A.VEERIYA VANDAYAR MEMORIAL

SRI PUSHPAM COLLEGE (AUTONOMOUS)

POONDI-613 503, THANJAVUR (DT)

SYLLABUS

B.Sc., Zoology

(From 2020 - 2021 onwards)

Program Outcomes: B.Sc., Zoology

PO1.Improve positive attitude towards ecological development

PO2.Understand the unity of life with the rich diversity of organisms and their ecological and evolutionary significance

PO3 - Students gain knowledge and skill in the fundamentals of animal sciences, understands the complex interactions among various living organisms

PO4 – Correlates the physiological processes of animals and relationship of organ systems

PO5 – Understanding of environmental conservation processes and its importance, pollution control and biodiversity and protection of endangered species

PO6 – Gain knowledge of Agro based Small Scale industries like sericulture, fish farming and vermicompost preparation.

Programme Specific Outcomes: B.Sc., Zoology

PSO1. Understand the wildlife and basic concepts of cell biology, genetics, taxonomy, physiology, ecology and applied Zoology

PSO2. Analyze the associations among animals, plants and microbes

PSO3. Perform procedures as per laboratory standards in the areas of Taxonomy, Physiology, Ecology, Cell biology, Genetics, Clinical science, Sericulture, Biochemistry, Animal biotechnology, Immunology and research methodology

PSO4.Explain the role and impact of different environmental management programmes

PSO5.Identify various prospective risk factors to health of humans

PSO6. Use tools of information technology for all activities related to zoology

A. VEERIYA VANDAYAR MEMORIAL SRI PUSPHPAM COLLEGE (AUTONOMOUS), POONDI, THANJAVUR DISTRICT
CBCS SYLLABUS – FOR B.Sc .ZOOLOGY STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2020- 2021 ONWARDS
DEPARTMENT OF ZOOLOGY

B.Sc. ZOOLOGY

Old S.No.	Sem	Part	category	Paper Code	Title of the Paper	Maximum Marks			Minimum Marks for Pass			Hours / Week	Credits
						CIA	E.E.	Total	CIA	E.E.	Total		
1.	I	Part I	Language	20U1ZOT1/H1	Tamil – I / Hindi –I	25	75	100	10	30	40	6	3
2.		Part II	Language	20U1ZOE1	English –I	25	75	100	10	30	40	6	3
3.		Part III Core	Major	20U1ZOC1	Invertebrata	25	75	100	10	30	40	6	6
4.				20U1ZOCP1	Practical I (Invertebrata)	40	60	100	16	24	40	3	4
5.			Allied	20U1ZOBOA1	Allied Botany – I	25	75	100	10	30	40	5	4
6.				20U2ZOBOAPL	Allied Botany – Practical (NS)	---	---	---	---	---	---	3	---
7.		Part IV	ESE	20U1ZOES	Environmental Study	---	100	100	---	40	40	---	1
8.	II	Part I	Language	20U2ZOT2/H2	Tamil – II / Hindi –II	25	75	100	10	30	40	6	3
9.		Part II	Language	20U2ZOE2	English –II	25	75	100	10	30	40	6	3
10.		Part III Core	Major	20U2ZOC2	Microbiology	25	75	100	10	30	40	6	5
11.				20U2ZOCP2	Practical II- (Microbial Techniques)	40	60	100	16	24	40	3	4
12.			Allied	20U2ZOBOA2	Allied Botany – I	25	75	100	10	30	40	5	4
13.				20U2ZOBOAPL	Allied Botany – Practical (NS)	40	60	100	16	24	40	3	4
14.		Part IV	VBE	20U2ZOVE	Value Based Education	25	75	100	10	30	40	---	---
15.			SBE	20U2ZOS1	Skill Based Education I- Clinical analysis of biological samples	25	75	100	10	30	40	1	1
16.	III	Part I	Language	20U3ZOT3/H3	Tamil – III/ Hindi –III	25	75	100	10	30	40	6	3
17.		Part II	Language	20U3ZOE3	English –III	25	75	100	10	30	40	6	3
18.		Part III Core	Major	20U3ZOC3	Chordata	25	75	100	10	30	40	6	6
19.				20U3ZOCP3	Practical III- Chordata	40	60	100	16	24	40	3	4
20.			Allied	20U3ZOCHA1	Allied Chemistry– I	25	75	100	10	30	40	5	4

Old S.No.	Sem	Part	category	Paper Code	Title of the Paper	Maximum Marks			Minimum Marks for Pass			Hours / Week	Credits
						CIA	E.E.	Total	CIA	E.E.	Total		
21.				20U4ZOCHAPL	Allied Chemistry – Practical (NS)	---	---	---	---	---	---	3	---
22.		Part IV	GS	20U3ZOGS	Gender Studies	---	100	100	--	40	40	---	---
23.			Extra credit		MOOC – (Massive Open Online Course)								
24.	IV	Part I	Language	20U4ZOT4/H4	Tamil – IV/ Hindi –IV	25	75	100	10	30	40	6	3
25.		Part II	Language	20U4ZOE4	English –III	25	75	100	10	30	40	6	3
26.		Part III Core	Major	20U4ZOC4	Biochemistry, Biophysics & Biostatistics	25	75	100	10	30	40	6	5
27.				20U4ZOCP4	Practical IV- Biochemistry, Biophysics & Biostatistics	40	60	100	16	24	40	3	4
28.			Allied	20U4ZOCHA2	Allied Chemistry – I	25	75	100	10	30	40	5	4
29.				20U4ZOCHAPL	Allied Chemistry – Practical (NS)	40	60	100	16	24	40	3	2
30.		Part IV	SBE	20U4ZOS2	Skill Based Education – II – Techniques In Clinical Lab (Practical)	25	75	100	16	24	40	1	1
31.			Extra credit	-	MOOC – (Massive Open Online Course)								
32.	V	Part III Core	Core	20U5ZOC5	Cell biology & Genetics	25	75	100	10	30	40	6	5
33.				20U5ZOC6	Developmental Biology & Evolution	25	75	100	10	30	40	5	5
34.				20U5ZOC7	Immunology	25	75	100	10	30	40	4	5
35.				20U5ZOCP5	Practical V- Cell Biology, Genetics, Developmental Biology, Evolution & Immunology	25	75	100	10	30	40	4	4

Old S.No.	Sem	Part	category	Paper Code	Title of the Paper	Maximum Marks			Minimum Marks for Pass			Hours / Week	Credits
						CIA	E.E.	Total	CIA	E.E.	Total		
36.			ME I	20U5ZOEL1A 20U5ZOEL1B 20U5ZOEL1C	A) Public Health &Hygiene B)Biosafety and Intellectual Property Rights C)Nanotechnology in Pharmaceutical Application	25	75	100	10	30	40	4	3
37.			ME II	20U5ZOEL2A 20U5ZOEL2B 20U5ZOEL2C	A) Aquaculutre B)Vermiculture C) Apiculture	25	75	100	10	30	40	4	4
38.		Part IV	NME	20U5ZONME	Aquaculture	25	75	100	10	30	40	2	1
39.				20U5ZOSSD	Soft Skill Development	---	100	100	---	40	40	1	---
40.				20U6ZOC8	Animal Physiology & Environmental Biology	25	75	100	10	30	40	5	5
41.			Core	20U6ZOC9	Genetic engineering	25	75	100	10	30	40	5	5
42.				20U6ZOC10	Economic Zoology	25	75	100	10	30	40	4	5
43.		Part III Core		20U6ZOCP6	Practical vi– Animal Physiology & Environmental Biology and Genetic engineering	40	60	100	16	24	40	6	4
44.	VI		ME III	20U6ZOEL3A 20U6ZOEL3B 20U6ZOEL3C	A) Computational Biology(Bioinformatics) B) Bioinstrumentation C) Bio-Statistics and Computer Applications in Biology	25	75	100	10	30	40	4	4
45.			ME IV	20U6ZOEL4A 20U6ZOEL4B 20U6ZOEL4C	A) Animal &Env. Biotech B) Poultry Science C) Sericulture	25	75	100	10	30	40	4	3
46.		Part IV	GK	20U6ZOGK	General Knowledge	---	100	100	---	40	40	1	---
47.			Comp Test	20U6ZOCN	Comprehensive Test	---	100	100	---	40	40	1	---
48.		Part V		20U6ZOEA	**Extension Activities**	---	---	---	---	---	---	---	1
					Total			**4300**				**180**	**140**

LIST OF CORE OPTIONAL PAPERS
B.Sc ZOOLOGY (2020 -2021)

S.No.	Semester	Category	Paper Code	Title of the Paper	Maximum Marks			Minimum Marks for Pass			Hours / Week	Credits
					C.I.A.	E.E.	Total	C.I.A.	E.E.	Total		
1.	I	Core -Option	20U1ZOCO1	Economic Zoology	25	75	100	10	30	40	6	6
2.	II	Core - Option	20U2ZOCO2	Applied Entomology	25	75	100	10	30	40	6	6
3.	III	Core-Option	20U3ZOCO3	Nutrition & Dietetics	25	75	100	10	30	40	6	6
4.	IV	Core-Option	20U4ZOCO4	Nanotechnology in Pharmaceutical Application	25	75	100	10	30	40	6	6
5.	V	Core-Option	20U5ZOCO5	Animal Behaviour	25	75	100	10	20	40	6	6
6.	VI	Core-Option	20U6ZOCO6	Biodiversity	25	75	100	10	20	40	6	6

ABBREVIATIONS

ESE: Environmental Studies	SSD: Soft Skill Development
VBE: Value Based Education	GK: General Knowledge
SBE: Skill Based Elective	NME: Non-Major Elective
GS: Gender Studies	EA:Extension Activities
ME:Major Elective	SS:Self Study
CC:Certificate Course	
MOOC: Massive Open Online Course	

B.Sc ZOOLOGY (2020 -2021)

Parts	Total No. of Courses	Total Marks	Total Credits	Classification
Part –I	**04**	**400**	**12**	√
Part - II	**04**	**400**	**12**	√
Part – III				
Core	16	1600	76	
Allied	06	600	20	√
Major Eective	04	400	14	
	26	**2600**	**110**	
Part – IV				
Environmental Studies	01	100	**01**	
Value Based Education	01	100	00	
Skill Based Elective	02	200	**02**	
Soft Skill Development	01	100	00	
Non-Major Elective	01	100	**01**	√
Gender Studies	01	100	00	
General Knowledge	01	100	00	
Comprehensive Test	01	100	**01**	
	09	**900**	**05**	
Part –V EA	**Extension Activity**		**01**	**X**
Total	**43**	**4300**	**140**	√

Comprehensive Knowledge Test: Objective type question pattern with 100 compulsory questions carrying 100 marks to be answered in 3 Hours with 2 credits. The portion is entire core courses.

MOOC: massive Open Online Course is introduced in the third and fourth semester as an extra credit course from this academic year 2020 – 2021. The students can avail any one or more of the courses available in MOOC to equip their skill and knowledge themselves.

Field visit / Industrial visit / hands-on training Program having minimum 15 hours of contact time as extra credit course is introduced for second year UG students to gain experimental learning.

Evaluation of the visit report will be held at the end of IV semester.

Components of Evaluation

Internal Marks - 40

External Marks -60

Total - 100

Project is introduced for III year students to cater for the needs of advanced learners as extra credit course.

Components of Evaluation

Internal Marks - 40

External Marks -60

Total - 100

Soft skill development course prescribed in V semester is changed as Life Skill Development.

This course will be handled by both Internal Staff and External Experts.

Mode of Assessment for this course is oral Examination.

Components of Evaluation

Internal Marks - 40

External Marks -60

Total - 100

Skill based elective offered by the Zoology Department

1. Clinical Analysis of Biological samples
2. Techniques in Clinical Lab (Practical)

Certificate Course offered by the Zoology Department

1. Apiculture, Poultry science and Ornamental Fish culture will be conducted for UG students as an Extra Credit Course
2. MOOC online course – Extra Credit Course

Non- Major Elective paper offered by the Zoology Department

1. NME – Aquaculture

DEPARTMENTOF ZOOLOGY: PROGRAMME OUTCOMES

BSc., ZOOLOGY WITH BIOTECHNOLOGY

Programme Specific Outcomes: BSc., Zoology with Biotechnology

PSO1. Understand the wildlife and basic concepts of cell biology, genetics, taxonomy, physiology, ecology and applied Zoology

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PSO6. Use tools of information technology for all activities related to zoology

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POONDI, THANJAVUR DIST.

Question Pattern for UG and PG Programmes for students to be admitted during 2020 – 2021 and afterwards.

Total Marks: 75

QUESTION PATTERN

SECTION – A

(Question 1 to 10)

10 x 2 = 20 Marks

1. Short Answer Questions.
2. Two Questions from each unit (All are answerable)

SECTION – B

(Question 11 to 15)

5 x 5 = 25 Marks

1. 5 Paragraph type questions with "either / or" type choice.
2. One question from each unit of the Syllabus.
3. Answer all the questions.

SECTION – C

(Question 16 to 20)

3 x 10 = 30 Marks

1. 5 Essay type questions – any three are answerable.
2. One questions from each unit of the Syllabus.

B.Sc., Zoology

Semester	Subject Code	Title Of The Paper	Hours Of Teaching / Week	No. of Credits
I	**20U1ZOT1**	**இக்கால இலக்கியம்** **(செய்யுள் , உரைநடை, சிறுகதை, புதினம், நாடகம் இலக்கிய வரலாறு)**	**6**	**3**

நோக்கம்

1. தமிழ் மரபுக்கவிதை, புதுக்கவிதை முதலானவற்றை அறிமுகப்படுத்துதல்.
2. சிறுகதை, நாவல், கட்டுரை முதலான இலக்கிய வடிவங்களைக்காத்தல்.
3. இக்கால இலக்கியத்தின் மீதான கப்பை விருவித்தல்.

கூறு: 1 செய்யுள் ***நேரம்:18***

1. பாரதியார் : கண்ணன் என் காதலன் — கண்ணம்மா என் காதலி (முதல்பாடல் மட்டும்)

2. பாரதிதாசன் : தமிழின் இனிமை, தமிழ் உணர்வு

3. கவிமணி : ஒற்றுமையே , உயர்வு நிலை - நாட்டுக்குழைப்போம்

4. சுரதா : சிக்கனம்

கூறு: 2 செய்யுள் ***நேரம்:18***

1. பட்டுக்கோட்டை கல்யாணசுந்தரம்:நாட்டுக்கொரு வீரன்

2. கண்ணதாசன் : காலக்கணிதம்

3. மு.மேத்தா: கண்ணீர் பூக்கள், ஊர்வலம், தாய், வெளிச்சம் வெளியே இல்லை

4. அப்துல் ரகுமான் : தேவகானம் - தேர்ந்தெடுக்கப்பட்ட 5 பாடல்கள்.

