15
	2.2	Ethical Issues in Genetically Modified Organisms: Foods and Crops. Use of Genetically Modified Organisms and their Release in the Environment, their Handling and Disposal. General guidelines for recombinant DNA research activity.		
	2.3	Stem cell research and ethical issues involved in stem cell research. animal cloning, human cloning and their ethical aspects. organ transplantation and ethical issues. Bioethics in biodiversity and resource management. ethical, legal and social implications of human genome project. Genetics studies on ethnic races.		
3	3.1	Use of animals in research and testing, and alternatives for animals in research-In-silico, in-vivo, in-vitro, ex-vivo, 3D printing	4	15
	3.2	Animal rights and animal laws in India- Prevention of cruelty to animals Act 1960 Wildlife protection act 1972 and Amendments, Biodiversity Act 2003.		
	3.3	Animal protection initiatives - Animal Welfare, Animal Welfare Board, India CPCSEA		
	3.4	Working with Humans, harm, risk, and benefits, Consent. Testing of Drugs on Human Volunteers. Children and Vulnerable people, Equality, Anonymity, Confidentiality.		
	3.5	Right to information Act 2005		
4	4.1	Introduction to Intellectual Property Rights, Types of IP: Patents, Trademarks, Copyrights. Advantages and Disadvantages of IPR. Intellectual Property Rights and Agricultural Technology, and their Implications for India and other Developing Countries. International Organizations and Intellectual Property Rights. Introduction to - GATT, WTO, WIPO and TRIPS.	3, 6	15
	4.2	Plagiarism. Need for plagiarism detection, plagiarism detection soft wares Artificial intelligence- ethical issues.		
	4.3	Basics of Patents, Types of patents; Indian Patent Act 1970; – amendments of 1999, 2000, 2002 and 2005.		

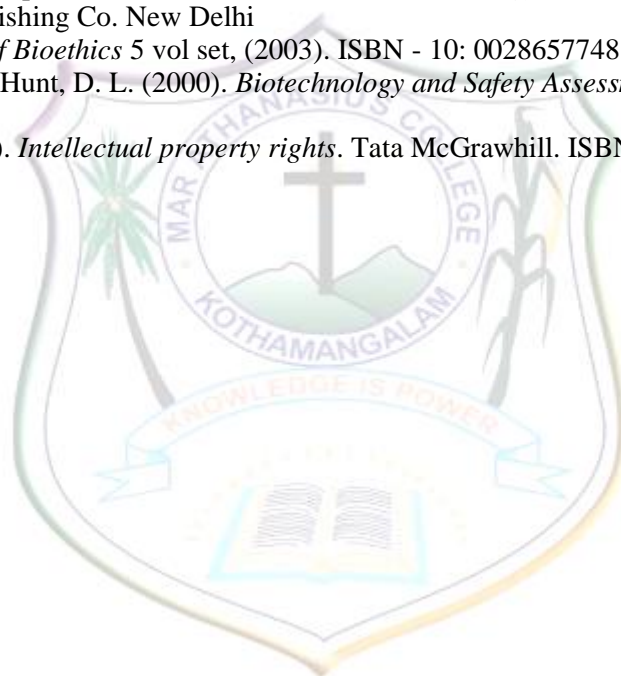
		Process Involved in Patenting. Patenting of Living Organisms Traditional Knowledge, their commercial exploitation and protection. Infringement.		
5		Teacher Specific Module		

#### MODE OF EVALUATION AND ASSESSMENT

<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 30 marks Quiz, Test Papers, seminar	<b>B. End Semester Examination</b> Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks
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#### Recommended Readings

1. Beier, F. K., Crespi, R. S. & Straus, T. (1985). *Biotechnology and Patent protection*. Oxford and IBH Publishing Co. New Delhi
2. *Encyclopedia of Bioethics* 5 vol set, (2003). ISBN - 10: 0028657748
3. Fleming, D.A., Hunt, D. L. (2000). *Biotechnology and Safety Assessment* (3rd ed.) Academic press
4. Ganguli. (2001). *Intellectual property rights*. Tata McGrawhill. ISBN - 10:0074638602





**Mar Athanasius College (Autonomous), Kothamangalam**  
**FYUGP SYLLABUS**

Programme	B Sc (Honours) Zoology				
Course Name	Research Methodology				
Type of Course	DCE				
Course Code	M24ZY7DCE402				
Course Level	400				
Course Summary	This course provides a comprehensive introduction to the principles and practices of research methodology in science. It covers the essential steps in the research process, including the formulation of research questions, the design and implementation of studies, data collection and analysis, and the interpretation and presentation of research findings.				
Semester	7	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		4	-	-	-
Pre-requisites, if any	Basic knowledge in science				

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Recall the practices in future for further experiments	K	5
2	Compare the processes involved in scientific method and design of experiment	An	5
3	Address ethical issues in the conduct of research	U, I	5, 6
4	Analyse the importance of Review of literature and various Reference styling	An	5
5	Write and present research findings in a clear and professional manner	C, S	5
6	Develop scientific temper and research aptitude	S	5, 6

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**  
**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Research methodology: Nature of Research: Concept, Meaning and Definition. Introduction to research methods, concepts of research – basic v/s applied research, Historical and Descriptive/ Analytical Research, Conceptual and Experimental/ Empirical Research.	2, 6	15
	1.2	Research processes: Research design, identification of research gaps Research problems: Identification, selection and formulation of hypothesis, conceptualization of research problems, data tools and techniques		
2	2.1	Review of literature: Identification of sources of literature, Types of literature Collection and Review of research literature, and their	4	15

		evaluation Necessity and importance of review of literature Text reference and Back reference, Cross reference		
	2.2	Reference styling examples (API, MLA, Harward etc.) and concept of Research citation		
	2.3	Presentation of Research findings: Report/ thesis writing/ research correspondence General strategies for preparation of Research Proposal, Project proposal writing, Data representation in Technical Reports, Poster presentation in Scientific conferences and Workshops		
3	3.1	Academic search engines PUBMED, Google scholar, Science.gov, Preparation of manuscripts for national and international journals Yardsticks employed in evaluation of manuscripts for publication	1, 5, 6	15
	3.2	Types of research articles- Research review articles and original research articles		
	3.3	Impact factors, Thomson Routers and NCBI, SCI indexing. Citation index & impact factor of journals H index and H index formula i 10 index, g-index		
4		Activity	2, 6	15
	4.1	Prepare a research proposal on any topic of interest. Review of literature on the given topic using Search engines like Google Scholar Understanding of various reference styles- APA, MLA, Chicago, Harward etc		
	4.2	Prepare a poster and a Research paper on the given topic Submit a review paper on the given topic		
	4.3	Present a research paper / Poster in one conference or symposium Attend one national and international conference		
5		Teacher Specific Module		

<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 30 marks Quiz, Test Papers, seminar	<b>B. End Semester Examination</b> Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks


### Recommended reading

1. Louis Cohen, (2007). *Research Methods in Education* (6th ed.). Lawrence Manion, and Keith Morrison, Paperback Publications.
2. Robert K. Yin, (2003). *Case Study Research: Design and Methods: (Applied Social Research Methods)*. Paperback Publications.



3. Jane Ritchie and Jane Lewis, (2003). *Qualitative Research Practice: A Guide for Social Science Students and Researchers*. Paperback.
4. Stephen F. Davis, (2005). *Handbook of Research Methods in Experimental Psychology*, Black Well Publications. London.