கூறு: 3 சிறுகதை ***நேரம்:18***

1. கேட்டிவி : குரல்கொடுக்கும் வானம்பாடி (1-10)

2. கேட்டிவி : மனோரஞ்சிதம் (1-10)

கூறு: 4 புதினம் ***நேரம்:18***

புதினம் : துணிந்தவன் - வல்லிக்கண்ணன்

கூறு: 5 நாடகம், இலக்கிய வரலாறு ***நேரம்:18***

1.நாடகம் : மாமன்னன் இராசராசன் - கு.வெ.பாலசுப்பிரமணியன்

2.இலக்கிய வரலாறு : இருபதாம் நூற்றாண்டு இலக்கியங்கள்

பயன்கள்

1. தமிழ் இலக்கியத்தின் மீதான ஆர்வம் மிகும்.
2. புதிய இலக்கிய வளங்களை அறிவர்.
3. கவிதை, சிறுகதை ஆகியவற்றைப் படைக்க முயல்வர்.
4. போட்டித் தேர்வுகளுக்குச் செல்பவர்கள் பயன் பெறுவர்.
5. நாடகக் கலைத்திறனை அறிவர்

Semester	Course Code	Title of The Course	Hours of Teaching/ Week	No. of Credits
I	**20U1ZOE1**	**PART – II - Prose, Poetry and Communication Skills**	**6**	**3**

Objective

- To initiate the students to understand English through Prose, Poetry and Basic Communicative Grammar.

Unit – I

Shakespeare - Shall I Compare Thee to a Summer's Day?
John Milton – On His Blindness
William Wordsworth – The Solitary Reaper
P.B.Shelley – Song to the Men of England
Robert Frost – The Road not Taken
Nissim Ezekiel - Night of the Scorpion

Unit – II

1) The Running Rivulets of Man, 2) Parliament is Marking Time
3) The Lady in Silver Coat, 4) Mr. Applebaum at Play

Unit – III

1) The Feigning Brawl of an Impostor, 2) Thy Life Is My Lesson
3) Solve the Gamble, 4) The Stoic Penalty

Unit – IV

1) Nobility in Reasoning, 2) Malu the Frivolous Freak
3) Bharath! Gird Up Your Loins! 4) Honesty is the Cream Of Chastity

Unit – V

1) The sentence 2) Parts of Speech 3) Nouns-I 4) Nouns –II
5) Adjectives 6) Comparison of Adjectives 7) Articles 8) Pronouns
9) Demonstrative, Indefinite, Interrogative, Distributive and Reciprocal Pronouns
10) Relative Pronouns 11) Adverbs.

Course outcomes:

After the completion of this course, students will be able to

- **understand and appreciate the English Prose, Poetry and basic functional communicative Grammar and study on style and substance.**
- **develop interest in appreciation of literature**
- **integrate the use of the four language skills: LSRW.**
- **communicate appropriately and use English effectively**
- **imbibe ethical, moral, national and cultural values**

Prescribed Texts:

K.T.V. *A Melodious Harmony.* Thanjavur: Rajendra Publishing House, 2017.
Natarajan, K. *FlyingColours.* Chennai: New Century Book House (P) Ltd., 2017.
Advanced Grammar and Composition. Chennai: New Century Publishing House, 2017.

B.Sc., Zoology

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	**20U1ZOC1**	**INVERTEBRATA**	**7**	**6**

Objectives:

1. To know the nomenclature, systematic position, classification of Invertebrates with suitable examples.
2. To study the economic importance of protozoans, insects and molluscs.
3. To study the parasitic adaptation of invertebrates.

Hrs 18

Unit I

Principles of Taxonomy

General Characters and detailed classification of Phylum Protozoa upto classes with suitable examples of biological interest.

Detailed study – Paramecium

General topic – 1.Protozoan diseases in human–Malaria, Amoebiasis and Sleeping Sickness.
2.Protozoans Parasites of Man – Plasmodium, Entamoeba, Trypanosoma, Giardia and Leishmania, mode of infection and its control.

Unit II **Hrs 18**

General characters and detailed classification of phylum Porifera and Coelenterata up to classes with suitable examples.

Detailed study – Ascon Sponge, Obelia.

General topics: 1. Canal system in sponges. 2. Coral and coral reefs.

Unit III **Hrs18**

General characters and detailed classification of phylum Platyhelminthes and Nemathelminthes upto classes with suitable examples.

Detailed study – *Taenia solium*, *Ascaris lumbricoides*

General topics: 1. Parasitic adaptation of platyhelminthes. 2. Nematodes parasites in Man.

Unit IV **Hrs 18**

General characters and detailed classification of Phylum Annelida and Arthropoda upto classes with suitable examples.

Detailed study – Earthworm, Prawn

General topics: 1. Peripatus and its affinities. 2. Mouth parts of Insects

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Unit V **Hrs 18**

General characters and detailed classification of Phylum Mollusca and Echinodermata up to classes with suitable examples.

Detailed study – *Lamellidens marginalis, Asterias rubens*.

General topics: 1. Economic importance of Mollusca. 2. Larval forms of Echinoderms.

Course Outcomes

After completion of this course,students will be able to

- Understand The Principles Of Taxonomy And Classification OfInvertebrates.
- Acquire Knowledge On The Characteristic Features OfInvertebrates.
- Gain Awareness On TheParasiticAdaptationOfHelminths.
- UnderstandTheEconomicImportanceOfMollusca
- RealizeTheSignificanceOfEchinoderm LarvalForms.

References

1. EkambaranathaIyyer E.K– A Manual of Zoology (Vol.I).
2. Kotpal, R.L. 1996. Modern Text Book of Zoology Invertebrates. Rastogi Publications, New Delhi.
3. Agarwal, V.K. 2003. Invertebrate Zoology. S.Chand& Company Ltd. New Delhi.
4. Nair, N.C., Leelavathy, L.SoundaraPandian, N.Murugan, T and Arumugam, N. 2009. A Text Book of Invertebrates. Saras Publications, Nagerkoil.
5. Rastogi, V.B. 1984. Invertebrate Zoology, KedarNath Ram NathPublicationos, Meerut.

Web Link:

1.https://www.syllabusfinder.com/university-of-toronto/eeb266-introduction-to-animal-biodiversity---invertebrates-fall-2014

2. https://fas.calendar.utoronto.ca/course/eeb266h1(Toronto University, Canada).

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	**20U1ZOCP1**	**Practical – I – (INVERTEBRATA)**	**3**	**4**

Objectives:

1. To know the evolutionary trend in the digestive, nervous systems of Earth worm, Cockroach, Pila and Freshwater mussel.
2. To understand the mode of feeding in the insects observing the mouthparts.

Dissections

Earthworm : Digestive and nervous Systems.
Prawn : Nervous system.
Cockroach : Digestive, nervous and reproductive systems
Pila : Alimentary Canal and nervous system
Fresh Water Mussel : Digestive system

Mountings

Earthworm : Body setae and penial setae
Prawn : Appendages
Cockroach : Mouthparts
Honeybee : Mouthparts
Housefly : Mouthparts
Pila : Radula
Freshwater mussel : Pedal ganglion

LIST OF SPOTTERS

Protozoa **:** Entamoeba,Trypanosoma. Paramecium – Binary fission and Conjugation, Plasmodium

Porifera **:** Sponge - Gemmules, spicules,

Coelenterata **:** Obelia – Entire, Medusa; Physalia, Aurelia, Sea anemone and Corals

Platyhelminthes **:** *Fasciola hepatica* entire, T.S. of Redia larva, Cercaria larva, *Taenia solium* – entire, T.S. and Scolex.

Nematoda **:** Ascaris male and female, T.S. of male and female, Dracunculus, Ancylostoma and Wuchereria

Annelida **:** Neries entire, Parapodium, Heteroneries, Earthworm entire, Leech entire , T.S. of Leech, Nephridium, Trochophore larva, Peripatus.

Arthropoda **:** Daphnia, Cyclops, Sacculina, Limulus. Nauplius, Zoea, Mysis, Megalopa, Phyllososma, Alima, Honey bee, *Bombyx mori.*

Mollusca **:** Chiton, Dentalium, Sepia, Nautilus, Mytilus, Loligo Glochidium Larva.

Echinodermata	**:**	Starfish, Sea urchin, Sea–Cucumber. Bipinnaria larva, Auricularia Larva, Pluteus Larva, Pedicellaria, Aristotle's Lantern. A record of lab work and report on field trip should be maintained and submitted at the time of practical examination for valuation.

Mark Details:

Methodology	**=**	20
Execution	**=**	30
Record	**=**	10
Total	**=**	60

Candidates will be required to identify and comment upon specimen of Zoological interest Microscopic preparations, pertaining to types and examples studied under classification. A record of laboratory work and a **report on local field trip should be maintained and submitted at the time of practical examination for valuation.**

Course Outcomes

After completion of this course, students will be able to

- students get identification knowledge of Algae from the classification
- get more idea about the life cycle of algae and fungi
- students get awareness about the general characteristics of fungi
- learn more information about the internal structures and development biology
- understand the physiological processes of plants.

Reference:

G.S. Sandhu – Advanced Practical Invertebrate Zoology,
Gurdarshan Singh – Manual of Laboratory specimens – Invertebrates.
H.S. Bharmah – Practical Zoology : Invertebrates.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	**20U1ZOBOA1**	**Allied Botany – I**	**5**	**4**

Objectives:

- To make the students more competent in various areas in plant science.
- To get elementary knowledge in the classification of Cryptogames.
- To learn the form, occurrence, cell structure and reproduction of algae and fungi.
- To observe the internal structures of dicots and monocots of angiosperms.
- To understand in detail about physiological activities of plants.

Unit I

Elementary knowledge of bacteria, Classification, Ultrastructure of E.coli. Economic importance of bacteria. General account of plant viruses (TMV)

Unit II

Classification of cryptogames. Study of Nostoc, Chlorella, Ectocarpus, Polysiphonia, Albugo.

Unit III

Penicillium, Polyporus, Polytrichum, Lycopodium, Cycas (excluding developmental studies).

Unit IV

Types of tissues, Primary structure of dicot stem, root and leaf. Secondary thickening in dicot stem. Structure of mature anther and ovule, fertilization, structure of dicot embryo.

Unit V

Absorption of water, photosynthesis: Light reaction, dark reaction (Calvin cycle); Respiration: Glycolysis, Kreb's cycle.

Course outcomes:

After completion of this course, students would be able to

- students get identification knowledge of Algae from the classification
- get more idea about the life cycle of algae and fungi
- students get awareness about the general characteristics of fungi
- learn more information about the internal structures and development biology
- understand the physiological processes of plants.

Books for Reference:

1. Ganguly, A.K., (1971). General Botany, Vol. II, The New Book Stall, Calcutta.
2. Rao, K.N., Krishnamurthy, K.V. and Rao, G., (1979). Ancillary Botany, Viswanathan Private Ltd.
3. Dutta, A.C., College Botany, Vol. I & II.

Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
I & II	**20U2ZOBOAPL**	**Allied Botany- Practical (NS)**	**3**	**--**

Objectives:

- To know the various forms of algae, fungi ,bryophytes, pteridophytes and gymnosperms.
- To study the various aspects of internal structure of root stem and leaves
- To make the students to understand the various principles of physiological experiments.
- To Understand the techniques of horticulture and mushroom cultivation.

A study of the vegetative and reproductive structure of the following genera-Nostoc, Chlorella, Ectocarpus, Polysiphonia, Albugo, Penicillium, Polyporus, Polytrichum, Lycopodium and Cycas..

A study of the simple and complex permanent tissues – internal structure of stem, root, leaf, (both dicot and monocot)

Critically comment on some simple experimental setup in physiology.
Thistle funnel experiment
Hydrilla funnel experiment
Kuhne's fermentation tube
Ganonq's light screen experiment
Parired respiroscope (Anaerobic respiration)
Ganong's photometer.

Observe the morphological characters of the following families – Annonaceae, Rutaceae, Rubiaceae, Apocynaceae, Euphorbiaceae and Poaceae

Acquire elementary practical knowledge on Biotechnology, Horticulture and Mushroom cultivation (Photos/ Diagrams/Techniques/Implements/Tools)

Course outcomes:
After completion of this course, students would be able to

- To learn the vegetative and reproductive structure of thallophytes bryophytes, and pteriodophytes
- Understand the tissue system and internal structures of plants
- Students get awareness about the physiological experiments
- Observe the morphological characters of some important families
- Acquire some basic knowledge on biotechnology, horticulture and mushroom technology

B.Sc., Zoology

Semester	Subject Code	Title Of The Paper	Hours Of Teaching/ Week	No. of Credits
II	**20U2ZOT2**	**இடைக்கால இலக்கியம் – பயன்முறைத் தமிழ் –இலக்கண வரலாறு**	**6**	**3**

நோக்கம் :

1. *தமிழிலக்கிய வரலாற்றில் பக்தி இலக்கியங்கள் பெறும் சிறப்பை உணர்வர்.*
2. *சமய வழிச் சமூக மாற்றத்திறன் பெறுவர்.*
3. *சமய நல்லிணக்க உணர்வை மாணவர்கள் பெறுவர்.*

கூறு: I **நேரம்: 18**

1. *திருஞானசம்பந்தர் தேவாரம் : சீகாழி திருப்பதிகம் (பா.எ.360—370)*
2. *திருநாவுக்கரசர் தேவாரம் : திருவையாற்றுப் பதிகம் (பா.எ.124—133)*
3. *சுந்தரர் தேவாரம் : திருமழபாடி பதிகம் (பா.எ.1-10 பாடல்கள்)*
4. *மாணிக்கவாசகர் : திருவாசகம் - பிடித்த பத்து*

கூறு: 2 **நேரம்: 18**

1. *பெரியாழ்வார்: திருமொழி - தாய்ப்பால் உண்ண அழைத்தல் 10 பாடல்கள்*
2. *குலசேகர ஆழ்வார்: பெருமாள் திருமொழி- தாலாட்டு - 10 பாடல்கள்*
3. *ஆண்டாள் நாச்சியார்: நாச்சியார் திருமொழி- திருமணக்கனவை உரைத்தல்*
4. *திருப்பாணாழ்வார்: அமலனாதிபிரான் -10 பாடல்கள்*

கூறு: 3 **நேரம்: 18**

1. *குமரகுருபரர்: மீனாட்சியம்மைப் பிள்ளைத் தமிழ் வருகைப் பருவம் - 10 பாடல்கள்*
2. *திரிகூடராசப்பக்கவிராயர் : குற்றாலக் குறவஞ்சி - குறத்தி மலைவளம் கூறல்*
3. *வீரமாமுனிவர்: தேம்பாவணி - காட்சிப்படலம் முழுவதும்*
4. *உமறுப்புலவர் : சீறாப்புராணம்-விலாதத்துக் காண்டம்- கதீஜா கனவு கண்ட படலம்.*

கூறு: 4 பயன்முறைத் தமிழ் **நேரம்: 18**

எழுத்தியல்: உயிரெழுத்து, மெய்யெழுத்து, உயிர்மெய்யெழுத்து, முதலெழுத்து, சார்பெழுத்து, மொழிக்கு முதலாக இருதியாக வரும் எழுத்துக்கள், போலி.
சொல்லியல்: இலக்கண, இலக்கிய வகையிலான சொற்கள்.
பொதுவியல் : எழுத்துப் பிழைகளை நீக்குதல், எழுத்துப் பிழைகளும் திருத்தங்களும், வலிமிகுதல், வலிமிகாமை, வாக்கிய அமைப்புகள் நிறுத்தற் குறியீடுகள்.