	<b>Mar Athanasius College (Autonomous), Kothamangalam</b> <b>FYUGP SYLLABUS</b>
Programme	B Sc (Honours) Zoology
Course Name	Biodiversity Conservation and Management
Type of Course	DCE
Course Code	M24ZY7DCE403

Course Level	400					
Course Summary	This course provides an in depth knowledge of the principles, challenges, and strategies involved in the conservation of biodiversity. It covers ecological, social, and policy aspects of conservation biology, emphasizing the importance of preserving and restoring biodiversity at local, regional, and global scales.					
Semester	7	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	60
		4	-	-	-	
Pre-requisites, if any	Basic knowledge in science					

### COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Describe the concept of biodiversity	U, An	1, 2
2	Understand threats in biodiversity & strategies for biodiversity conservation	U	1, 2, 4
3	Make use of various conservation methods for sustainable development	A	4
4	Assess the threats of biodiversity	E	4, 5
5	Equip the students to Practice the strategies for sustainable development and lifestyle	S,I	4, 5, 6
6	Motivate them to practice the millennium development goals and strategies	I, Ap	5, 6

\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

### COURSE CONTENT Content for classroom transaction (Units)

Module	Units	Course Description	CO No.	Hours
1	1.1	Biodiversity-concepts and patterns. Distribution of biodiversity. Biodiversity hotspots and their characteristics, global distribution.	1, 2	15
	1.2	Types of biodiversity-wild biodiversity, agro-biodiversity, domesticated biodiversity. Values of biodiversity, ecosystem functions and biodiversity, mobile links and valuating ecosystem services.		
	1.3	Threats to biodiversity: Causes of biodiversity loss. Tools and techniques for biodiversity estimation-biodiversity indices, relative abundance, Species diversity and genetic diversity.		
2	2.1	Strategies for biodiversity conservation: <i>In-situ</i> conservation: sanctuaries, biospheres reserves, national parks, nature reserves, preservation plots. <i>Ex-situ</i> conservation: botanical gardens, zoos, aquaria, homestead garden; herbarium; <i>In-vitro</i> Conservation: germplasm and gene bank; tissue culture: pollen and spore bank, DNA bank. H.I.P.P.O, GEF-World Bank initiatives.	2, 3	15
	2.2	CBD, IPRs, National and international programmes for biodiversity conservation. CITES and TRAFFIC. Indian Biodiversity Act 2002 and laws, National Board of Biodiversity, State Board of Biodiversity. Ecosystem people		

		and traditional conservation strategies; People's participation in conservation-PFM, community reserve and People's Biodiversity Register (PBR). Biodiversity Management Committee (BMC). Wildlife values and eco-tourism, wildlife distribution in India, problems in wildlife protection-Policies and programmes. Threatened animals of India.		
3	3.1	Biological Invasions: Introduction Elton's hypothesis – Invasion patterns and process biological attributes for invasion: Reproductive potential, Allelopathy Phenotypic plasticity, fitness to the new environment.	4	15
	3.2	Hypotheses for invasion success: Natural enemy hypothesis evolution of invasiveness hypothesis, empty niche hypothesis, novel weapon hypothesis, disturbance hypothesis and Propagule pressure hypothesis. Invasive alien species of India (plants and animals).		
	3.3	Databases of biological invasions. Impacts and management of invasions: impacts of exotics on biodiversity, productivity, nutrient cycling.		
	3.4	Management: Bio-control programmes, mechanical and chemical control Positive utilization Quarantine and EIA of biological invasion.		
4	4.1	Conservation and Sustainable Development: Anthropocene - agricultural society, industrial society, industrial revolution and resource utilization, environmental consequences. Modern agriculture and green Revolution- environmental impacts. Tragedy of the commons.	5, 6	15
	4.2	Basic needs-Imperatives relating to sustainable development. Johannesburg Conference 2002 and follow up Conference on sustainable development. The earth charter; Securing Sustainable futures		
	4.3	Millennium Development Goals and Strategies (MDG) Sustainable Development Goals (SDGs-2030); need and scope for evolving participatory, community based environmental management strategies. Education for sustainability. Building sustainable societies and lifestyles. Ecological Footprint analysis and its significance. Environmental concerns in traditional societies, Gandhian environmentalism.		
		Activity Assessment of density, frequency, and abundance of plants/animal in a community using various techniques i.e. transect, quadrat etc. Insect diversity in soil. Plan a biodiversity conservation strategy for a given ecosystem Visit to a forest ecosystem and document the Key species / endangered, threatened, critically endangered species		
5		Teacher Specific Module		

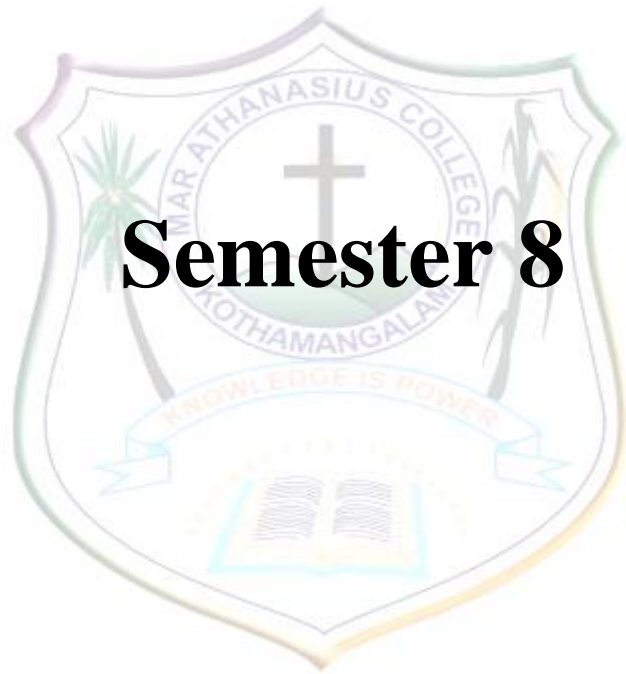
#### MODE OF EVALUATION AND ASSESSMENT

<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 30 marks Quiz, Test Papers, seminar	<b>B. End Semester Examination</b> Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks
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	Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks
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### Recommended Reading

1. Alongi, D. M. (1998). *Coastal Ecosystem Processes*. CRC Press, New York.
2. Chapman, G. P. (1977). *Human and Environmental Systems: A Geographer's Appraisal*. Academic Press, London.
3. Chapman, J. L. & Reiss, M. J. (2005). *Ecology: Principles and Applications*. Cambridge University Press, London.
4. Cunningham, P. William and Cunningham. A. M. (2011). *Principles of Environmental Science- Inquiry and Applications*. 4th Edition. Tata Mc Graw Hill Education Pvt. Ltd, New Delhi
5. Daniel. D. Chiras. (2012). *Environmental Science* (9<sup>th</sup> ed.). Jones and Bartett India. Pvt. Ltd. New Delhi
6. Elton, C. S. (1958). *The Ecology of Invasion by Plants and Animals*. Methuem, London.
7. Forman, R.T.T. & Godron, M. (1986). *Landscape Ecology*. John Wiley & Sons, New York.
8. Fox, C.W., Roff, D.A. & Fairbairn, D.J. (2001). (Eds.). *Evolutionary Ecology: Concepts and Studies*. Oxford University Press.
9. Kamaljith S Bawa, Richard B Primack & Meera Anna Oomen. (2011). *Conservation biology- A Primer for South Asia Universities Press Pvt. Ltd. Hyderabad. India*
10. Krebs, C. J. (2008). *Ecology: The Experimental Analysis of Distribution and Abundance* (6th ed.). Benjamin Cummings Publ., USA.
11. Krishnamurthy, K.V. (2004). *An Advanced Textbook on Biodiversity: Principles and practice*. Oxford and IBH. Publ. Co. New Delhi.
12. Kurian Joseph and Nagendran, R. (2004). *Essentials of Environmental Studies*. Pearson Education (Singapore) Pvt. Ltd. New Delhi.
13. Levin, S. A. (2000). (Ed.). *Encyclopedia of Biodiversity*. Academic Press.
14. Mayhew, P. J. (2006). *Discovering Evolutionary Ecology: Bringing Together Ecology and Evolution*. Oxford University Press.
15. Miller, G.T. (2004). *Environmental Science*. Thomson, California.
16. Odum, E. P. and Barrett, G. W. (2005). *Fundamentals of Ecology*. Thomson Asia Pvt. Ltd., Singapore
17. Primack, R. B. (1998). *Essentials of Conservation Biology*. Sinauer Associates.
18. Pullin, A. S. (2002). *Conservation Biology*. Cambridge University Press, UK.
19. Ray, J G. (2010). *Basic Principles of Ecology and Environment*. Pratibha Publications, Changanacherry, Kerala.



# Semester 8



## Mar Athanasius College (Autonomous), Kothamangalam

### FYUGP SYLLABUS

Programme	B Sc (Honours) Zoology				
Course Name	Immunology				
Type of Course	DCC				
Course Code	M24ZY8DCC400				
Course Level	400				
Course Summary	This course focuses on the understanding of the principles, mechanisms, and applications of the immune system in health and disease. It covers basic concepts in immunology, including the structure and function of the immune system, and immune response pathways.				
Semester	8	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3	-	1	-
Pre-requisites, if any	Basic knowledge in Physiology				

### COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Identify and describe the types, organs, cells of immunity and immunological processes	U, K	3, 4
2	Create a knowledge on hypersensitivity reactions in human body	C	3
3	Predict antigen- antibody interactions and serological tests and describe antigens and immunoglobulins	An	3, 4, 5
4	Analyse the immune mechanisms behind autoimmunity, hypersensitivity, immunodeficiency and transplantation rejection	An	4, 5
5	Understanding about vaccines and recent trends in immunization	U	4, 5, 6
6	Create a positive attitude towards maintaining the proper community health	C	4, 6

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

### COURSE CONTENT

#### Content for classroom transaction (Units)

Module	Units	Course Description	CO No.	Hours
1	1.1	Introduction to Immunology: Historical account; Cells and organs of immune system; Lymphocytes, their origin and differentiation (B-Lymphocytes and T-Lymphocytes); antigens, types and classification; complement system.	1	15
	1.2	Types of Immunity: Innate and acquired, humoral and cellular		
	1.3	Humoral immunity - B-lymphocytes and their activation Structure and function of immunoglobulins; immunoglobulin classes and subclasses Idiotypes and idiotypic antibodies		
	1.4	Cellular immunity - Major histocompatibility complex. Thymus		

		derived lymphocytes (T cells) their classification, antigen presenting cells (APC) - macrophages, dendritic cells, Langerhans cells, their origin and functions; mechanisms of phagocytosis; identification of cell types of immune system; immunosuppression, immune tolerance.		
2	2.1	Immune hypersensitivity: Mechanisms of T cell activation, cytokines and their role in immune response Leukocyte migration and inflammation; hypersensitivity of macrophage activation and granuloma formation, immune regulations, immune response to infectious organisms, Vaccines.	2, 3, 4	15
	2.2	Transplantation and Autoimmunity: Transplantation and Grafting: Graft rejection, evidence and mechanism of graft rejection, prevention of graft rejection, immunosuppressive drugs, HLA and disease, mechanisms of immunity to tumor antigens.		
	2.3	Autoimmunity: Autoantibodies in humans, pathogenic mechanisms, experimental models Auto immune diseases, treatment of auto immune disorders.		
3	3.1	Types of Vaccines-Whole organism vaccines, Purified macromolecules as Vaccines, Recombinant vector vaccines, DNA and mRNA vaccines. Synthetic peptide vaccines, Multivalent subunit vaccines. Therapeutic cancer vaccines	5	15
	3.2	Vaccine Development Process - Preclinical research and animal testing, Clinical trial phases (I, II, III), Regulatory approval and post-marketing surveillance. Ethical aspects of vaccine research and distribution: Public perception and vaccine hesitancy, Balancing individual rights and public health		
4		Practical	1, 6	30
	4.1	Histological study of Bone marrow, Thymus, Spleen and lymph nodes through slides/ Photograph		
	4.2	Make a report on any five autoimmune diseases Prepare an immunization chart Prepare a report on hypersensitivity make use case studies.		
	4.3	Identification of blood group using antigen-antibody reaction Estimation of ESR and micro hematocrit		
	4.4	Study the macrophage phagocytosis using heat killed yeast cells and spleen macrophages of fish (Demonstration) Differential count of WBC		
5		Teacher Specific Module		

<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10

Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks
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### Recommended Readings

1. Abbas, A. K., Lichtman, A. H., Pillai, S. (2011). *Cellular and Molecular Immunology* E-Book. United Kingdom: Elsevier Health Sciences.
2. Abbas, K. Abul and Lechtman H. Andrew (2003.) *Cellular and Molecular Immunology*. V Edition. Saunders Publication.
3. David, M., Jonathan, B., David, R. B. and Ivan R. (2006). *Immunology*, VII Edition, Mosby, Elsevier Publication.
4. Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I. M. (2017). *Essential Immunology*. United Kingdom: Wiley.
5. Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). *Immunology*, VI Edition. W.H. Freeman and Company.







**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc (Honours) Zoology				
Course Name	Genetic Engineering				
Type of Course	DCC				
Course Code	M24ZY8DCC401				
Course Level	400				
Course Summary	This course offers the understanding of the concepts, techniques, and applications of genetic engineering in various fields, including biotechnology, medicine, agriculture, and environmental science. It covers fundamental concepts in molecular genetics, gene manipulation methods, and their practical applications in modifying organisms for desired traits.				
Semester	8	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3	-	1	-
Pre-requisites, if any	Basic knowledge in Biotechnology				

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Record the modern genetic engineering techniques in biology	K	3
2	Insights into gene cloning techniques and vectors	I	3, 5
3	Knowledge about DNA sequencing and recombinant DNA technology	C, I	4, 5
4	Produce a genomic DNA library and screening for recombinants	S	4, 5
5	Understand the future and scope of GM microbes and Gene therapy in the revolution of vaccine industry	U	5, 6
6	Explore the application of Next generation sequencing (NGS) technology	E,C	5, 6

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Introduction to Recombinant DNA technology: Basic principles, tools and techniques; role of enzymes used in genetic engineering (endo and exonucleases, RNase, DNase, restriction endonucleases), role of kinases, phosphatases, ligases - reaction, methods of blunt end joining - linkers and adaptors	1, 2, 4	15
	1.2	Vectors – properties of a vector, plasmids (pBR322, pUC19/18, Ti) cosmids, phagemids, shuttle vectors, expression vectors, ARS, mini chromosomes, BACs, PACs, YACs, HACs (Brief account only).		
	1.3	Methods of screening and selection of recombinant cells - selectable markers, reporter systems - <i>Lac Z</i> system, GFP.		
2	2.1	Procedure of cDNA synthesis, reverse transcriptase PCR, real time PCR	3	15