கூறு: 5 இலக்கண இலக்கிய வரலாறு **நேரம்: 18**

1. *இலக்கண வரலாறு (தமிழ்த்துறை வெளியீடு)*
2. *தமிழ் இலக்கிய வரலாறு: இடைக்கால இலக்கியம்*

பயன்கள்

1. *பல்வகை சமய இலக்கியப் போக்குகளை அறிந்து கொள்வர்.*
2. *சமயவழித் தமிழரின் வாழ்வியலை அறிவர்.*
3. *பல்வகை சமயக் கோட்பாட்டினை அறிந்துகொள்வர்.*
4. *பிழையின்றி எழுதப் பழகுவர்.*
5. *சமயங்களின் இன்றியமையாமையை உணர்வர்*

Semester	Course Code	Title of The Course	Hours of Teaching/ Week	No. of Credits
II	**20U2ZOE2**	**PART – II- Extensive Readers and Communicative Skills**	**6**	**3**

Objective

- To impart language and communicative skills through short stories, one- act plays and communicative grammar.

Unit – I

Shakespeare – The Seven Stages of Man

Longfellow – A Psalm of Life

Nissim Ezekiel – Enterprise

William Wordsworth – The world is too much with us

Unit – II

Anton Chekhov - The Bear

Cedric Mount - The Never-Never Nest

Farrell Mitchell - The Case of the Stolen Diamonds

M.V. Rama Sharma - The Mahatma

Unit - III

Fyodor Dostoevsky - The Christmas Tree and the Wedding

The Duchess - The Jewelry

O. Henry - The Romance of a Busy Broker

Unit – IV

Verb, Verbs – Mood and Tense, Concord or Agreement of the verb with the subject.

Unit – V

The Auxiliaries, Model Auxiliaries, Preposition, Conjunctions, Interjection.

Course outcomes

After the completion of this course students will be able to

- **promote the linguistic and communicative objectives through the study of poems, short stories and the communicative grammar.**
- **gain language and communicative skills through short stories**
- **identify and differentiate different forms of literature.**
- **engage in reflective writing after learning the prescribed lessons.**
- **enhance the communicative skills through LSRW**

Prescribed Texts:

- *Voices of Vision*, Board of Editors, NCBH, Chennai, 2016.
- *Communicative Grammar,* The Department of English Course Material.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	**20U2ZOC2**	**MICROBIOLOGY**	**6**	**6**

Objectives:

1. To study about the Microscope – structure and functions of various microscopes.
2. To study the classification of microorganisms and their structure.
3. To study about the preparation of bacterial culture medium and Gram's staining techniques.
4. To study the pathology of various microbes.
5. To study the role of microbes in agriculture, food and dairy industries.

Unit I **Hrs 18**

Classification: Prokaryotic and eukaryotic microorganisms, microbial diversity – fungi, algae, bacteria, protozoans viruses. Nutritional classifications of microorganisms. Basic structure – Virus, Bacteria and yeast bacteria virus.

Unit II **Hrs 18**

Scope of Microbiology –History principle and applications of Microscopy – optical, TEM and SEM; Sterilization methods – dry heat and moist heat, radiation, chemical, filteration; significance of Pasteur's experiment.

Unit III **Hrs 18**

Bacterial culture technology – Bacterial culture medium – composition and preparation. Types of Media preparation of culture media (Enriched media and differential media). Bacteria - Isolation and pure cultures. Serial dilution technique, Streak plate method and Pour plate method Gram staining technique – Preservation and maintenance of bacterial culture

Unit IV **Hrs 18**

Normal microfloara of the human body: skin, throat and GI tract; Causative agents, symptoms and mode of transmission. Human diseases - Viral diseases: Influenza, Mumps, Viral Hepatitis, Poliomyelities, AIDS, and Chicken pox. Bacterial diseases: Pneumonia, whooping cough; Typoid, Cholera, Diphtheria, Tuberculosis and Leprosy. Fungal Diseases: Aspergillosis, dermatomyces and oppourtusitic mycosis.

Unit V **Hrs 18**

Agricultural microbiology. Culture techniques and applicatioins of Azospirillum, Azolla, Acetobacter and BGA . Phosphate biofertilizer and VAM fungi Mass culture and its uses.

Unit VHrs 18

Agricultural microbiology. Culture techniques and applicatioinsofAzospirillum, Azolla, Acetobacter and BGA . Phosphate biofertilizer and VAM fungi Mass culture and its uses.

Course Outcomes

After completion of this course, students will be able to

- **Understand The Classification Of ProkaryoticMicroorganisms.**
- **Realize The Techniques Of Microscopy And Culture MethodsOfBacteria, Fungi AndYeast.**
- **Explore The Knowledge On Pathogen, Pathogenesis And DiagnosisOfVariousMicroorganisms.**
- **Focus The Knowledge On The Culture Of Azospirillum, Azolla,Acetobacter,BGA,AndVAM Fungi.**
- **Skill in advanced techniques.**

References:

1. Ross, F.C. – Introductory Microbiology (Bell and Howell Co, London).
2. Pelzer, M.J.Reid, R.D and Chan, E.C.S – Microbiology (McGraw Hill).
3. Purohitm S.S. Microbiology – Fundamentals and Applications, (Agro Bios).
4. Dubey, R.C. &Maheshwari, D.K. A Text Book of Microbiology. (S.Chand& Co.)
5. Sharma, P.D. – Microbiology (Rastogi Publication).
6. Powar, C.B and Daginawala, H.E – General Microbiology (Himalaya Publishing House Meerut).
7. Anita Rozar – Practical methods for Environmental Microbiology and Biochemistry.
8. Bisen – Handbook of Microbiology (CBS Pulishers, New Delhi).
9. Michael, J. Waites – Industrial Microbiology – and Introduction (Blackwell Sciences, New York)
10. Patel, A.H. – Industrial Microbiology (Tata McGraw Hill Publishers).
11. Power, C.B. and DaginaWala – Industrial Microbiology (Tata McGraw Hill).

Web link: https://catalog.slu.edu/courses-az/bchm/ (Saint Louis University)

Semester	Subject Code	Title of the Paper	Hours of Teaching/ Week	No. of Credits
II	**20U2ZOCP2**	**Practical - II (MICROBIAL TECHNIQUES)**	**3**	**4**

Objectives:

1. To study about the Microscope – structure and function of various microscopes.
2. To study the classification of microorganisms and their structure.
3. To study about the preparation of bacterial culture medium and Gram's staining techniques.
4. To study the pathology of various microbes.
5. To study the role of microbes in agriculture, food and dairy industries.

PRACTICALS

1. Cleaning and preparation of glasswares.
2. Sterilization of glasswares and media.
3. Preparation of fungal culture media – PDA and Rose Bengal Agar medium.
4. Preparation of Bacterial culture media – NA and Nutrient broth medium.
5. Identification of microorganisms in water and soil samples.
6. Pure culture technique – Serial dilution, Streak plate and pour plate technique.
7. Staining techniques – Gram's staining and Lactophenol cotton blue staining.
8. Biochemical test – Fermentation of Carbohydrate and Amylase test.

SPOTTERS

Hot air oven, Autoclave, Pressure cooker, Agar plate, Inoculation needle, Petri plates, Laminar air flow, Colony counter, Haemocytometer.

HIV, Bacteriophage, Yeast, *E.coli, Pseudomonas, Bacillus subtilis, Streptococci, Vibrio cholera, Aspergillus niger, A.flavous, Pencillium janthinelum, P.citrinum* and *Fusarium* sp.,

Course Outcomes

After completion of this course, students will be able to

- aware on the sterilization technique.
- develop skills in preparation of culture media for microbes.
- acquire knowledge in pure culture technique.
- attain skills in staining technique for microbes

Reference:

Anita Rozar – Practical methods for Environmental Microbiology and Biochemistry.
Bisen – Handbook of Microbiology (CBS Pulishers, New Delhi).
Michael, J. Waites – Industrial Microbiology – and Introduction (Blackwell Sciences, New York)
Patel, A.H. – Industrial Microbiology (Tata McGraw Hill Publishers).

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	**20U2ZOBOA2**	**Allied Botany – II**	**5**	**4**

Objectives:

- To enable the students to get a faire knowledge Morphology and Taxonomy of Angiosperms
- To learn the various applied aspects of Biotechnology, Horticulture and Mushroom cultivation technology
- To acquires skills to engage themselves in self-employment especially in the fields of Horticulture and Mushroom culture.

Unit I

Morphology – leaf and its modifications, inflorescence, flower and fruits. Outline of Bentham and Hooker's system of classification.

Unit II

Study the range of characters and economic importance of Annonaceae, Rutaceae, Apocynaceae, Euphorbiaceae and Poaceae.

Unit III

Biotechnology – definition and importance of biotechnology, principles of genetic engineering and r-DNA technology.

Unit IV

Horticulture, scope and importance – propagation methods (Cuttage, layering - air layering) Gardening and Landscaping, Lawns, Indoor plants, Bonsai techniques.

Unit V

Mushroom cultivation – introduction, Nutritive value and importance of mushrooms. Cultivation of Oyster mushroom, spawn preparation, preservation of mushrooms, recipes made from mushrooms (Mushroom soup and omelette).

Books for Reference:

- Ganguly, A.K., (1971). General Botany, Vol. II, The New Book Stall, Calcutta.
- Rao, K.N., Krishnamurthy, K.V and Rao, G., (1979). Ancillary Botany, Viswanathan Private Ltd.
- Dutta, A.C., (1971). College Botany, Vol. I & II.

Course outcomes:

After completion of this course, students would be able to

- Get basic knowledge on morphology and classification of plants
- Understand the characteristic features and economic importance of different families
- Students get awareness about the biotechnology especially r-DNA technology
- Learn more about various horticultural techniques
- Understand the importance and cultivation methods of edible mushroom.

Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
I & II	**20U2ZOBOAPL**	**Allied Botany- Practical (NS)**	**3**	**2**

Objectives:

- To know the various forms of algae, fungi ,bryophytes, pteridophytes and gymnosperms.
- To study the various aspects of internal structure of root stem and leaves
- To make the students to understand the various principles of physiological experiments.
- To Understand the techniques of horticulture and mushroom cultivation.

Unit I

A study of the vegetative and reproductive structure of the following genera-Nostoc, Chlorella, Ectocarpus, Polysiphonia, Albugo, Penicillium, Polyporus, Polytrichum, Lycopodium and Cycas..

Unit II

A study of the simple and complex permanent tissues – internal structure of stem, root, leaf, (both dicot and monocot)

Unit III

Critically comment on some simple experimental setup in physiology.

Unit IV

Observe the morphological characters of the following families – Annonaceae, Rutaceae, Rubiaceae, Apocynaceae, Euphorbiaceae and Poaceae

Unit V

Acquire elementary practical knowledge on Biotechnology, Horticulture and Mushroom cultivation (Photos/ Diagrams/Techniques/Implements/Tools)

Course outcomes:

After completion of this course, students would be able to

- To learn the vegetative and reproductive structure of thallophytes bryophytes, and pteriodophytes
- Understand the tissue system and internal structures of plants
- Students get awareness about the physiological experiments
- Observe the morphological characters of some important families
- Acquire some basic knowledge on biotechnology, horticulture and mushroom technology.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	**20U2ZOS1**	**SKILL BASED EDUCATION –I - CLINICAL ANALYSIS OF BIOLOGICAL SAMPLES**	**1**	**1**

Objectives:

1. To study the Safety regulation and first aid.
2. To know the Clinical tests of Blood, Urine, Sputum, Stool, Semen.

UNIT I

Scope for study of clinical laboratory technology, Functional Components of Clinical Labs, Needs of Clinical Labs, Storage and Handling of Chemical, Safety regulation and first aid, Quality Improvement for Clinical Laboratory.

UNIT II

Blood cell counting - Erythrocyte sedimentation rate (ESR), Determination of packed cell volume. (PCV), Determination of Haemoglobin, Determination of Blood sugars (glucose), Cholesterol, Urea, Albumin, Hypoglycaemia and Hyperglycemia

UNIT I

Scope for study of clinical laboratory technology, Functional Components of Clinical Labs, Needs of Clinical Labs, Storage and Handling of Chemical, Safety regulation and first aid, Quality Improvement for Clinical Laboratory.

UNIT II

Blood cell counting - Erythrocyte sedimentation rate (ESR), Determination of packed cell volume. (PCV), Determination of Haemoglobin, Determination of Blood sugars (glucose), Cholesterol, Urea, Albumin, Hypoglycaemia and Hyperglycemia

Course Outcomes

After completion of this course, students will be able to

- learnfunctional components of clinical labs
- acquire depth knowledge in safety regulations clinical laboratory
- analyze the cell counting of human blood.
- determine glucose, cholesterol, urea, albumin in blood.

Reference:

1. Biological chemistry – Lehinger
2. Human physiology by peark
3. Medical Laboratory Technology – A procedure manual for routine diagnostic Tests – Vol – I – III By Kanai L. Mukherjff.
4. Clinicalchemistry: principles,techniques,andcorrelations: editedbyMichaelL.Bishop, Edward P.Fody,Larry E.Schoeff. Other m titles:Eighthedition.Philadelphia: WoltersKluwer,[2018] Includesbibliographicalreferencesandindex.

https://www.tamut.edu/faculty/syllabi/201520/20520.pdf (Texas A&M University, Texarkana)
https://canvas.harvard.edu/courses/63100/assignments/syllabus (Hardvard University)

Semester	Subject Code	Title Of The Paper	Hours Of Teaching / Week	No. of Credits
III	**20U3ZOT3**	**காப்பியங்கள், கட்டுரைகள், இலக்கிய வரலாறு**	**6**	**3**

நோக்கம்

1. காப்பியங்களின் உள்ளடக்கம், உத்திகளைக் கற்றுக்கொடுத்தல்.
2. காலந்தோறும் காப்பியங்களில் காணலாகும் பாடுபொருள்களின் மாற்றங்களை எடுத்துரைத்தல்.
3. காப்பியச்சுவையை மாணவர்கள் அறிந்து கொள்ளச் செய்தல்.

கூறு: 1 காப்பியங்கள் 1 **நேரம்: 18**

1. சிலப்பதிகாரம்: மதுரைக்காண்டம்-வழக்குரைகாதை
2. மணிமேகலை; மலர்வனம் புக்ககாதை
3. சீவக சிந்தாமணி: சுரமஞ்சரியார் இலம்பகம்
4. கம்பராமாயணம்: கங்கைப் படலம்

கூறு: 2 காப்பியங்கள் 2 **நேரம்: 18**

1. பெரியபுராணம் : மெய்ப்பொருள் நாயனார் புராணம்-முழுவதும்
2. அரிச்சந்திரபுராணம்: மயான காண்டம்
3. தேம்பாவணி: திருமணப் படலம்-1-10 பாடல்கள்
4. சீறாப்புராணம் : நபி அவதாரப் படலம்-1-10 பாடல்கள்.