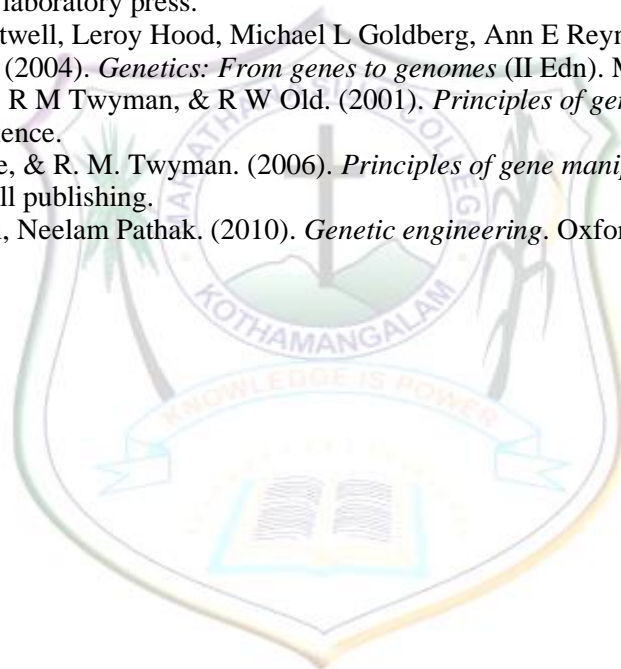
	2.2	Various techniques and strategies used in gene cloning in prokaryotes ( <i>E. coli</i> ) and eukaryotes ( <i>Saccharomyces cerevisiae</i> , <i>Pichia pastoris</i> ), Gene transfer methods: Physical, Chemical and Biological. Transformation into bacteria and yeast, transfection into animal cells, selection of recombinant cells, expression of recombinant proteins (brief study only).		
3	3.1	Gene Screening and DNA sequencing: Genomic and cDNA library. Procedure for the construction of a genomic library using phage $\lambda$ system. Identification of desirable clones from library Locating and isolating a gene - <i>in situ</i> hybridization, DNA sequencing	3, 4, 5, 6	15
	3.2	Application of recombinant DNA technology: Overview of transgenic plants for herbicide, insect and disease resistance, stress resistance (Bt cotton, golden rice, brinjal) and transgenic animals -cow, sheep, poultry, fish. Animals as bioreactors		
	3.3	Uses of GM microbes: Bacteria and yeast- producing useful proteins, basic genetic research		
	3.4	Gene therapy: somatic cell and germline therapy, vectors used in gene therapy, <i>In vivo</i> and <i>ex vivo</i> therapy Gene therapy of SCID, Cystic fibrosis, gene augmentation therapy, Problems and fears associated with gene therapy		
	3.5	Recombinant vaccines (e.g., Hepatitis B vaccine), DNA vaccines, edible vaccines		
4		Practical	2, 3	30
	4.1	Isolation and visualisation of DNA		
	4.2	Isolation of Plasmid DNA Studying the properties of Cloning Vectors		
		Quantification of DNA using spectroscopy		
	4.3	Southern Blotting PCR		
	4.4	Transformation SDS PAGE (Demonstration)		
4.5	Project report on animal cell culture OR on a visit to any Biotechnology Institute			
5		Teacher Specific Module		

MODE OF EVALUATION AND ASSESSMENT	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

### Recommended Reading

1. Abul K Abbas, Andrew H Lichtmay, & Shiv Pillai (2007). *Cellular and molecular immunology* (4 ed.). Elsevier.

2. Anthony J F Griffiths, Susan R Wesler, Sean B Carroll, & John Doebley (2008). *Introduction to genetic analysis* (10<sup>th</sup> ed.). W H Freeman and Company.
3. Benjamin A Pierce (2008). *Genetics: A conceptual approach* (4<sup>th</sup> ed.). W H Freeman and Company
4. Benjamin Lewin. (2006) *Genes IX*. Jones and Bartlett.
5. Bernard R Glick, Jack J Pasternak, Cheryl L Pattein (2010). *Molecular biotechnology: Principles and applications of recombinant DNA*. ASM press.
6. Daniel L Hartl & Elizabeth W Jones. (2009). *Genetics: analysis of genes and genomes* (7<sup>th</sup> ed.). Jones and Bartlett publishers.
7. David A Micklos, Greg A Freyer with David A Crotty (2003). *DNA Science: A first course* (2<sup>nd</sup> ed.). L K Inter.
8. Desmond S T Nicholl. (2010). *An introduction to genetic engineering* (3<sup>rd</sup> ed.). Cambridge.
9. James D Watson, Amy A Caudy, Richard M Myers, & Jan A Witkowski (2007). *Recombinant DNA* (3<sup>rd</sup> ed.). W H Freeman.
10. Jeremy W Dale & Malcolm von Schantz. (2002). *From genes to genomes*. John Wiley & Sons Ltd.
11. Joseph Sambrook & David W Russell (2001). *Molecular cloning: A laboratory manual*. Cold spring harbor laboratory press.
12. Leland H Hartwell, Leroy Hood, Michael L Goldberg, Ann E Reynolds, Lee M Silver, & Ruth C Veres (2004). *Genetics: From genes to genomes* (II Edn). McGraw Hill.
13. S B Primrose, R M Twyman, & R W Old. (2001). *Principles of gene manipulation* (7<sup>th</sup> ed.). Blackwell Science.
14. S. B. Primrose, & R. M. Twyman. (2006). *Principles of gene manipulation and genomics* (7<sup>th</sup> ed.). Blackwell publishing.
15. Smita Rastogi, Neelam Pathak. (2010). *Genetic engineering*. Oxford.





**Mar Athanasius College (Autonomous), Kothamangalam**  
**FYUGP SYLLABUS**

Programme	B Sc (Honours) Zoology					
Course Name	Genomics and Proteomics					
Type of Course	DCE					
Course Code	M24ZY8DCE400					
Course Level	400					
Course Summary	This course offers the study of the principles, methodologies, and applications of genomics and proteomics in biological research and biotechnology. It covers the study of entire genomes and proteomes, including genome sequencing, gene expression analysis, protein structure and function, and their implications in health and disease.					
Semester	8	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	-	1	-	75
Pre-requisites, if any	Basic knowledge in Bioinformatics					

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Knowledge in basic genomic and proteomic studies and its applications	C	3, 4
2	Detailed study on comparative genomics	U	4, 5
3	Discuss the Design drugs from data of functional genomics and proteomics	U,I	4, 5
4	Describe proteins interaction, activity, modification and function	U	3, 4, 5
5	Explore the Developments in Proteomics and genomics happening across the world	An	5, 6
6	Discover the latest tools in protein structure prediction	An, C	5, 6

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**  
**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Genomics, Proteomics, Transcriptomics, Metagenomics, Structural genomics, and functional genomics approaches and its applications (Brief study only)	1, 2	15
	1.2	Human genome diversity Organization of human genome Mitochondrial genome Gross base composition of nuclear genome, CpG islands, RNA- encoding genes, Functionally identical/similar genes, Diversity in size and organization of genes		
	1.3	Gene families: Multigene families – Classical gene families, families with large, conserved domains, families with small conserved domains, Gene super families, Gene families in clusters		
	1.4	Pseudogenes, Repetitive DNA and transposable elements,		