கூறு: 3 கட்டுரைத் தொகுப்பு **நேரம்: 18**

1. கேட்டிவி - இராகபாவம் (1-10)
2. கேட்டிவி - பயணங்கள் தொடரும்

கூறு: 4 கட்டுரைகள், கடிதங்கள் மொழிபெயர்ப்புப் பயிற்சி **நேரம்: 18**

பயிற்சிக்கட்டுரைகளும் கடிதங்களும் -பாவை வெளியீடு
கட்டுரைப் பயிற்சி - 10 மதிப்பெண்கள்
மொழிபெயர்ப்புப் பயிற்சி - 5 மதிப்பெண்கள்

கூறு: 5 **நேரம்: 18**

அ. இலக்கிய வரலாறு

காப்பிய இலக்கியங்கள் - சிற்றிலக்கியங்கள்

பயன்கள்

1. காப்பியங்கள் வாயிலாக அக்காலச் சமுதாயச் சூழலை அறிவர்.
2. பல்வேறு காப்பியங்களையும் ஒப்பிட்டு அவற்றின் தனித்தன்மைகளை அறிந்துகொள்வர்.
3. மீட்டுருவாக்கச் சிந்தனைகளை அறிவர்.
4. கட்டுரை எழுதும் திறன் பெறுவர்.
5. கடிதங்கள் எழுதும் பயிற்சி பெறுவர்.

Semester	Course Code	Title of The Course	Hours of Teaching /Week	No. of Credits
III	**20U3ZOE3**	**PART - II Shakespeare, Extensive Readers and Communicative Skills**	**6**	**3**

Objective

- To introduce the language and creativity of the world renowned dramatists and novelists to enhance the communicative skills of the learners.

Unit – I

Julius Caesar

The Merchant of Venice

Unit – II

Macbeth

Twelfth Night

Unit – III

Romeo and Juliet
Tempest

Unit – IV

Charles Dickens – David Copperfield.

Unit – V

Simple, Compound, Complex and Compound – Complex Sentences, Analysis of Simple Sentences, Clauses, analysis of Complex Sentences, Analysis of Compound Sentences and Compound – Complex Sentences, Synthesis of Sentences, Transformation of Sentences – I, Transformation of Sentences – II

Course outcomes

After the completion of this course students will be able to

- **promote their communicative skills through the study of Shakespeare and modern communicative methods.**
- **expand their perception interacting with the culture across the world**
- **imbibe moral and ethical prescriptions**
- **appreciate the creative genius and affluent expressions of Shakespeare**
- **develop the creative and analytical faculty**

Prescribed Texts:

Natarajan, K.ed. *Selected Scenes from Shakespeare*. Chennai: NCBH, 2017.
Hardy, Thomas.*The Mayor of CasterBridge*.(abridged)Chennai: Macmillan Publishers,2012.
Communicative Grammar.Department of English Edition. 2017.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20U3ZOC3**	**CHORDATA**	**6**	**6**

Objectives:

1. To study about the chordate animals upto orders with suitable examples.
2. To study about the accessory respiratory organs and migration of fishes.
3. To study the parental care in Amphibia, poisonous and non-poisonous snakes of South India, flight adaptation and migration of birds.
4. To study prototheria ,metatheria and dentition in mammals.
5. To study the detailed information about Amphioxus, Scoliodon, Frog, Pigeon and Rat.

Hrs 18

Unit I

General characters of Chordata and its outline classification – Origin of Chordates – General characters of Prochordates and its classification.

Detailed study – Amphioxus

General Topics: 1. External features of Balanoglossus and Ascidian.
2.Retrogressive metamorphosis in Ascidian.

Unit II **Hrs 18**

Vertebrata – General characters and its outline Classification. External features of Petromyzon; Pisces – General characters and classification up to orders with suitable examples.

Detailed study – Scoliodon (Shark)

General topics: 1. Accessory respiratory organs of fishes
2. Migration of fishes.

Unit III **Hrs 18**

Amphibia and Replitia – General characters and classification up to orders with examples.

Frog – External characters and life history

Detailed study – Calotes.

General topics: 1. Parental care in Amphibia
2. Identification of Poisonous and non-poisonous snakes in South India.

Unit IV **Hrs 18**

Aves – General characters and classification upto orders with examples.

Detailed study – Pigeon

General topics : 1. Flight Adaptation
2. Flightless birds.
3. Migration of birds.

Unit V **Hrs 18**

Mammalia – General characters and classification up to orders with examples.

Detailed study : Rat

General topics : 1. Prototheria and Metatheria – Salient features and examples.
2. Dentition in Mammals.
3. Adaptations of Aquatic Mammals.

Course Outcomes

After completion of this course, students will be able to

- identify chordate animals.
- realize the importance of accessory respiratory organs and migratory behaviour of fishes.
- gain the knowledge on parental care in Amphibia.
- aware on poisonous and non-poisonous snakes of South India,.
- acquire knowledge on the organization of Amphioxus, Shark, Frog, Pigeon and Rat.

References

1. EkambaranathaIyyerE.K– A Manual of Zoology (Vol.II)(Chordata).
2. Kotpal, R.L. 1996. Modern Text Book of Zoology Vertebrates. Rastogi Publications, New Delhi.
3. Alexander – The Chordates.
4. Goodrich – Structure and Development of Vertebrata (Vol.I and II)
5. Jothie, M. – Chordate Morphology.
6. Dhami, P.S. and Dhami, J.K. 1982. Chordate Zoology, R.Chand& Co. Publishers, New Delhi.
7. R. McNeill Alexander, 1981. The chordates, Cambridge University, Cambridge.
8. Weichert, C.K., 1965. Anatomy of the chordates, McGraw Hill Book Company,Inc. New York.
9. Yapp, W.B., 1965. Vertebrates, Their structure and life, Oxford University Press, New York, U.S.A.
10. Malcolm Jollie, 1962. Chordates Morphology, Reinhold Publishing Corporation.New York.

Web Link:

1.https://www.studocu.com/ph/document/notre-dame-of-dadiangas-university/vertebrate-structure-function-and-morphology/lecture-notes/bio-23-syllabus-edited-2019/5423920/view(Notre Dame of daldiangas University)

2.https://books.google.co.in/books?id=Vqs8AAAAIAAJ&pg=PA23&dq=chordates+-+oxford+university+press&hl=ta&sa=X&ved=2ahUKEwjXs92E9qjqAhVa7XMBHTwbCkIQ6AEwAXoECAEQAg#v=onepage&q=chordates%20-%20oxford%20university%20press&f=false(Oxford University)

3.https://www.biodiversitylibrary.org/item/28799#page/9/mode/1up

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20U3ZOCP3**	**Practical – III (CHORDATA)**	**3**	**4**

Objectives:
1. To know the various systems of Calotes and Rat.
2. To study the important chordate animals as spotters.

Dissection

1. Fish : Digestive System, Arterial system and venous system
2. Rat : Digestive System, Arterial system and venous system – Virtual Lab.

Mounting : Placoid scale of shark, Brain of Fish and Rat.

Candidates are required to indentify and comment upon specimen of Zoological interest, microscopic preparations pertaining to types and examples studied under classifications and osteology of types.

List of Spotters – Chordates

Amphioxus, Balanoglossus, Tornaria larva, Ascidia, Petromyzon, Shark, Mullet, Eel, Arius, Exocoetus, Saccobranchus, Synapta, Echenies, Gambusia, Clarias, Anabas, Varanus, Draco, Calotes, Hemidactylus, Chaemeleon, Oligodon, Cobra, Viper, Python, Pit viper, Pigeon, Owl, Parrot, Kingfisher, Rat, Bat, Loris, Dentition – Rabbit.

Pectoral, girdle : Frog, Calotes, Pigeon and Rabbit
Pelvic Girdle : Frog, Calotes, Pigeon and Rabbit
Fore and Hind Limbs : Frog, Calotes, Pigeon and Rabbit
Skull : Frog, Calotes, Pigeon and Rabbit

Course Outcomes

After completion of this course, students will be able to

- Identify chordate specimens
- Understand the importance of girdles and skulls of chordates
- Develop skills in the structural organization on the fish and rat.

Acquire knowledge on mounting of placoid scales and brain.

Field work Report:

A record of lab work and report on Field Trip (places of zoological interest) should be maintained and submitted at the time of practical examination for valuation.

Reference:

1. G.S. Sandhu – Advanced Practical Chordate Zoology
2. Gurdarshan Singh – Manual of Laboratory specimens – Chordates
3. H.S. Bharmah – Practical Zoology; Chordates.

Semester	Subject code	Title of the paper	Hours of Teaching/ Week	No. of Credits
III	**20U3ZOCHA1**	**Allied chemistry – I**	**5**	**4**

OBJECTIVE

- To acquire a basic knowledge of animal diversity and organization.
- To study the general aspects of Invertebrates and Parasites.
- To study the general aspects of Chordata animals and their anatomy
- To learn the general principles.

UNIT I Fundamental concepts

Bonding – nature of bonds – ionic, covalent, coordinate and hydrogen bonds - Cleavage of covalent bonds – homolytic and heterolytic fission – electrophiles, nucleophiles and free radicals . Types of organic reactions – substitution, addition, elimination, rearrangement – definition and examples. Hybridisation – states of hybridization of carbon in methane, ethane, ethylene, acetylene.

UNIT II Fuel gases, Plant nutrients and Fertilizers

Fuel gases – natural gas, water gas, semi water gas, carburetted water gas, producer gas, LPG and oil gas – composition, manufacture (elementary idea) and uses. Plant nutrients – major nutrients – role of nitrogen, phosphorus and potassium in plant life, micro nutrients. Fertilizers – definition, urea, ammonium sulphate, superphosphate of lime, triple superphosphate and potassium nitrate – preparation and uses.

UNIT III Industrial Organic Chemistry

Pesticides – DDT, BHC – preparation and uses. Refrigerant – freon 12 – preparation, properties and uses. Polymers – definition, classification – natural and synthetic, homo and copolymers, natural polymers – cotton, silk and wool, preparation and applications of the synthetic polymers – polythene, PVC, teflon and nylon. Synthetic dyes – classification, preparation and uses of methyl orange and indigo, food colours.

UNIT IV Colloidal State and Chromatography

Colloidal system – definition, types -Emulsions– definition, types – o/w and w/o emulsions – tests for identification, properties and applications. Gels – definition, classification, preparation and properties – syneresis, imbibition and thixotropy. Electrophoresis – applications. Chromatography–column and paper chromatography – experimental procedures only.

UNIT V Pharmaceutical chemistry

Antiseptic & disinfectants – phenolic compounds – Dettol, phenyle & Lysol – Definition – differences – medicinal uses and side effects. Anaesthetics – general anaesthetics and local anaesthetics – Definition, examples, uses and side effects. Analgesics – narcotic– morphine & pethidine, non-norcotic – salicylic acid & its derivatives – medicinal uses and side effects. Organic pharmaceutical aids – Preservatives, antioxidants, colouring, flavouring and sweetening agents – Definition, examples and uses.

Course Outcomes

After completion of this course, students will be able to

- Acquire a basic knowledge of animal diversity and organization.
- Gain knowledge on general aspects of Invertebrates and Parasites.
- Learn the general aspects of Chordata animals and their anatomy

Text Books:

1. Text Book of Ancillary Chemistry,**V.Veeraiyan** et al,revised edition, 1997.
2. Allied Chemistry, **R. Gopalan** and **S. Sundaram,** , S. Chand & Sons, 2nd edition, 1993.

Reference Books:

1. Text Book of Organic Chemistry**, P.L. Soni** and **H.M. Chawla**, S.Chand& Sons, , 29th edition, 2014 (Unit III).
2. Principles of Inorganic Chemsitry, **B.R. Puri,L.R. Sharma** and **K.C. Kalia** Vishal Publishing Co, Reprint 2016 (Unit I & II).
3. Principles of Physical Chemistry,**B.R.Puri, L.R. Sharma,** Vishal Publishing Company, Jalandhar, 44th edition 2009. (Unit IV)
4. A text book of pharmaceutical chemistry, **Jayashree Ghosh**, S.Chand and Company Ltd., New Delhi, 1st edition, 2004. (Unit V)
5. Pharmaceutical Chemistry, **S. Lakshmi**, S.Chand& Company Ltd., New Delhi, 3rd edition, 2004. (Unit V)

Semester	Subject Code	**Title of the Paper**	Hours of Teaching /Week	No. of Credits
III & IV	**20U4ZOCHAPL**	**Allied chemistry practical (Non – semester)**	**3+3**	**--**

Objectives

To introduce the concepts of numerical solution of ordinary differential equation and 3 dimensional analytical geometry.

A. Volumetric Analysis

1. Estimation of HCl (or H_2SO_4) by NaOH using a standard oxalic acid solution
2. Estimation of NaOH by H_2SO_4 (or HCl) using a standard Na_2CO_3 solution
3. Estimation of oxalic acid by $KmnO_4$ using a standard Mohr's salt solution
4. Estimation of Ferrous sulphate by $KmnO_4$ using a standard oxalic acid solution.
5. Estimation of Mohr's salt by $KmnO_4$ using a standard oxalic acid solution.
6. Estimation of KMnO4 by thio using a standard $K_2Cr_2O_7$ solution.
7. Estimation of $K_2Cr_2O_7$ by thio using a standard $CuSO_4$ solution
8. Estimation of $CuSO_4$ by thio using a standard $K_2Cr_2O_7$ solution

B. Organic qualitative analysis

Systematic analysis of an organic compound , Preliminary tests, detection of element present, Aromatic or aliphatic, Saturated or unsaturated, nature of the functional group and exhibiting confirmatory tests for given organic compounds.

The following substance are prescribed:

Benzoic Acid, Cinnamic acid, Phenol, Cresol, Aniline, Toludine, Urea, Benzaldehyde, Glucose

Reference:

1. Venkateswaran V. Veerasamy R. Kulandaivelu A.R., Basic principles of Practical Chemistry, 2nd edition, Sultan Chand & sons, New Delhi, (1997)

Semester	Subject Code	Title Of The Paper	Hours Of Teaching /Week	No. of Credits
IV	**20U4ZOT4**	**சங்க இலக்கியம் – அற இலக்கியம் – செம்மொழி தமிழ்–இலக்கிய வரலாறு**	**6**	**3**

நோக்கம்:

1. பழந்தமிழ் இலக்கியங்களின் திணைத்துறைக் கோட்பாடுகளை அறிதல்.
2. திணைசார் சமுதாய வாழ்வின் பல்வேறுபட்டப் பரிமாணங்களைப்
3. புலவர்கள் வாயிலாகவும் திணை இலக்கியத்தின் வாயிலாகவும் அறிதல்.
4. பழந்தமிழ் இலக்கியங்களின் உயர்தனித்தன்மை வாய்ந்த சிறப்பியல்புகளை அறிதல்.