		Origin of gene families (Haemoglobin, Myoglobin as examples)		
2	2.1	Structural genomics and genome projects: (a) Basic steps in genome sequencing. Shot gun sequencing of small genomes. Map based sequencing Whole genome shot gun approach	2, 4, 5	15
	2.2	(b) Genome mapping: Genetic mapping and physical mapping. Cytogenetic and linkage map (brief study only). Molecular markers – RFLP, RAPD, AFLP, SSLP, SNP. Construction of linkage maps using molecular markers – E.g., RFLP maps. Physical mapping – restriction mapping, STS, SNP, EST		
	2.3	(c) Sequence assembly – methods used. Next generation sequencing strategies – Pyro sequencing		
	2.4	(d) Genome Projects: Human genome project, <i>E. coli</i> genome project, Drosophila Genome Project, Mouse genome project.		
3	3.1	Functional genomics: Transcriptome, expression profiling (mRNA profiling). Gene expression analysis using dot blotting and microarrays.	3, 4, 5, 6	15
	3.2	Chromatin immunoprecipitation (ChIP) and its applications. Determination of gene functions -knock out and knock down mutants, antisense RNA and RNAi, gene overexpression.		
	3.3	Orthologs and Paralogs, gene identification by comparative genomics; comparative genomics as a tool in evolutionary studies. Metagenomics		
	3.4	Proteome, proteomics. Separation and identification of cellular proteins by 2D gel electrophoresis and mass spectrometry.		
	3.5	Protein structure analysis: Structure prediction of primary, secondary and tertiary structure of proteins- SCOP, DALIDD, CATH classification.		
	3.6	Determining protein structure: Homology modelling, CASP, Ab initio prediction, Molecular dynamics & conformational energy calculation, Prediction of function (Brief account only)		
4		Practical	1, 6	30
	4.1	Nucleotide BLAST BLAST-P		
	4.2	Identification of Genome sequences Identification of Amino acid sequences		
	4.3	Protein hydrophobicity index- Prot scale		
	4.4	RASMOL		
	4.5	Genome data view- Zebra fish and gen scan analysis		
	4.6	Molecular docking (Autodock Vina)		
5		Teacher Specific Module		

### MODE OF EVALUATION AND ASSESSMENT

MODE OF EVALUATION AND ASSESSMENT	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

### Recommended Reading

1. Brown, T. A. (2006). *Genomes 3*. (n.p.): Taylor & Francis Group.
2. Coleman and Tsongalis. (1997). *Molecular Diagnosis*, Humana Press
3. Dale & Scharz. (2003). *From Genes to Genomes*. Wiley
4. Hawley & Mori. (1999). *The Human Genome*. Academic
5. Lewis, R. (1999). *Human Genetics: Concepts and Applications*. United Kingdom: WCB/McGraw-Hill.
6. Liebler, D. C. (2002). *Introduction to Proteomics: Tools for the New Biology*. United Kingdom: Humana Press.
7. Pasternak, J. J. (2005). *An Introduction to Human Molecular Genetics: Mechanisms of Inherited Diseases*. Germany: Wiley.
8. Primrose, S. B., Twyman, R. (2009). *Principles of Genome Analysis and Genomics*. Germany: Wiley.
9. Strachan, T., Read, A. P. (2011). *Human Molecular Genetics*. United Kingdom: Garland Science.
10. Sudbery, P. (2002). *Human Molecular Genetics*. United Kingdom: Prentice Hall.



**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc (Honours) Zoology				
Course Name	Green Biotechnology				
Type of Course	DCE				
Course Code	M24ZY8DCE401				
Course Level	400				
Course Summary	The course explores the principles, methods, and applications of biotechnology for sustainable development and environmental conservation. It covers biotechnological approaches aimed at addressing global challenges related to food security, renewable energy, environmental remediation, and climate change mitigation.				
Semester	8	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3	-	1	-
Pre-requisites, if any	Basic knowledge in Biotechnology				

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the application of Biotechnology	U	2, 5
2	Knowledge about applications of green biotechnology in crop improvement and pesticide control	U, R	5, 6
3	Develop skill to apply biotechnology in various fields like environmental conservation	S	5, 6
4	Gain a deep understanding on sustainable practices in energy efficiency, renewable resources	U	3, 5, 6
5	Make use of interdisciplinary knowledge of Biochemistry Biology and Biotechnology for sustainable development	A	3, 6
6	Explore the methods for using plants and microbes to clean up soil, water and the environment	E, A	5, 6

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Definition, introduction, describe green biotechnology. history of green biotechnology. Concept and implication of Green Biotechnology, aims, and future with green biotechnology.	2, 3, 4	15
	1.2	Carbon sequestration- Bio sequestration- carbon sequestration through biological process. Methods of carbon sequestration in ocean. Methanogenic microbes for methane reduction. Biochemistry of methanogenesis, natural occurrence of methanogenesis. Role of methanogenesis in global warming. Microbes for phytic acid degradation in agriculture and industry		
	1.3	Manipulation of Plastic degrading microbes. Genetic Engineering (GMOs) approaches to control environmental pollution. Genetic engineering approach for bioremediation and		

		phytoremediation. Risk mitigation of genetically modified bacteria and plants designed for bioremediation		
2	2.1	Biotechnological approach to enhance the growth and biomass. application of biotechnology for the production of biomass based fuels. production of fuels, chemicals, and materials from biomass.	3, 4, 5, 6	15
	2.2	Introduction of biofuels, biodiesel and bioethanol. Biotechnological approaches for production of biofuels, biodiesel and bioethanol. Engineering of plant cell walls for enhanced biofuel production. Applications and current worldwide status of transgenic research in the production of biofuels, biodiesel and bioethanol		
	2.3	Anaerobic biotechnological approaches for production of liquid energy carriers from biomass. Generation of alternate fuels from -Algae-based fuels, Biodiesel from plant source, Alcohol fuels from plant source, recycling organic waste, etc		
3	3.1	Bio-pesticides their types and their importance and applications. Agriculturally important beneficial microorganism. Bio-fertilizers and their types its importance and applications. Different plant growth promoting rhizobacteria- mechanisms of action, pathogenic roles, biocontrol agent, nitrogen fixation, symbiotic relationships	2, 4	15
	3.2	Genetic engineering approaches to increasing crop productivity by manipulation of photosynthesis process genes		
	3.3	Nitrogen fixation and its improvement through genetic engineering approach. Concept of C3 and C4 carbon fixation cycle in plant		
	3.4	Marker-free transgenic concept and application. Controversy and disadvantage of use of markers in transgenic development. Biotechnological approaches for disease and pest resistant crops		
4		Practical	1, 2, 4	30
	4.1	Isolation of methanogenic microbes		
	4.2	Estimation of indole acetic acid		
	4.3	Isolation of plant growth promoting micro-organisms		
	4.4	Isolation of <i>Bacillus thuringiensis</i> and plant growth promoting rhizobacteria		
	4.5	Production of biofertilizers, biopesticides and biofuel		
	4.6	Lab Visit or short videos to demonstrate Biofuels – Bio diesel and bio ethanol. Submit a report on bio-control agents		
5		Teacher Specific Module		

MODE OF EVALUATION AND ASSESSMENT	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10



Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks
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**Recommended Readings**

1. Kirkosyan A & Kaufman P. B. (2009). *Recent Advances in Plant Biotechnology*. Springer.
2. Kumar A. (2004). *Environmental Biotechnology*. Daya Publishing House.
3. Murray D. C. (1993). *Green Biotechnology*. Dominant Publishers and Distributors.
4. Murray D. C. (2011). *Green Biotechnology*. Dominant Publishers and Distributors.
5. Pooja. (2010). *Textbook of Green Biotechnology*. Discovery Publishing House Pvt. Ltd.





**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc (Honours) Zoology					
Course Name	Bioprocess Technology					
Type of Course	DCE					
Course Code	M24ZY8DCE402					
Course Level	400					
Course Summary	This course aims to study the principles, methods, and applications of bioprocessing. It covers the design, optimization, and scale-up of bioprocesses used in various industries, including pharmaceuticals, biopharmaceuticals, food and beverages, and environmental biotechnology.					
Semester	8	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	-	1	-	75
Pre-requisites, if any	Basic knowledge in Microbiology and Biochemistry					

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the basic principles and methods of fermentation	U	2, 5
2	Knowledge about various bioprocesses	I	1, 2, 5
3	Detailed knowledge on bioreactor designing and application	U	5
4	Develop practical skills in bioreactor operation and fermentation techniques	S	3, 5
5	Gain knowledge and skill relevant to industries like biopharmaceuticals, Biotechnology and environmental remediation	U, I	5, 6
6	Equip the students to discover alternatives and methods to handle the wates generated from bioprocess	E, S	5, 6

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	The fundamental concept of fermentation and bioprocess technology. Types of bioprocesses. Design and formulation of media for industrial bioprocess. Criteria for medium design, carbon/nitrogen sources, nutrients. Sterilization of media.	1, 2	15
	1.2	Fermentation process. Role of microorganisms in fermentation. Types of fermentation - batch, fed batch, continuous fermentation submerged and solid-state fermentation process. Control during fermentation- pH, aeration, agitation, temperature, foam control		
2	2.1	Raw materials for bioprocessing, comparison of chemical and biochemical processing based	2, 4, 5	15

		on energetics and environmental issues. Development of inoculum, kinetics of enzymatic and microbial processes, optimisation studies, sterilization of media, air and equipment, modes of cell cultivation.		
	2.2	Media formulation, sterilization of equipment, gas compressor types and principles of compression, air filtration, solid and liquid handling. Industrially fermented broth (filtration and ultrafiltration), centrifugation, solvent extraction, chromatographic separation, liquid extraction of biopolymers and antibiotics ion exchange recovery of antibiotics and proteins		
3	3.1	Bioreactors, general principles of bioreactor design and their operation, bioreactor design, criteria, operation. Types of bioreactors- – airlift, stirred tank, bubble column, rotary drum. Agitation and aeration in the bioreactor, impeller and sparger design.	3, 4	15
	3.2	Concept of scale up, scale up challenges. Influence of various bioprocess parameters viz. pH, temperature, medium components on product synthesis.		
	3.3	Bioprocess monitoring and control, automated control vs manual control of bioprocesses.		
4	4.1	Downstream processing: definition, cost involved in downstream processing. Typical steps involved in downstream processing. Criteria for downstream processing, Target application of product vs cost, separation of cells and broth. Typical unit operation for downstream processing filtration. Methods for cell breakage for harvesting intercellular products.	4, 6	15
	4.2	Commercial production of various bioprocess-based products (Bioethanol, butanol, citric acid, acetic acid). Antibiotics- penicillin, streptomycin, tetracycline. Single cell protein; amino acids: glutamic acid, lysine.		
	4.3	Types and nature of wastes generated from bioprocesses. Waste treatment and disposal methods		
4		Practical	4, 5, 6	30
	4.1	Bioreactors - components of a bioreactor and type of bioreactors		
	4.2	Sterilization of media		
	4.3	Demonstration of the production of bioproducts- Bio ethanol, Bioplastics (short video / Lab visit)		
	4.4	Industrial visit to a fermentation unit		
	4.5	Solid state fermentation		
	4.6	Submerged fermentation		
5		Teacher Specific Module		

<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b>	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs

Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	Part A (Short answer) – 10 out of 12 x 1 = 10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks
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**Recommended Readings**

E M T El-Mansi, C F A Bryce, A L Demain, & A R Allman (2007). *Fermentation Microbiology and Biotechnology* (2<sup>nd</sup> ed.). Taylor & Francis

Peter F Stanbury & Allan Whitaker. (1999). *Principles of Fermentation technology*.

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Pauline M. Doran. (1995). *Bioprocess Engineering Principles*. Academic Press Ltd.





**Mar Athanasius College (Autonomous), Kothamangalam**  
**FYUGP SYLLABUS**

Programme	B Sc (Honours) Zoology				
Course Name	Comparative Anatomy of Vertebrates				
Type of Course	DCE				
Course Code	M24ZY8DCE403				
Course Level	400				
Course Summary	This course aims to provide the undergraduate students a thorough knowledge of structural details and comparative account of the different organ systems of the body from lower to higher vertebrates, thus enabling them to appreciate the incredible vertebrate diversity. The course furnishes an understanding of evolutionary basis of morphological and anatomical differences as well as similarities that occur among vertebrates.				
Semester	8	Credits			Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3	-	1	-
Pre-requisites, if any	Basic knowledge in Animal Anatomy				

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Develop an understanding of diversity of animal forms across different vertebrate groups	U	1, 2, 3
2	Examine how the vital organs and systems different to meet the diverse requirement in animals	An, E	3, 4
3	Understand the evolutionary trends in the organisation of anatomical features in higher animals	U, An	3, 4, 5
4	Acquire proficiency in anatomical terminology	S	3, 5
5.	Develop skill of comparative anatomy in Research and biomedical studies	S	4, 5, 6
6	Recognise the interdisciplinary nature of comparative anatomy integrating the knowledge from physiology, evolution and ecology	Ap	3, 4, 5

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Definition and scope of comparative anatomy, an overview of vertebrate body plan, Homologous structures across vertebrates	1, 2	15
	1.2	Skin structure and function in different vertebrates, anatomy of skin- epidermis and dermis, Organisation of structures like hair nail and hoof		

	1.3	Comparative study of skeletal elements, skull of shark, frog, calotes, pigeon, human, Dentition in different animal groups		
	1.4	Limbs and girdles and vertebral column of vertebrates		
2	2.1	Muscle types and organisation in vertebrates Adaptions for different kind of locomotion, Red muscle and white muscle, Fast muscle slow muscle, Tonus muscle	3, 4, 6	15
	2.2	Comparative anatomy of digestive tract according to the diet pattern, Ruminant stomach and carnivorous stomach		
	2.3	Structure and function of respiratory organs across vertebrates – Fish, frog, calotes, bird and man		
	2.4	Comparative anatomy of circulatory systems, heart structure, aortic arches- in fish, frog, calotes, pigeon and humans, specialisation in circulation related to diving, arial and aquatic habitat		
3	3.1	Comparative neuro anatomy Brain structure and organisation in different vertebrates- brain of fish, frog, calotes, pigeon and human	2, 4	15
	3.2	Sense organs – Photo, Gustatory , olfactory and auditory receptors in vertebrates		
4		Practical	4, 5, 6	30
	4.1	Comparison of Hooves, nail, hair of different groups of animals Using Microscopic slides compare the anatomy skin of any two different group of animals Virtual lab /Models/ Photographs to study the brain Using photographs/ models compare the heart of different vertebrates		
	4.2	Study of disarticulated skull of frog/fowl/rabbit Study of types scales in fishes Study of the vertebrae and girdles of different vertebrate groups Study of carapace, plastron and skull of turtle/tortoise Study of dentition in frog and rabbit		
	4.3	Prepare a report of an anatomy lab or museum visited		
5		Teacher Specific Module		

<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

### Recommended Reading

1. Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education
2. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies

3. Hilderbrand, M and Gaslow, G.E. Analysis of Vertebrate Structure, John Wiley and Sons
4. Walter, H.E. and Sayles, L.P. Biology of Vertebrates, Khosla Publishing House





**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc (Honours) Zoology					
Course Name	Environment Management and Climatology					
Type of Course	DCE					
Course Code	M24ZY8DCE404					
Course Level	400					
Course Summary	This course focuses on the principles, methods, and strategies for managing environmental resources and addressing climate-related challenges. It covers topics on geomorphology, EIA and environment auditing, and management practices with a focus on understanding climate processes, assessing climate change impacts, and implementing sustainable practices for environmental conservation and resilience.					
Semester	8	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	75
		3	-	1	-	
Pre-requisites, if any	Basic knowledge in Environmental Science					