கூறு: 1 **நேரம்: 18**

குறுந்தொகை *1.குறிஞ்சி : தலைவன் கூற்று-யாயும் ஞாயும் யாராகியரோ - பா.எ.-40*
2.முல்லை : தலைவி கூற்று-கருங்கால் வேம்பின் ஒண்பூ யாணர் - பா.எ.-24
3.மருதம் : தோழி கூற்று-யாய் ஆகியளே விழவு முதலாட்டி - பா.எ.-10
4.நெய்தல் : தலைவி கூற்று :நள்ளன் றன்றே யாமம் - பா.எ.-6
5.பாலை: செவிலி கூற்று-பறைபடப் பணிலம் - பா.எ.-15

நற்றிணை: *1. குறிஞ்சி-நின்ற சொல்லர் பா.எ. 1*
2. முல்லை:இறையும் அருந்தொழில் -பா.எ.161
3. மருதம்:அறியாமையின் அன்னை - பா.எ.50
4. நெய்தல்:இவளே கானல் நண்ணிய - பா.எ.45
5. பாலை:புணரில் புணராது பொருளே-பா.எ.16

கலித்தொகை: *1. பாலை: எறித்தரு கதிர் தாங்கி- பா.எ.9*
2. குறிஞ்சி : காமர் கடும்புனல்- பா.எ.39

அகநானூறு: *1. குறிஞ்சி:நீர்நிறம் கரப்ப-பா.எ.18 2. முல்லை: வந்துவினை- பா.எ.44*

கூறு: 2 **நேரம்: 18**

1.ஐங்குறுநூறு : குறிஞ்சி -அன்னாய் வாழிப்பத்து -பா.எ.201-210
2.புறநானூறு : பாடல் எண்கள் - 9,16,20,51,109
3.பதிற்றுப்பத்து:ஆறாம் பத்து-பா.எ.1 வடுவடு நுண்ணுயிர், பா.எ.2.கொடி நுடங்கு நிலைய
4.பரிபாடல் : ஏழாம்பாடல் - வையை

கூறு: 3 பத்துப்பாட்டு **நேரம்: 18**

1. குறிஞ்சிப்பாட்டு - முழுவதும்

கூறு: 4 அறநூல்கள் **நேரம்: 18**

1. திருக்குறள்: செய்ந்நன்றியறிதல், வினைத்திட்பம், நெஞ்சொடு கிளத்தல்
2. மூதுரை: 1-10 பாடல்கள். 3. நல்வழி: 11-20 பாடல்கள்
4. நீதிநெறி விளக்கம்: 51-60 பாடல்கள்

கூறு: 5 **நேரம்: 18**

அ. செம்மொழித் தமிழ்— இலக்கிய வரலாறு: செம்மொழி வரலாறு:

மொழி விளக்கம்-மொழிக்குடும்பங்கள்-உலகச் செம்மொழிகள்-இந்தியச் செம்மொழிகள் — செம்மொழித் தகுதிகள்-வரையறைகள் - தமிழின் தொன்மை - தமிழ்ச் செம்மொழி நூல்கள்.

ஆ. இலக்கிய வரலாறு:

சங்க இலக்கியங்கள், பதினெண் கீழ்க்கணக்கு நூல்கள்.

பயன்கள்

1.பழந்தமிழ் இலக்கியங்களை ஆய்வியல் நோக்கில் அணுகுவதற்கான வழிமுறைகளை உணர்த்துதல்.

2.பண்டைத்தமிழரின் அக, புற வாழ்வியலை மாணவர்கள் அறியச் செய்தல்

3.அறத்தின் பெருமையை உணர்வர்

4.ஒழுக்க நெறிகளைப் பின்பற்றுவர்

5.தமிழ் செம்மொழியின் பண்புகளை உணருதல்

6.சங்க இலக்கியத்தின் தொன்மை உணர்தல்

Semester	Course Code	Title of The Course	Hours of Teaching/ Week	No. of Credits
IV	**20U4ZOE4**	**PART - II** **English For Competitive Examinations**	**6**	**3**

Objective

- To prepare the learners for competitive examinations and the fundamentals of practical communication.

Unit – I

Sequence of Tenses and Direct and Indirect Speech

Punctuation and Capitals

Unit – II

Synonyms and Antonyms

One – Word Substitutes for Phrases and Clauses.

Unit – III

Paragraph – Writing, Letter Writing.

Unit – IV

Precise – Writing, Expansion of Passages

Unit – V

Essay – Writing, Writing stories from outlines.

Course outcomes

After the completion of this course students will be able to

- **develop English language skills by equipping themselves to face competitive exams**
- **improve English language abilities and gain the skills of writing and vocabulary building**
- **gain confidence to face competitive exams**
- **assimilate grammatical rule clearly and precisely**
- **hone their presentation and public speaking skills**

Prescribed Text:

English for Competitive Examinations, NCBH, Chennai, Dec. 2019.

Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
IV	**20U4ZOC4**	**BIO-CHEMISTRY, BIO-PHYSICS AND BIO-STATISTICS**	**6**	**6**

Objectives:

- To study the classification, structure and biological importance of carbohydrates, protein, lipid.
- To study the Enzymes and enzyme kinetics
- To study the basics of biophysics.
- To study the basics of biostatistics.

Biochemistry

Unit I **Hrs 18**

Carbohydrates: Classification, structure, properties and functions.

Lipids: Classification, structure, properties and functions, Essential non-essential, saturated and unsaturated fatty acids and Steriods.

Unit II **Hrs 18**

Proteins: Basic structure and classification. Classification of amino acids with examples – simple, acidic, basic, hydroxylic, sulphated and aromatic amino acids.

Nucleic acids - Basic molecular structure of DNA, RNA and their types.

Hrs 18

Unit III

Enzymes: Classification and properties of enzymes, mode of Action – Theories of enzyme action, enzyme Kinetics. Concept of Vmax or Km. Regulation of enzyme activity. Enzymes in food industry and food processing.

Biophysics **Hrs 18**

Unit IV

Colloids: Types and its Properties - Tyndall effect, Surface tension, Brownian movement, filteration, osmosis and dialysis. – Principles of Colorimeter and Spectrophotometer- Beer's and Lambart's law and their applications. Radiology – Applications of UV, fluorescence, atomic absorption, infrared.

Biostatistics **Hrs 18**

Unit V

Biostatistics: –Scope, Types of data, Collection of data; Measures of central tendency: Mean, median and mode – Standard deviation.

Graphical and diagramatic representation – bar types, pie diagram and histogram.

Course Outcomes

After completion of this course, students will be able to

- know the classification, structureand importance of biomolecules
- explore the types of enzymes and enzyme kinetics.
- understand the principles and applications of Colorimeter and Spectrophotometer.
- aware on effect of radiation.
- learn the tools of statistics.

Reference:

1. Biological chemistry – Conn and Stump; Tata McGraw Hill Publishers
2. Biochemistry – Power and Chatwall; Himalaya Publishing House, New Delhi
3. The Text Book of Biochemistry – A.V.S.S. RamaRao
4. An Introduction to Practical Biochemistry – David T.Plummer
5. Principles of Biochemistry – Albert L.Lehninger, Damodaran, M.Vasudevan – Macmillan Publishers.
6. Ackerman, E. (1962). Biophysical science, Prentice Hall. Casey, E.J. Biophysics Concepts and mechanisms.
7. Epstein, J.F. (1963) Biophysics – Selected topics, Addition, Wesley Publishers Co. Thayen, J., Biophysical technique – Chapman and Hall.
8. Snedecor, G.W. and W.G. Cocharn, 1978. Statistical methods. Oxford and IBH Publishing Co Pvt. Ltd.
9. Sokal, R.R. and F.J. Rohif, 1981. Biometry. W.H. Frecman, New York.

WebLink:

1.http://www.sbs.ntu.edu.sg/prospective/undergraduate/Curriculum%20and%20Course%20Descriptions/Pages/Major-Core/BS1005.aspx (NUS)

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	**20U4ZOCP4**	**Practical – IV (BIOCHEMISTRY, BIOPHYSICS AND BIO-STATISTICS)**	**3**	**4**

Objectives:

1. To understand the level of sugar, proteins, and lipids in biological samples by qualitative and quantitative estimation.

A. Bio-Chemistry

1. Qualitative test for Carbohydrate.
2. Qualitative test for Protein.
3. Qualitative test for Lipid**.**
4. Quantitative estimation of sugar in biological samples (Anthrone Method).
5. Quantitative estimation of proteins in biological samples (Folin-Phenol/Biuret method).
6. Separation of amino acids by circular paper chromatography.
7. Extraction and separation of lipids (TLC).
8. Measurement of pH of the given sample.

B. Biostatistics

1. Determination of mean, median and mode.
2. Determination of standard deviation.

C.Biophysics

1. Verification of Beer's and Lambert's law.
2. Estimation of soluble sugar in the given sample – Colorimetric method (Phenol Sulphuric acid method).

Spotters

Colorimeter, Spectrophotometer, NMR, ECG, EEG, pH meter, TLC, Homogenizer, Centrifuge, SDS-PAGE, ELISA – kit, Micro pipette.

Mark Details:

Practical = 50
Record = 10
Total = 60

Internship report submission:

A report on Internship (zoological related industries, farms) should be maintained and submitted at the time of practical examination for valuation.

Course Outcomes

After completion of this course, students will be able to

- Develop skills in qualitative and quantitative estimation of biomolecules.
- Acquire knowledge in separation technique.
- Learn the applications of biostatistical tools.
- Understand the principle and working mechanism of colorimetric method.

Reference:

1. An Introduction to Practical Biochemistry – David T.Plummer
2. Principles of Biochemistry – Albert L.Lehninger, Damodaran, M.Vasudevan – Macmillan Publishers.
3. Ackerman, E. (1962). Biophysical science, Prentice Hall. Casey, E.J. Biophysics Concepts and mechanisms.

Semester	Subject code	Title of the paper	Hours of Teaching/ Week	No. of Credits
IV	**20U4ZOCHA2**	**Allied chemistry-II (For Biologists)**	**5**	**4**

Objective

- To study ordinary Differential equation and partial differential equation
- To study Fourier series and Laplace transforms.
- To acquire basic knowledge about the beneficial role of animals.
- To study the various types cultures.

UNIT I Acids, Bases and Catalysis

Acids and bases – Arrhenius and Lewis theories of acids and bases, pH scale, buffer solutions – definition – examples of acidic and basic buffer solutions, importance of pH and buffer in living systems. Hardness of water – types and determination of hardness by EDTA titration. Catalysis – types of catalysis, characteristics of catalysts, promoters and catalytic poison, biocatalysts – enzyme catalysis, industrial applications of catalysts.

UNIT II Carbohydrates, Vitamins and Cosmetics

Carbohydrates – classification, glucose and fructose – sources, manufacturing method, reactions of glucose, derivatives of starch and cellulose – applications. Vitamins – classification, sources and deficiency diseases of vitamins A, D, E, K, C, B_1, B_2, B_5, B_6, and B_{12}.

UNIT III Amino acids, Proteins and Nucleic acids

α-Amino acids – essential and non essential amino acids, α-amino acid-preparation by Gabriel-phthalimide reaction and Strecker's method, isoelectric point, zwitter ion formation, action of heat, ninhydrin test. Peptides – definition only, proteins – classification, characteristics and biological functions, elementary treatment of primary and secondary structure. Nucleic acids – DNA & RNA – composition and structure (elementary treatment), differences between DNA & RNA.

UNIT IV Biochemsitry

Metabolism – anabolism and catabolism. Digestion and absorption of carbohydrates, glycolysis, TCA cycle, glycogenesis, glyconeogenesis, maintenance of blood sugar level. Digestion and absorption of proteins, urea biosynthesis. Digestion and absorption of lipids - β-oxidation of fatty acids.

UNIT V Food Chemistry

Food additives – sweetners, preservatives, emulsifying and stabilizing agents, flavouring agents, antioxidants and colouring agents. Food adulteration – definition and types of adulterations – adulterants in soft drinks, milk and milk products, edible oils and fats. Packaging hazards – prevention and control. Simple tests for common adulterants in coffee powder, tea leaves, cane sugar, honey, turmeric, common salt, dhals, and ice creams.

Course Outcomes

After completion of this course, students will be able to

- To study ordinary Differential equation and partial differential equation
- To study Fourier series and Laplace transforms.
- To acquire basic knowledge about the beneficial role of animals.

Text Books

1. Text Book of Organic Chemistry, **P.L. Soni and H.M. Chawla**, S. Chand & Sons, 27th edition, 1997.
2. Principles of Physical Chemistry,**B.R.Puri, L.R. Sharma,** Vishal Publishing Company, Jalandhar, 44th edition 2009. (Unit IV)

Reference Books :

1. Elements of Physical Chemistry, **B.R. Puri, L.R. Sharma, M.S. Pathania,** Vishal Publishing Co. 43rd edition, 2008-09. (Unit I)
2. TextBook of Biochemistry, **O.P. Agarwal and G.R. Agarwal,** , Goel Publishing House, 7th edition, 1993. (Unit III & IV)
3. Chemistry for Changing Times, **John W.Hill,** St. edition, subject Publishing House, 1986 (Unit II)
4. Food Science, **B.Srilakshmi**, New Age International (P) Ltd., Publishers, 3rd edition ,2003 (Unit V).
5. Food Additives – Characteristics, Detection and Estimation, **S.N. Mahindru** Tata McGraw Hill Publishing Company Limited. (Unit V).

Semester	Subject Code	**Title of the Paper**	Hours of Teaching /Week	No. of Credits
III & IV	**20U4ZOCHAPL**	**Allied chemistry practical (Non – semester)**	**3+3**	**2**

C. Volumetric Analysis

1. Estimation of HCl (or H_2SO_4) by NaOH using a standard oxalic acid solution
3. Estimation of NaOH by H_2SO_4 (or HCl) using a standard Na_2CO_3 solution
4. Estimation of oxalic acid by $KmnO_4$ using a standard Mohr's salt solution
5. Estimation of Ferrous sulphate by $KmnO_4$ using a standard oxalic acid solution.
6. Estimation of Mohr's salt by $KmnO_4$ using a standard oxalic acid solution.
7. Estimation of KMnO4 by thio using a standard $K_2Cr_2O_7$ solution.
8. Estimation of $K_2Cr_2O_7$ by thio using a standard $CuSO_4$ solution.
9. Estimation of $CuSO_4$ by thio using a standard $K_2Cr_2O_7$ solution.

D. Organic qualitative analysis

Systematic analysis of an organic compound, Preliminary tests, detection of element present, Aromatic or aliphatic, Saturated or unsaturated, nature of the functional group and exhibiting confirmatory tests for given organic compounds.

The following substance are prescribed:

Benzoic Acid, Cinnamic acid, Phenol, Cresol, Aniline, Toludine, Urea, Benzaldehyde, Glucose

Reference:

1. Venkateswaran V. Veerasamy R. Kulandaivelu A.R., Basic principles of Practical Chemistry, 2nd edition, Sultan Chand & sons, New Delhi, (1997)

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	**20U4ZOS2**	**Skill based education – II – TECHNIQUES IN CLINICAL LAB (PRACTICAL)**	**1**	**1**

Objectives:

1. The main objective of introducing this paper is to learn the basic techniques in Clinical Lab technology.

1. Sample collection and storage techniques.
2. Transport of clinical specimens
3. Sterilization and Disinfection techniques.
4. Preparation of fungal and bacterial media
5. Simple Staining for bacterial identification
6. ABO Blood grouping Test
7. Blood cell counting (RBC and WBC)
8. Analysis of Semen, Sputum and Stool.
9. Urine analysis – Sugar, Urea and Creatinine
10. Diagnosing Equipment: ECG, EEG, Sphygmomanometer, Haemocytometer. ELISA, RT-PCR

Course Outcomes

After completion of this course, students will be able to

- learn maintenance of clinical laboratory.
- improve the medical oriented practical techniques.
- gain the Knowledge on sterilization method.
- gain knowledge on medical laboratory facilities.