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Describe the basic principles of physical, social and economic environment	An, I	1, 2, 3
2	Understand the principles and concepts of environmental management and climatology	U	5
3	Analyse the impacts of climate change on natural and human systems	An	3,5
4	Evaluate strategies and policies for climate adaptation and mitigation	E	3, 5, 6
5	Apply tools and methods for environmental assessment and management	A	5, 6
6	Develop and propose solutions for sustainable environmental management and resilience-building	C	5, 6

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Lithosphere - Weathering and soil formation, - soil colloids, adsorption and exchange of anions and cations, role of microbes in soil, types of soil, soil profile, classification of rocks, folds, faults and dykes and other geological formations and their environmental significance.	1	15
	1.2	Geomorphological processes-plate tectonics, sea floor spreading, mountain building, evolution of continents and structural deformation.		
	1.3	Atmosphere -Physico-chemical characteristics, divisions, composition and significance of atmospheric components.		
	1.4	Hydrosphere -Visible and invisible hydrosphere, Range of		



		aquatic habitats, water cycles between earth and the atmosphere, Global water balance, ice sheets, origin and composition of sea water, sea level changes, River basins and watershed. Physico-chemical characteristics of water-diffusion of oxygen from the atmosphere to surface waters. Influence of pH, turbidity and light on aquatic life. Physical and chemical properties of soil		
2	2.1	Basic principles: Management of physical, social, and economic environment. Concepts and scope of environmental planning, regional planning and management. Integrated landscape management.	2, 3	15
	2.2	Cost-benefit analysis and Resource economics. Environmental modelling- simulation modelling, input-output modelling, Linear programming, Software and resource management.		
	2.3	Toolbox for environmental management – An overview of Ecological footprints, SEA, Ecological Economics, conflict resolution strategies. Eco funds.		
	2.4	Environmental auditing and standards Eco labelling and certification, accreditation – need, objectives and benefits; Corporate social responsibility and Corporate environmental responsibility, ISO standards for environmental management systems (EMS) ISO 14000, 14001 and 26001; OHSAS 18001.		
	2.5	An overview Population, Resources and ecosystem management Exponential growth in human numbers and the implications.	3, 5	
	2.6	Major management concepts and methodologies. The five basic laws of Ecology and their relevance for ecosystems management; paradigm shifts in the management of Ecosystems- influence of economics in ecology.		
	2.7	Management practices for various ecosystems: grasslands, forests, mountains, wetlands and coastal areas. Environmental planning and management of – waste lands, reclaimed lands, mining areas, human settlements, industrial lands and agricultural lands. Eco restoration/remediation; local knowledge and management systems.		
	2.8	Environmental Impact Assessment (EIA): Introduction- Definition, history, aim, principles, concept and scope. Baseline data collection, Methods and steps - Adhoc method, checklist method, matrices, Map overlays method, network method, index method Impact assessment and impact evaluation-EIA Processes, Stages, EIA Statement Environment management plan- Risk assessment and disaster management programme. Life Cycle Assessment (LCA) and its significance.		
3	3.1	Definitions and scope of climatology, weather and climate, components of climate system, earth's thermal environment, earth intercepts solar radiation, seasonal variation in intercepted solar radiation, air temperature in relation to altitude, global circulation of air masses, wind and earth's rotation on ocean currents, climatic types and zones.	2, 4, 6	15
	3.2	Global climatic phenomena- <i>El Nino</i> and <i>La Nina</i> , causes and factors of climate change. Effect of climate change on ecosystems. Organisms and microclimate.		
	3.3	Climatic regions of India, tropical monsoon climate-onset, rain bearing systems, break in the monsoon, retreat of monsoon.		

		Monsoon in Kerala, oceanic and continental influence.		
	3.4	Global climatic change, - floods, tsunami, drought, avalanche, earthquakes, lightening. Effects of global warming on – environment, land use pattern, ocean, biodiversity, agriculture, human health		
	3.5	Measures to reduce climatic change- Afforestation, restoration of traditional agricultural practices, sequestering CO <sub>2</sub> , IPCC, UNFCCC		
4	4.1	Practical Study of a simple ecosystem (Pond, River, Estuary, Grassland, forest)	1, 2, 6	30
	4.2	Study of the effect of human interaction with the environment (Case study and report)		
	4.3	Identify and prepare report on an environmental problem in your locality		
	4.4	Segregate domestic waste into biodegradable and non-biodegradable		
	4.5	Determine the texture of various soil samples		
	4.6	A report on Climate models (Computer programmes)		
5		Teacher Specific Module		

MODE OF EVALUATION AND ASSESSMENT	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

### Recommended Reading

1. Asit K. Biswas *et.al.* (1987). *EIA for Developing Countries*. United Nations University, Tokyo.
2. Carter, L. (1996). *Environmental Impact Assessment*. McGraw Hill, New Delhi
3. Gadgil, M. & Guha, R. (1995). *Ecology and Equity- The Use and Abuse of Nature in Contemporary India*. Penguin India.
4. Gadgil, M. & Guha, R. (1998). *The Fissured Land; An Ecological History of India*; Oxford University Press, New Delhi.
5. Goldsmith, B. (1992). (Ed.) *Monitoring for Conservation and Ecology*. Chapman and Hall, London.
6. Knight, R L and White, L. (2009). *Conservation for a New Generation Redefinig Natural Resources Management*. Island Press, USA
7. Kurian Joseph and Nagendran, R. (2004). *Essentials of Environmental Studies*. Pearson Education (Singapore) Pvt. Ltd. New Delhi.
8. Lawrence, D.P. (2003). *Environmental Impact Assessment: Practical Solutions to Recurrent Problems*. John Wiley and Sons, New Delhi.
9. Meffe, G. K., L. , Nielsen, R. & Knightand Schenborn. (2002). *Ecosystem Management: Adaptive, Community Based Conservation*. Plenum Press.
10. Miller. G.T., Jr. (2004). *Environmental Science*. Thomson, California.
11. Milner Gulland, E. J. & J Marcus Rowcliffe. (2007). *Conservation and Sustainable Use a handbook of Techniques*. Oxford University Press
12. Peter Calow. (1998). (Ed.) *Handbook of Environmental Impact Assessment*. Mc Graw Hills Inc New Delhi.
13. Prabodh. K. Maiti & Paulami Maiti. 2011. *Biodiversity, Perception, Peril and Preservation*. PHI Learning. Pvt. Ltd. New Delhi.
14. Pullin, A.S. (2002). *Conservation Biology*. Cambridge University Press, UK.