Understand the hematological and urological techniques.

Reference

1. Medical Laboratory Technology – K.M. Samuel.

Practical Manual of Medical Bacteriology (MLS 2413)- 2nd Edition 2014: Dr.G.I.D. Dushyanthie, A.D. Athukorala, Dr. JananieKottahachchi, University of Jayewardenepura

Web Link

1.http://www.sbs.ntu.edu.sg/prospective/undergraduate/Curriculum%20and%20Course%20Descriptions/Pages/Major-Core/BS1005.aspx (NUS)

2.https://www.uu.se/en/admissions/master/selma/kursplan/?kKod=3KK014&lasar=

3. **https://www.medsci.uu.se/education/courses/course-syllabus/?kpid=34117&lasar=&typ=2** (Uppsala University, Sweden)

Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
V	**20U5ZOC5**	**CELL BIOLOGY AND GENETICS**	**6**	**5**

Objectives:

1. To study the structure and functions of plasmambrane and cytoplasmic organelles.
2. To study the ultra structure and functions of nuclear components and importance of cell division.
3. To know the Mendelian principles, crossing over, linkage, chromosomal mapping, mutations, sex linked inheritance, non-disjunction of chromosome, and sex determination.
4. To study the fine structure of gene, Operon concept, and Inborn error metabolism in man.

Cell Biology

Unit I **Hrs 18**

Scope of cell biology- Cell fractionation techniques: Centrifugation – Principles and Types - Differential and Density gradient. Cytoplasm – Physical, chemical organization and properties of cytoplasmic matrix. Ultra structure and functions of plasma membrane.

Unit II **Hrs 18**

Structure and functions of Cytoplasmic organelles – Mitochondria, Golgi complex, Endoplasmic reticulum, Centrosome, Ribosomes, Lysosomes.

Unit III **Hrs 18**

Organization and Functions Nucleus and Nucleolus, Chromosomes and their role, Giant Chromosomes – Polytene and lamp brush, Cell Divisions – Mitosis and Meiosis.

Genetics **Hrs 18**

Unit IV

Mendelian Principles – Monohybrid and Dihybrid cross. Linkage and crossing over. Chromosomal mapping. Multiple alleles – ABO & Rh Blood grouping Sex–Linked inheritance - Colour blindness and Haemophilia in man - Non-disjunction of Chromosomes. Sex determination in Drosophila and Man.

Unit V **Hrs 18**

Fine structure of Genes – Cistron, Recon, Muton – operon model. Gene mutation. Chromosomal aberration – Population Genetics – Hardy Weinberg law – Inborn error metabolism in man – Phenylketonuria, Alkaptonuria and Albinism - Genetic Counseling.

Course Outcomes

After completion of this course, students will be able to

- gain the knowledge on the structure and functions of plasma membrane and cytoplasmic organelles.
- understand the ultra structure and functions of nuclear components and importance of cell division.
- realize theMendelian principles, crossing over, linkage, chromosomal mapping, mutations, sex linked inheritance, non disjunction of chromosomes and sex determination.
- know the fine structure of gene and operon concept.

acquire knowledge on Inborn error metabolism in man.

Reference:

1. Loewy, A. g and P. Seikovitz – Cell structure and function (Half Rinchart and Winstion) 1969.
2. Ambrose, E.J, and Easty, D.M – Cell Biology (ELBS).
3. Derobertis – Cell Biology.
4. Swanson, C.F. and P.L. waster – The cell (4thEdn), Prentice Hall of India, 1978.
5. Langley – Cell function.
6. Stern and Nancy – The Biology of the cells.
7. Livine, R.P. – Genetics (Hort R.W.N.Y 1969).
8. Swanson, C.P.T.Marg. – Cytogenetics.
9. Waddington, C.H – The strategy of Genes.
10. Garber, Ed. – Cyto – Genetics – An introduction (McGraw Hill).
11. Stent, G.S. – Molecular Genetics.
12. Witeheusel, H.L.K. – Towards on understanding of the mechanism of Heriditary.
13. Watson, J.O. – Molecular Biology of the genes (3rdEdn).

Web Link:

1.https://exhibits.stanford.edu/syllabi/catalog/vw989wm2044 (Stanford)
2.https://exhibits.stanford.edu/syllabi/catalog/pp577kr2000 (Stanford)
3.https://www.mcgill.ca/study/2020-2021/faculties/medicine/graduate/programs/master-science-msc-human-genetics-thesis-bioinformatics#msc-humgen-t_hgn4_bii_concentration_md (McGill university)

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
V	**20U5ZOC6**	**DEVELOPMENTAL BIOLOGY AND EVOLUTION**	**5**	**5**

Objectives:

1. To study the various theories of developmental biology and gametogenesis.
2. To study parthenogenesis, types of eggs, cleavage, blastulation, and gastrulation in amphioxus, Frog, Chick, and Mammals.
3. To study the organogenesis of chick and placenta in mammals.
4. To study about the origin of life and evidences of evolution.
5. To study the speciation and isolation, mimicry and colouration and evolution of Horse and Man.

Developmental Biology **Hrs 18**

Unit I

Scope of Embryology–Theories on development – Epigenesis, Beer's Law, Germplasm Theory, Mosaic theory, Regulative theory, Gradient theory and Spemann and Manglod's Theory of organizers – Spermatogenesis, Oogenesis – Fertilization – Physico-chemical changes during fertilization – Parthenogenesis.

Unit II **Hrs 18**

Types of eggs in chordates, cleavage–Patterns of Cleavage – Blastulation in Amphioxus, Frog and chick – Gastrulation in Amphioxus, Frog and Chick – Fate map.

Unit III **Hrs 18**

Organogenesis - Development of Heart, Eye and Brain of Frog – Extra embryonic membranes in Chick – Placenta in mammals – Regeneration – types of Regeneration.

Evolution **Hrs 18**

Unit IV

Origin of Life–Evidences of evolution-Palaentological, Anatomical, Embryological, Physiological and Biochemical evidences. Theories of evolution - Lamarkism, Darwinism and Devries.

Unit V **Hrs 18**

Speciation – Isolatic mechanism - Mimicry and colouration - Evolution of Horse - Evolution of Man – Cultural evolution of Man.

Course Outcomes

After completion of this course, students will be able to

- Understand the theories of developmental biology.
- Gain the knowledge on gametogenesis and fertilization.
- Acquire knowledge on organogenesis.
- Develop skills in the role of extra embryonic membrane.

Aware on mimicry and colouration.

Reference:

1. Balinsky – An introduction to embryology V Edn, Saunders Co, Philadelphia, 1981.
2. Rayam, C.P.– An outline of developmental Physiology, I Edn, Bergman, London, 1961.
3. Weber, R. – The biochemistry of animal Development, Vol. I and III, academic Press.
4. Ebert, J.C. Interacting systems in Development, Holt Rainbart and Winston, New York, 1965.
5. Berril, N.J. – Deelopmental Biology, TMH Edn., New Delhi 1961.
6. Bodemes, C.W. – Modern Embryology, Holt Rinebert Winston, New York, 1968.
7. Rough, R – Experimental Embryology, Burgress, Minneopolis, 1945.
8. Needham, J – A History of embryology, Burgress, Minneopolis, 1945.
9. Savage – Evolution (Modern Biology Series, 1969).
10. Stabbins – Process of Organic Evolution (Prentice Hall).
11. Dowdeswell, W.H. – The mechanism of Evolution (Helmann, London, 1956).
12. Shappart, P.M. – Natural Selection and Heredity (Hutchinson).
13. Ehrlich / Holin / Pauell – The process of evolution (McGraw Hill).
14. Mayr, El, Animal Species and Evolution (Harvard Uni, HarvadUni, Press, 1963.
15. Simpson, G.G. – The major adaptation (CUP).
16. Huxley, J – Evolution, The modern synthesis (Harpers N.Y), 1942.

Web link:

1. https://as.nyu.edu/content/dam/nyuas/biology/documents/Biol.UA26DevelopmentalBiology.pdf (New York University).
2. https://ched.gov.ph/wp-content/uploads/2017/10/Sample-Curricula-Bachelor-of-Science-in-Biology.pdf (Republic of the Philippines – Page No: 54 – syllabus of developmental biology).

Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
V	**20U5ZOC7**	**IMMUNOLOGY**	**4**	**4**

Objectives:

1. To study about different immunities and Lymphoidal organs.
2. To study about the Biosynthesis of Immunglobulins with functions and Theories of antibody formation.
3. To study the structure and functions of Antigens and Antibodies.
4. To study about the antigen-antibody reactions.

Unit I **Hrs12**

Immunity: Kinds of immunity –Natural and acquired. Primary lymphoidial organs: Thymus, Bursa of Fabricus, Bone marrow. Secondary Lymphoidal organs - Spleen-Lymph nodes-Payer's Patches.

Unit II **Hrs12**

Antigens and Antibodies-Antigens and Haptens, Size, Solubility and chemical nature of Immunoglobins. IgG, IgA, IgM, IgD&IgE. Basic structure of antibody (IgG).

Unit III **Hrs12**

Biosynthesis and functions of Immunoglobulins. Theories of antibody formation. Immune response:- Humoral and cell mediated immune response: Phagocytosis and Pinocytosis.

Unit IV **Hrs12**

Antigen - Antibody reactions - Precipitation- Agglutination- Cytolysis- Complement fixation- Flocculation - Opsonization- Immunofluorescence. MHC of Man – Hypersensitivity - Type I and Type II.

Unit V **Hrs12**

Autoimmunediseases – Thrombocytopenia - Thyrotoxicosis- Rheumatoid arthiritis and Haemolyticaneamia. Immunotechniques: RIA and ELISA.

Course Outcomes

After completion of this course, students will be able to

- Understand the difference between the innate and adaptive immunity
- Classify immunoglobulins and understand their roles.
- Realize the various mechanisms that regulate immune responses
- Know the different types of antigen-antibody interactions
- Realize the adverse effect of immune system causing autoimmune disorders.

References:

1 Jean Francis Bach – Immunology, 6th Ed. Wiley Medical Publication, New York, 1982.
2 Jean Fracis Bach – Immunology, 6th Ed. Wiley Medical Publication, New York, 1982.
3 Glynn,L. and Steward,M.W,-Structure and functions of Antibodies, John Wiley Sons, NY.
4 Hildermann, W.H. – Essentials of Immunology, Elsevier publications, Oxford.
5 Joshi, K.R – Immunology, Agrobios Publication jodhpur, 2002.
6 K.R. Joshi and N.O. Osama – Immunology, Agrobios, India.
7 Rastogi, S.C. – Elements of Immunology.
8 Jean Francis Bach – Immunology, 6th Ed. Wiley Medical Publication, New York, 1982.
9 Joshi, K.R – Immunology, Agrobios Publication, Jodhpur, 2002.
https://medicine.nus.edu.sg/mbio/doc/modules/LSM3223.pdf (NUS)

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
V	**20U5ZOCP5**	**Practical – V (CELL BIOLOGY, GENETICS, DEVELOPMENTAL BIOLOGY, EVOLUTION & IMMUNOLOGY)**	**4**	**4**

Objectives:

1. To learn the handling of microscope and to observe the cell divisions.
2. To identify the blood groups and Mendelian characters of Man
3. To observe the various hours of chick embryo.
4. To know the evolutionary significance with suitable examples.
5. To identify the primary and secondary lymphoid organs in Rat.

1. Cell Biology

1. Mitosis - Squash preparation of onion root tip.
2. Meiosis - Squash preparation of grasshopper testis.
3. Giant chromosome - Squash preparation of salivary gland of Chironomous larva.

2.Genetics

1.Blood grouping.

2.Drosophila – sex differences – Identification of different mutant.

3.Mendelian traits – tasters and non – tasters, tongue rollers and non-rollers and other common human traits.

3. Developmental Biology

1.Observation of various stages of chick embryo.

2.Observation of early developmental stages of Frog (Metamorphosis).

3.Temporary mounting of the invertebrate larvae (From Plankton Collection).

4. Evolution

Comments on animals of Evolutionary significance (Palaentological evidences).

5.Immunology

Dissection of Lymphoid organs in Rat.

Field work Report:

A record of lab work and report on field trip (places of evolutionary interest) should be maintained and submitted at the time of practical examination for valuation.

Course Outcomes

After completion of this course, students will be able to

- develop skills in squash preparations and identify the giant chromosome.
- know the importance of blood grouping.
- identify the mendelian traits.
- observe the developmental stages of chick embryo.
- realize the paleontological evidences.
- identify the Lymphoid organs in Rat.

Reference:

1. Taylor, R.G.W – Practical Cytology, Academic Press, London.
2. Michael, A. Tribe, Michael, R. Erant and Roger, K. Snook – Electron Microscopy and cell Structure: Basic Biology course, Cambridge University Press, London.
3. Benjamin, H. Willies and Sane, M. Oppenheimer, - Foundations of Experimental Embryolog, Eastern Economy Edn.
   Sinha.J, Chatterjee. A.K. P.Chattopadhyay – Advanced Practical Zoology.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
V	**20U5ZOEL1A**	**Major Elective – I** **PUBLIC HEALTH AND HYGIENE**	**4**	**4**

Objectives:

1. To study about the awareness on public health and hygiene.
2. To create knowledge on health education.

UNIT :I

Public Health – Definition – Physical, Mental, Social and Positive Health, Role of science in health, Self-care strategies – Health problems in India – Population explosion and Birth control in India.

UNIT – II

Environmental and Health – Water borne diseases - Food Hygiene & Kitchen Safety: Cooking & baking, Disinfect, Food preparation, Temperature, Food poisoning Contamination, Cooking and reheating food – Roles and responsibilities of Health service agencies.

UNIT – III

Methods of Excreta disposal – Sanitory Health measure – during festival – First Aid with reference to accidents – Blood transfusion – Blood Grouping.

UNIT – IV

Communicable diseases: (Hepatitis B , AIDS and Tuberclosis).

Non-Communicable diseases: (Diabetes, Osteoporosis and Chronic lung disease)

Primary Health care system: Maternal & Child helath.

UNIT – V

Public Health care Institutes in India – National Institute of Epidemiology (NIE), Vector Control Research Institute (VCRI), National AIDS control organization (NACO) – National Malaria Eradication Programme (NMEP) – National Tuberculosis Eradication Programme (NTEP).

Course Outcome

- Apply the knowledge to lead a healthy life.
- Realize the factors affecting Health.
- Redress problems associated with health and hygiene thereby promoting fitness and wellbeing.
- To impart the awareness about social background of health and disease to bring out the importance of social intervention.

Reference:

1.Br.THOS, D., TUTTLE, B.S., M.D., Principles of Public Health, 1950, World Book Company.
2. "Construction Safety and Health". Workplace Safety & Health Topics National Institute of Occupational Safety and Health
3. Sri Lakshmi B. Food Science 5th Edition, New age International Publisher, New Delhi.

Web link:

1.http://guide.berkeley.edu/courses/pb_hlth/ (university of California, Berkeley)

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
V	**20U5ZOEL1B**	**Major Elective – I BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS**	**4**	**4**

Objectives:

1. To know about the safety measures in using micro organisms.
2. To learn the biosafety guidelines and regulations.
3. To know the importance of IPR and patents.

Unit I **Hrs12**

Biosafety: Introduction: Biosafety issues in biotechnology – historical background: Introduction to biological safety cabinets: Primary containment for bio hazards: Biosafety levels: Biosafety levels of specific micro organisms: Recommended Biosafety levels for infections agents and infected animals.

Unit II **Hrs12**

Biosafety Guidelines: Biosafety guidelines and regulations (National and international) – operation of biosafety guidelines and regulations of government of India: Definition of GMOs & LMOs: Roles of institutional Biosafety committee, RCGM, GEAC etc. For GMO applications in food and agriculture: Environmental release of GMOs: Risk Analysis: Risk Assessment: Risk management and communication: Overview of National Regulations and relevant International Agreements including cartegana protocol.

Unit III **Hrs12**

Introduction of Intellectual Property: Types IP patents, Trademarks, Copyright & Related rights. Industrial design, Traditional Knowledge. Geographical indications – Importance of IPR – Patentable and non-Patentable – Patenting life – legal protection of biotechnological inventions – world intellectual property rights organization (WIPO).

Unit IV **Hrs12**

Basics of patents and concept of Prior Art: Introduction to patents: Types of patent applications: Ordinary, PCT, Conventional, divisional and patent of Addition: Specifications. Provisional and complete: Forms and fees invention in context of "Prior art". Patent database searching. International databases. County wise patent searches (USPTO, esp@ ce net CEPo), PATENT scope (WIPo), IPO.

Unit V **Hrs12**

Agreements and Treaties: History of GATT & TRIPS Agreement : Madrid, Agreement : Hague Agreement : WIPO Treaties : Budapest Treaty : PCT Indian Patent Act 1970 and recent amendments.

Course Outcomes

After completion of this course, students will be able to

- aware on bio-safety levels for infections agents and infected animals.
- know the bio-safety guidelines and regulations
- realize the role of world intellectual property rights organization
- explore in Indian Patent Act 1970 and recent amendments.

Reference:

1. Environmental Health Hazards, Kumar (2004).
2. Progress in Bioethics, Jonathan *et al.*, 2010.
3. The Ethics of Protocells – Mark 2009.
4. Design and Destiny – Ronald and Turner, 2008.

http://www.icid.com/overview.html (Institute for Biosafety and Biosecurity Canada)
https://www.bitmesra.ac.in/UploadedDocuments/adminbioeng/files/M_Tech%20Syllabus%202011.pdf (Birla institute of technology, Mesra, Ranchi).
https://www.mcgill.ca/continuingstudies/area-of-study/intellectual-property (Mc.Gill University)

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
V	**20U5ZOEL2A**	**Major Elective –II AQUACULTURE**	**4**	**3**

Objectives:

- To study the water quality management
- To study the culture Techniques of Important Fresh water fishes.
- To study the culture Techniques of Ornamental fish culture
- To study the disease management during aquaculture.

Unit I **Hrs12**

Scope of Aquaculture – Status of Aquaculture in India, Aquaculture systems: Extensive – Intensive and Semi-intensive culture of fish – Inland fish Production in India – Marine Fishery resources in India – Ornamental fisheries.

Hrs12

Unit II

Selection of site, construction and preparation of pond – Liming - Manuring – Water quality management and monitoring – Eradication of pests and predators, weeds and their control.

Unit III **Hrs12**

Types of culture: Monospecies culture, Monosex culture, Polyculture, Composite fish culture –Murrel culture – Integrated fish farming – Hypophysation techniques, Bacterial diseases of Fish (Heamorrhagic septicemia & Epitheliocystis) and control measure.

Unit IV **Hrs12**

Shell fish culture: Prawn and Shrimp culture, Extensive, semi-intensive and intensive shrimp farming practices - Food and feeding - Diseases - Economic importantance of Prawn and Shrimp culture.

Unite V **Hrs12**

Post-harvest technology - Processing and Preservation of Fin fish and Shell fish – By-products of fishes – Types of fish Marketing - economics, Social issues in aquaculture-Role of MPEDA,FFDA in fisheries

Course Outcomes

After completion of this course, students will be able to

- know aquaculture practices in India.
- Understand the construction and maintenance the pond for fish and prawn culture.
- Maintain the aquarium tank for ornamental fish culture.
- Apply the hypophysation techniques for induced breeding.
- Realize the By-products of fishes

References

1. Fish and Fisheries – Kamaleshwar Pandey and J.P. Shukla, Rastogi Publications.
2. Fishery Biology and Aquaculture – K. Shanmugam (Leo Padhippagam).
3. Oliver, K 2003. World trade in ornamental species
4. Wheatson,F.W. and Lawson,T.B. Processing Aquatic Food Products
5. Muir,J.F. and Donald,R. Recent Advances in Aquaculture

Web Link:

1.https://agris.fao.org/agris-search/search.do?recordID=US880018188)
2.https://www.springer.com/gp/book/9781468487381 (Springer Book)

-

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
V	**20U5ZOEL2B**	**Major Elective - II VERMICULTURE**	**4**	**3**

Objectives

- To understand the biology of earthworms.
- To study the methods of vermicomposting
- To get Awareness to improve the soil fertility

UNIT –I **Hrs12**

Importance of Vermitechnology- Classification of earthworms- **Earthworm:** external features- Digestive system- excretory system- reproductive system- Life cycle- Economic importance of Earthworm.

UNIT – II **Hrs12**

Vermiculture: Methods of collection of earthworms. Steps involved in vermiculture. Factors influencing the culture of earthworms: Vermicomposting: steps of vermicomposting- Mechanism of vermicomposting- Changes during vermicomposting.

UNIT – III **Hrs12**

Methods of vermicomposting: Small scale or Indoor vermicomposting – Pit method- Heap method. Large scale or outdoor vermicomposting – Bed method- Window method. Vermitech 200. Vermiwash preparation-Composition and applications of vermiwash.

UNIT – IV **Hrs12**

Vermicompost:- Physical, chemical and biological characteristics of vermicompost. Nutritive value of vermicompost -Advantages and economic importance of vermicompost. Use of vermicompost in crop production- Use of vermicompost in Land improvement and reclamation.

UNIT – V **Hrs12**

Earthworm as a Farmer's friend: Role of earthworm in waste management – Solid waste management- Sewage waste management (Vermifilter)- Faecal waste management - Industrial waste management. Role of earthworm in soil fertility.

Course outcomes

After completion of this course, students will be able to

- Classify the earthworms and understand the biology of earthworm
- Culture the earthworms maintaining suitable Physico-chemical factors
- Prepare vermicompost using the suitable methods
- Analyse the nutritive value of vermicompost and its role in agriculture
- Realize the role of earthworms in environmental bioremediation

Reference

- 1.Clive A.Edwards, Norman Q. Aramon, Rhonda L.Sherman – Vermiculture Technology:
- Earthworms, Organic waste and Environmental Management.
- 2.Niir Board – The complete technology book on Vermiculture and vermicompost (Available
- Online).
- 3.Engineers India Research In A1 Books. Co.in. Rediff Books – Hand book of Bioinfertilizers and Vermiculture.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
V	**20U5ZONME**	**NON-Major Elective AQUACULTURE**	**2**	**1**

Objectives:

1. To study the water quality management
2. To study the culture Techniques of Important Fresh water fishes.
3. To study the culture Techniques of Ornamental fish culture
4. To study the disease management during aquaculture.

Unit I **Hrs15**

Scope and significance of Aquaculture – Different types of aquaculture systems - Pond design and construction - Water quality management - Culture practices of Fin Fish (*Catla catla*) & Shell fish (Shrimp). By-products of fishes – Fish Marketing – Aquaculture Authority and National Fisheries Development Board.

Unit II **Hrs15**

Ornamental fish culture: Ornamental fishes (Guppy, Moly, Gold fish, Angel Zebra danio), Advantages and benefits of ornamental fish keeping- Aquarium maintenance, feedings, breeding and marketing of freshwater ornamental fishes.

Disease management: Diseases (Fin Rot, Dropsy, Swim Bladder disorder, Body flukes) & their control measures.

Course outcomes

After completion of this course, students will be able to

- Analyze the physic-chemical factor of water.
- Apply the techniques to construct fish form.
- Maintain the aquarium tank for ornamental fish culture.
- Understand fish diseases management.

Reference

1. T.V.R. Pillay (1994) Aquaculture – Principles, Practices, Fishing News Book, Blackwell – London.
2. V.C. Jhingron and Gopalakrishana RajmPandchosh, methodology for survey of brackish water area in India, for coastal – aquaculture indopacibic fish council, 14th session.
3. C.M.C.R.I, Coastal Aquaculture – Marine Prawn Culture.
4. Jhingran, V.G (1998), Fish and Fisheries of Indian Hindustan Publishing corporation, New Delhi.
5. Stickney,R.R. Principles of Warmwater Aquaculture.

Web link:

1.Fish farming http://www.fishfarming.com/ ICAR
2.http://www.icar.org.in/indiafishvoice/intro.html CIFA http://www.cifa.in/tech.htm 3.Aquaculture articles: http://aquafind.com/articles/aquaculture.php Aquaculture Artices
4.http://www.aquarticles.com/
https://agris.fao.org/agris-search/search.do?recordID=US880018188)
https://www.springer.com/gp/book/9781468487381 (Springer Book)

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
V	**20U5ZOLSD**	**Life skill development**	**1**	**-**

Course objectives

- To enhance one's ability to be fully self aware by helping oneself to overcome all fears and insecurities and to grow fully from inside out and outside in.
- To increase one's knowledge and awareness of emotional competency and emotional intelligence at place of study/work.
- To provide opportunity for releasing one's potential through practical experience.
- To develop interpersonal skills and adopt good leadership behaviour for empowerment of self and others.
- To set appropriate goals, manage stress and time efficiently.
- To manage competency- mix at all levels for achieving excellence with ethics.

Unit – I **(30 hrs)**

Communication and Professional skills

1. Writing and different modes of writing.
2. Digital Literacy.
3. Effective use of social media.
4. Non verbal communication.
5. Resume skills.
6. Presentation skills.
7. Listening as a Team skill.
8. Brainstorming.
9. Social and cultural Etiquettes.
10. Internal communication.

Unit – II **(30 hrs)**

Leadership, management and Universal Human Value

1. Leadership skills.
2. Managerial skills.
3. Entrepreneurial skills.
4. Innovative Leadership and Design thinking.
5. SWOT (Strengths, Weaknesses, Opportunities and Threats Analysis)
6. EQ (Emotional Quotient)
7. Love and Compassion.
8. Truth.
9. Non Violence.
10. Righteousness.
11. Ethic and Integrity.

Course outcomes

At the end of the programme learners will be able to:

- Gain Self Competency and Confidence.
- Practice Emotional Competency.
- Gain Intellectual Competency.
- Gain an edge through Professional Competency.
- Aim for high sense of Social Competency.
- Be an integral Human Being.

References:

1. Bailey, Stephen, Academic Writing: A handbook for International Students, 2010 Rourlege.
2. Shlpa Sablok Bhardwaj (2018). Computer Applications for Class 9 MS Office Blueprint Education (Contributor).
3. http:// WWW.lyfemarketing.com / blog / how-digital – marketing – works/
4. http:// WWW.thoughtco.com/what-is-nnverbasl - communication - 1691351
5. http:// WWW.wikihow.com/Write-a-Neat-Resume
6. http:// WWW.gildabonanno.com/presentation-skill-coaching-videos
7. http:// blog.vantagecircle.com/active-listening/
8. Osborn, A.F. (1963) Applied imagination: Principles and procedures of creative problem solving (Third Revised Edition). New Yok, NY: Charles Scribner's Sons.
9. http:// WWW.thespruce.com/what-is-etiquette–and–why–is-it-important–1216650.
10. http:// WWW.talkfreely.com/blog/internal-and-eternal-communication.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
VI	**20U6ZOC8**	**ANIMAL PHYSIOLOGY AND ENVIRONMENTAL BIOLOGY**	**5**	**5**

Objectives:

1. To study the types of food components, metabolism of carbohydrate, protein and lipid, Blood composition and it's function, respiratory pigments and transport of 02 and CO2.
2. To study the structure and functions of Heart and Kidney, Osmo – ionic regulation in aquatic animals and modes of excretion.
3. To study the different types of effectors and receptors, muscle contractions and transmission of nerve impulse.
4. To study the physico–chemical parameters in eco system and to know the animal relationship and population.
5. To study about the animal association and various types of pollution.

Unit I **Hrs 18**

Food – Physiology of digestion in Man –Metabolism of Carbohydrates, Proteins and lipids. Blood – Composition and functions. Structure and functions of Heamoglobin – Transport of O_2 and CO_2 in Blood.

Unit II **Hrs 18**

Structure and physiology of circulation (man). Osmoionic regulation in Fishes. Mode of Excretion – Ammonotelism, Ureotelism and Uricotelism. Human kidney – Structure and functions – Urine formation.

Unit III **Hrs 18**

Types – Chemistry of muscle - Structure of Neuron - Transmission of nerve impulse, Reflex action - Role of hormones in reproductive cycles. Physiology of photo receptor organ (Human eye).

ENVIRONMENTAL BIOLOGY

Unit IV **Hrs18**

Abiotic factor - Temperature, light - Pond as an Ecosystem - Trophic levels, Food Chain - Food Web - Ecological pyramids and, Energy flow.

Unit V **Hrs 18**

Animal association - Symbiosis - Mutualism, Commensalism, Parasitism and Antagonism. Pollution: Water pollution, Air pollution, Noise pollution, Soil Pollution and radioactive pollution.

Course Outcome

After completion of this course, students will be able to

- Gain the knowledge on the types of food components and their functions.
- Understand the metabolism of carbohydrate, protein and lipid.
- Learn the structure and functions of Heart and Kidney,
- Understand the different types of effectors and receptors, muscle contractions and transmission of nerve impulse.
- Understand the physico–chemical parameters in eco system and animalrelationship .
- Aware on the various types of pollution

Reference

1. Geise, A.C – Cell Physiology 95th Edn) (Saunders, Phill) 1979.
2. Knut, Schinidt, Nelson – Animal Physiology 3rd Edn, (prentice Hall, 1977).
3. Hoar, S.W – General and Comparative physiology (Prentice Hall, 1976)
4. Prosser and Brown – Comparative Animal Physiology, 1961.
5. Verma, P.S, Tyagi, B.S., and Agarwal, V.K. – Animal Physiology, 3rd Edn, S, Chand and Company, New Delhi.
6. Nagabushnam.R, and R. Sarojini – Animal Physiology.
7. Odum, E.P – Ecology (Hr. and W.)
8. Odum, E.P – Fundamentals of Ecology. (W.B. Saunders, Philadelphia).
9. Mallamby, K. – The Biology of Pollution, Edward Arnold.
10. Dowdeswell, W.H – An introduction to Animal Ecology.
11. Allee, W.C. Emerson, A.E., Park, O. and Park, T. and Schmidt, - Principles of Animal Ecology, W.B. Saunders, Philadelphia.
12. Richard W. Hill Michigan State University Gordon A. Wyse University of Massachusetts, Amherst Margaret Anderson Smith College "ANIMAL PHYSIOLOGY THIRD EDITION".
13. SCOTT F. GILBERT Swarthmore College and The University of Helsinki "DEVELOPMENTAL BIOLOGY NINTH EDITION" Companion Website www.devbio.com

Web Link:

1.https://www.uwosh.edu/facstaff/kurtzc/documentfiles/S18%20319%20syllabus.pdf (University of Wisconsin-Oshkosh, America).

2.https://www.tamut.edu/faculty/syllabi/201520/20520.pdf (Texas A&M University, Texarkana)

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
VI	**20U6ZOC9**	**GENETIC ENGINEERING**	**5**	**5**

Objectives:

1. To study the role of enzymes in genetic engineering
2. To study the different types of cloning vectors.
3. To know about different methods of gene transfer techniques.
4. To study Hybridoma Technology for the production of Monoclonal antibodies.
5. To study about the GMO, Biochips and Biosensor.

Unit I **Hrs 18**

Introduction to Genetic Engineering.DNA manipulative enzymes: Nucleases, ligases, polymerases, Restriction endonucleases, reverse transcriptase, topoisomerase, Blunt and sticky ends, linkers, adapters, homopolymer tailing. DNA replications – types of mechanisms; Transcription and Translation in Prokaryotes and Eukaryotes.

Unit II **Hrs 18**

Cloning vectors – Plasmids, pBr322, pUC8, Bacteriophages, Phagemids, Cosmids, Bacterial artificial chromosomes; YAC vectors and Shuttle vectors.

Unit III **Hrs 18**

Gene cloning by Recombinant DNA Technology - Construction of r-DNA; Blotting techniques – Southern, Northern and Western, cDNA Library. Identification of recombinants from Gene library, methods of clone identification, Radioactive and non radioactive active DNA and RNA labeling techniques.

Unit IV **Hrs18**

Methods of Gene transfer, Electroporation, Shotgun method, microinjection, protoplast fusion in plant, cell fusion in animal cells. Hybridoma technology.

Unit V **Hrs 18**

Applications of r-DNA technology – Artificial insulin and Human Growth Hormone production – Genetically modified micro organisms – Biochips – Biosensor.

Course outcomes

After completion of this course, students will be able to

- Learn the role of enzymes in genetic engineering.
- Gain the knowledge of cloning vectors.
- equip with Gene cloning techniques and hybridoma technology.
- acquire the knowledge on genetically modified organisms, Biochips and Biosensors.

Reference

1. Primorse – Molecular Biochemistry, AMS Press, 2000.
2. Purohit, S.S,-Molecular Biology and Biotechnology, Daya Publishing House, New Delhi, 2002.

3. Agarwal, K.C.–Fundamental of Molecular Biology and Biotechnology, Daya Publishing House, New Delhi.
4. Helen Kreuzer–Recombinant DNA and Biotechnology, 2nd Edn, ASM Press, Washington DC.
5. Purohit, S.S–A text book of Biotechnology for Indian Universities, Agrobios, Jodhpur 2002.
6. Dubey, R.C. – A text book of Biotechnology, S.Chand and Co, New Delhi, 2002.
7. Gupta, P.K. – Biotechnology and Genomics, Rastogi Publications, 2004.
8. Joshi, P – Genetic Engineering and its applications, Agrobios, ISBN, India, Jodpur 2002.
9. George M. Malaeinski-Friefelders's Essentials of molecular Biology 4th edition-Nature Publication, New Delhi.

Web Link:

1.https://www.uu.se/en/admissions/master/selma/kursplan/?kpid=39434&type=1
(Uppsala University, Sweden)

2.https://student.utm.utoronto.ca/calendar/course_detail.pl?Depart=3&Course=BIO372H5
(Toronto university, Canada)

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	**20U6ZOC10**	**ECONOMIC ZOOLOGY**	**4**	**4**

Objectives:

1. To encourage young learners to take up the small scale industries.
2. To generate motivation for Self-Employment.
3. To disseminate information on economic aspects of Zoology.
4. To inculcate knowledge on useful animals to Mankind.
5. To satisfy the learners with modern techniques of Animal culture.

UNIT-I **Hrs 18**

Economic Entomology: Commercial importance of beneficial insects

Apiculture – Species of Honeybees – Honey extraction –General colony management during different seasons. Production and marketing of quality honey and value-added honey products.

Sericulture – Rearing of Silkworms - Study of different types of silk and silkworms in India and economic importance of Sericulture in India.

UNIT-II **Hrs 18**

Economics of aquaculture-

Pisciculture – Commercial culture of Indian Major carps. Techniques of induced breeding fish - By-Products of Fish and its commercial values.

Shellfish culture (Prawn, Shrimp & Crab) - Culture techniques of freshwater Prawn (Macrobrachium rosembergii) & Marine water Shrimp (Penaeus monodon)- preservation – Processing and export of shrimp.

UNIT-III **Hrs 18**

Poultry farming: Types of poultry -Brooding and Rearing of Chicks-Processing of Egg. Nutrition and Feeding of organic poultry. Small Scale Broiler farming for meat

UNIT-IV **Hrs 18**

Indigenous and Exotic species of Milk cow. Cross breeds of Cows and Buffaloes in India. Milk cow management.By-product of milk.Sheep farming- Indigenous and Exotic breeds of Sheep.

UNIT-V **Hrs 18**

Future strategies for Livestock Development Livestock forming– Transgenic Animal Technology – Genetic Improvement for best breeds - Economic importance of Dairy, Leather, Wool and Fur.

Course outcomes

After completion of this course, students will be able to

- Understand the significance and economic values of sericulture and apiculture..
- Gain the knowledge on significance of aquaculture and their economic importance..
- Knowledge on the poultry farm management practices.
- Knowledge on sericulture techniques and to make up value added product.

Reference:

1.Fishery Biology and aquaculture – K.Shanmugam – Leo Publications.
2.Fish and fisheries – Kameshwar Pandey and JP Sukla – Rastogi Publications
3.EntomologiaExperimentalisApplicata- Kluwer Academic Publishers, The Netherlands
4.Hernandez-Vergara Martha Patricia & Perez-Rostro Carlos Ivan (eds.) 2016, Sustainable Aquaculture Techniques, 269pp.
5.Jadhav, N.V. and Siddiqui, M.F. 2007. *Handbook of Poultry Production andManagement,* 2nd Edn, New Delhi.
6.Gupta J. K., V. V. Belavadi., Sh. Mohinder Singh, 2016. Apiculture, 75pp.
James R. Gillespie & Frank B. Flanders,2010. Modern Livestock & poultry Production 8th Edition,1073pp.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
VI	**20U6ZOCP6**	**Practical – VI (ANIMAL PHYSIOLOGY, ENVIRONMENTAL BIOLOGY AND GENETIC ENCIGEERING)**	**6**	**4**

Objectives:

1. To learn the estimation of O_2 consumption by fish, Enumeration of RBC and WBC and qualitative tests for nitrogenous excretory products.
2. To know about determination of Urine sugar in Man, demonstration of blood pressure in Man.
3. To study about the dissolved O_2, CO_2, salinity, pH in water samples, identification of plankton and animal relationship with suitable examples.
4. To learn the techniques of isolation of DNA, RNA and plasmid, southern blotting and separation of proteins by PAGE Electrophoresis.

Animal Physiology

1. Estimation of O_2 consumption in fresh water fish.
2. Total and differential counts of blood cells.
3. Qualitative tests for ammonia, urea and uric acid.
4. Demonstration of blood pressure in Man.
5. Determination of Urine sugar in Man.

Environmental Biology

1. Measurement of Physico – Chemical parameters in aquatic environment.
   a. Dissolved Oxygen
   b. Salinity
   c. pH (Using pH paper (or) pH meter or Lovidbond Comparator).
   d. Free Carbon –di-oxide, carbonates and bicarbonates.
2. Study of examples illustrating animal associations.
3. Study tour and report.

Genetic Engineering

1. Plasmid extraction
2. DNA Isolation

Field work Report : A record of lab work and report on field trip (places of zoological interest)should be maintained and submitted at the time of practical examination for valuation.

Mark Details

Methodology = 20
Execution = 30
Result = 10
Total = 60

Course outcomes

After completion of this course, students will be able to

- develop skills in techniques of qualitative tests.
- acquire skills in Physico – Chemical parameters in aquatic environment.
- learn the techniques of isolation of DNA, RNA and plasmid,
- skills in southern blotting and PAGE Electrophoresis.

Reference

1.Okotore, R.O. – Basic Separation technique in Biochemistry.
2.Sareen – Instrumental methods in Environmental Analysis.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
VI	**20U6ZOEL3A**	**Major Elective - III COMPUTATIONAL BIOLOGY(BIOINFORMATICS)**	**4**	**4**

Objectives:

1. To study about the scope of Bioinformatics and usage of www.
2. To study about the various databases in related with protein and nucleic acid sequences.
3. To know about the gene sequencing studies.

Unit I **Hrs15**

Scope of Bioinformatics, Application of Bioinformatics - Computer – Types of computers, Browsers used in Biology; Internet – Email.

Unit II **Hrs15**

Biological databases – Objectives of Biological databases, properties of databases, Symbols used in databases – Single letter codes for nucleotides, single letter codes for Amino-acids, Standard genetic code. Classification of biological database – Generalized databases, specialized databases.

Unit III **Hrs15**

Bioinformatics tool: Uses of bioinformatics tool – classification of bioinformatics tools – Homology and similarity tools – BLAST, FASTA clustral W – protein functional analysis tools : PFAM, SCANPS – Sequence analysis tools – structural analysis tools : PROTPARAM, GOR – Molecular modelling and visualizing tools – MMTK – visualizing tool – Rasmol – phylogenetic analysis tools - PHYLIP.

Unit IV **Hrs15**

Sequence alignment: Criteria for sequence alignment – sequence alignment techniques – optimal alignment – Global alignment and local alignment. Multiple sequence alignment. Structural alignment.

Unit V **Hrs15**

Usage of protein sequence database – SWISSPROT – one letter code and three letter code for amino acids – signal region. Cross reference to EMBL and DDBJ. Genome and its significance. Human genome project – Potential benefits of Human Genome Project.

Course outcomes

After completion of this course, students will be able to

- Understand the scope of Bioinformatics and usage of www.
- Gain the knowledge on various databases in related with protein and nucleic acid sequences.
- Knowledge on the gene sequencing.
- Realize the Potential benefits of Human Genome Project.

References

1. Information Theory and Living system – L.I. Garfield (1992), Columbia University.
2. Nucleic acid and Protein Sequence Analysis – M.J. Bishop and C.J. Ramalinga (1987), IRL Press.
3. Text Book of Bioinformatics – Sundharalingam and Kumaresan, Saras Publication.

Web Link:

1.https://canvas.harvard.edu/courses/8084/assignments/syllabus (Hardvarduniversity)
http://scse.ntu.edu.sg/Programmes/CurrentStudents/Graduate/Pages/msc-bioinformatics-desc.aspx#BI6106 (NUS)
https://www.uu.se/en/admissions/master/selma/kursplan/?kpid=39542&type=1 (Uppsala University Sweden)

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
VI	**20U6ZOEL3B**	**Major Elective – III** **B) BIOINSTRUMENTATION**	**4**	**4**
Objectives: To know the principle and Working mechanism of the following instruments.				

UNIT-I **Hrs15**

Microscopic Techniques: Principles and Applications of Light, Phase Contrast, Fluorescence Microscopy, Scanning and Transmission Electron Microscopy, Confocal Microscopy, Cytophotomatry and Flow Cytometry, patch clamping, advances of microscopy. Centrifugation: Preparative and Analytical Centrifuges, Sedimentation analysis RCF, Density Gradient Centrifugation.

UNIT–II **Hrs15**

Chromatography Techniques: Theory and Application of Paper Chromatography, TLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, GLC and HPLC.

UNIT–III **Hrs15**

Electrophonetic Techniques: Theory and Application of PAGE, Agarose Gel Electrophoresis 2DE, Iso-electric Focusing, Immuno diffusion, ImmunoElectrophoresis , ELISA , RIA , Southern , Northern and Western Blotting .

UNIT–IV **Hrs15**

Spectroscopic Techniques : Theory and Application of UV and Visible Spectroscopy, Fluorescence Spectroscopy, MS , NMR, ESR, Atomic Absorption Spectroscopy, X- ray Spectroscopy, LASAR , Raman Spectroscopy . MALDI

UNIT–V **Hrs15**

Radio-isotopic Techniques : Introduction to Radioisotopes and their Biological Applications , Radioactive Decay – Types and Measurement , Principles and Applications of GM Counter , Solid and Liquid Scintillation Counter, Autoradiography, RIA , Radiation Dosimetry .

Course outcomes

After completion of this course, students will be able to

- understand the Microscopic Techniques.
- skills in Chromatography Techniques.
- attain skills in Electrophonetic Techniques.
- acquire knowledge on Spectroscopic Techniques.
- know the Radio-isotopic Techniques.

Reference:

1. Physical Biochemistry:Application to Biochemistry and Molecular Biology – Freilder.
2. Biochemical Technique : Theory and Practice , - Robyt& White
3. Principle of Instrumental Analysis – Skoog& West
4. Principle & Technique – Practical Biochemistry 5th Ed. (2000) -Walker J.&Wilson K.
5. Biochemical Technique Theory & Practical- White, R.
6. Principle of Instrumental Analysis – Skoog et al.
7. Microbiology – Fundamental & Application (1995) -Atlas, R.M.
8. Biophysical Chemistry – Upadhyay&Nath.

Web Link:

1. https://catalog.csueastbay.edu/preview_program.php?catoid=19&poid=7617 (California state university)
2.https://www.manchester.ac.uk/study/undergraduate/courses/2020/00524/bsc-biology/course-details/BIOL10412#course-unit-details(Columbia University)

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
VI	**20U6ZOEL3C**	**MAJOR ELECTIVE – III BIO-STATISTICS AND COMPUTER APPLICATIONS IN BIOLOGY**	**4**	**3**

Objectives:

1. To know about the basic statistical concepts and their applications in Biology.
2. To know the basic idea about computer and their role in learning process & biology.

Unit I **Hrs15**

Biostatistics – Definition and Scope – Collection of Data – Census and Sampling methods – Variable: Discrete and continuous, Presentation of Data : Classification and tabulation, Diagrams and graphs: Bar, pie, Histogram, Line graph – Concept of Statistical population and sample characteristics of frequent distribution.

Unit II **Hrs15**

Measures of Central tendency : Mean, Median, Mode – Measures of Dispersion: Range, Standard deviation – Correlation Analysis.

Unit III **Hrs15**

Basic components of computer – Input devices and output devices – CPU – Flow chart – Importance of Computer in Biology.

Unit IV **Hrs15**

The computer system – BASIC : Character sets in BASIC language – Constants and variables –System commands