15. Simon Dresner. (2008). *The Principles of Sustainability Solutions*. Earthscan paperbacks
16. S.V.S. Rana. (2010). *Essentials of Ecology and Environmental Science* (4th ed.). PHI Learning. Pvt. Ltd. New Delhi.
17. Tyler Miller, G Jr. (2005). *Advantage Series: Sustaining the Earth an Integrated Approach* (7<sup>th</sup> ed.). Thomson/Brooks Cole. USA
18. UN General Assembly. (2010). *Keeping the promise: a forward-looking review to promote an Agreed action agenda to achieve the Millennium Development Goals by 2015*. Report of the Secretary General.
19. Westman W.E. (1995). *Ecology, Impact Assessment and Environmental Planning*. John Wiley and sons. NY, USA.
20. World Commission on Environment and Development (1987). *Our Common Future*. New York: Oxford University Press





**Mar Athanasius College (Autonomous), Kothamangalam**

**FYUGP SYLLABUS**

Programme	B Sc (Honours) Zoology					
Course Name	Environmental Pollution and Ecotoxicology					
Type of Course	DCE					
Course Code	M24ZY8DCE405					
Course Level	400					
Course Summary	Environmental Pollution and Ecotoxicology course offers an interdisciplinary examination of the sources, effects, monitoring, and mitigation of pollution in the environment. It covers various types of pollution, including air pollution, water pollution, soil contamination, and noise pollution; toxicity; and ecological, human health, and socio-economic impacts.					
Semester	8	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	75
		3	-	1	-	
Pre-requisites, if any	Basic knowledge in Environmental Science					

**COURSE OUTCOMES (CO)**

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Relate different types of pollution & sources of pollution.	U, E	4, 5
2	Illustrate the impacts of different pollution on human health & environment.	An	3, 4
3	Apply different measures to control pollution in their daily life	A	4, 5
4	Motivate the student to examine different methods for treatment of water & air for quality	I, Ap	5, 6
5	Create awareness on the use of various tools and techniques for the study of pollution	I	5, 6
6	Practice various toxicology testing bio assays	S	4, 5, 6

*\*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

**COURSE CONTENT**

**Content for classroom transaction (Units)**

Module	Units	Course Description	CO No.	Hours
1	1.1	Brief history of human civilization, industrialization, and urbanization. Definition of pollution. Different types of pollution- Air, Water and soil and their local, regional, and global aspects.	1, 4	15
	1.2	Sources and classification of air pollution; particulates and gaseous pollutants in the atmosphere. Primary and secondary pollutants.		
	1.3	Air pollution monitoring - methods, air quality standards; ISI, EPA.		
	1.4	Sampling and measurement of particulate matters (SPM) - gaseous pollutants, CO <sub>2</sub> , CO, NO <sub>2</sub> , SO <sub>2</sub> , H <sub>2</sub> S, oxidants, ozone and hydrogen fluoride		
	1.5	Control of gaseous emission: adsorption by liquids, adsorption by solids, combustion and condensation. Control of SO <sub>2</sub> , NO <sub>x</sub> , CO, CO <sub>2</sub> and		

		hydrocarbons		
	1.6	Effects of air pollutants on human health, animals, vegetation, materials and structures Sick building syndrome GHGs, climate change, carbon footprint and carbon trade		
2	2.1	Sources of water pollution-Domestic, industrial and agricultural. Health effects of water pollution. Water borne and water related diseases. Effects of water pollution on aquatic system.	2, 3, 4	15
	2.2	Water quality standard for potability - Pollution parameters, BOD, COD, Coliform bacteria. Treatment of water for potable purpose Primary and secondary treatment. Sludge disposal.		
	2.3	Biological treatment: Kinetics of Biological growth - activated sludge treatment - trickling filters - anaerobic digestion, combined aerobic and anaerobic treatment process, aerobic process.		
	2.4	Advanced wastewater treatment - removal of dissolved organic and inorganic - precipitation, iron exchange, reverse osmosis, electro dialysis, adsorption and oxidation. Removal of nutrients. Removal of heavy metals - overall wastewater treatment for sewage water		
	2.5	Water pollution treatment using constructed wetlands		
	2.6	Traditional water purification techniques		
3	3.1	Sources of soil pollution: agricultural, industrial and domestic. Hazardous waste compounds, formulations and classes of substances, chemical classification of hazardous waste.	1, 2, 4	15
	3.2	Soil factors affected by pollution – physico-chemical and biological impacts. Control of soil pollution. Soil quality parameters and test method.		
	3.3	Properties of sound and noise. Effects of noise on People and ecosystem. Basic principles of noise control; National and International Standards. Assessment and measurement of sound. Thermal Pollution - causes and consequences Oil pollution - causes and consequences.		
	3.4	Radiation pollution- Definition, Radioactivity, Radionuclide, Radiation emissions, sources, Radioactive decay and buildup. Biological effects of radiation. Radioactive pollution impacts on ecosystem, safety standards. Urban sky glow, Light Trespass, Glare, Clutter, Effects of light Pollution		
4	4.1	Definition, scope and history of toxicology, Acute and chronic toxicity, selective toxicity, dose, synergism and antagonism.	5, 6	15
	4.2	Dose – Response relationships – Graded response, quantal response, Time action curves, Threshold Limit value (TLV); LC50; Margin of safety; Toxicity curves; Cumulative toxicity and LD50 and CTF.		
	4.3	Toxic chemicals in the Environment – Biochemical aspects of As, Cd, Pb, Hg, Cu, O3, PAN, pesticides, MIC and other carcinogens. Bio accumulation and		

		biomagnification. Occupational toxicology- hazardous chemicals, disorders from chemical exposure at work, assessment of occupational hazards.		
	4.4	Toxicity testing; Bioassay – Definition, purpose, criteria for selection of test organism, methodology, estimation of LC50, Limitation and importance of bioassay, acute toxicity (single); sub-acute toxicity; chronic toxicity; teratogenicity, carcinogenicity and mutagenicity.		
	4.5	Biomonitoring of toxic chemicals - objectives, programs and parameters, concepts of bio indicators. Biotransformation of Xenobiotics (Selective Toxicity).		
4		Practical	5, 6	30
	4.1	Probit analysis of Lc 50		
	4.2	Case study of Teratogenicity, mutagenicity and carcinogenicity		
	4.3	Estimation of soil organic carbon		
	4.4	Estimate the heavy metal content (demonstration)		
	4.5	Estimation of physico-chemical parameters of water samples Estimate dissolved oxygen Estimation of Co2		
	4.6	Estimation of Coliform bacteria (Total and faecal)		
5		Teacher Specific Module		

<b>MODE OF EVALUATION AND ASSESSMENT</b>	
<b>A. Continuous Comprehensive Assessment (CCA)</b> Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	<b>B. End Semester Examination</b> Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

#### Recommended readings:

1. APHA-AWWA-WPCF. (1989). *Standard Methods for the Examination of water and Wastewater* (17th ed.). Publishers.
2. Butter, G. C. (1988). *Principles of Ecotoxicology*. John Wiley and Sons.
3. Cockerham, G. L. & Shane, B. S. (1994). (Eds.). *Basic Environmental Toxicology*. CRC Press.
4. Eisenbude, M. (1998). *Environmental Radioactivity*. Academic Press. NY.
5. Fellenberg, G. (1999). *Chemistry of Pollution*. John Wiley and Sons, New Delhi
6. Hayes, W. A. (2001). *Principles and Methods of Toxicology*. CRC Press. NY.
7. Lodge, Jr., J. P., Lodge, J. J. P. (2017). *Methods of Air Sampling and Analysis*. United States: CRC Press.
8. Klaassen, C. D & J. B. Walkins. 2003. *Essentials of Toxicology*. Mc Graw –Hill Professional New Delhi.
9. Delhi Lutgens, F.K. and Tarbuek, J. E. (1992). *The Atmosphere*. Prentice Hall, New Jersey.
10. Niesink, R. J. M., De Vries, J. and Hollinger, M. A. (1996). (Eds.). *Toxicology- Principles and Applications*. CRC Press.
11. Oehme, W. F. (1989). *Toxicity of Heavy Metals in Environment*. Marcel Dakkar Inc., New York.
12. Purnima, B.B., A. K. Janin & Arun. K. Jain. (2011). *Waste Water Engineering Including Air Pollution*. Laxmi Publications (P) Ltd. New Delhi
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14. Wilber, C.G. (1989). *Biological aspects of Water Pollution*. Charles C. Thomas Publishers. Illinois. USA

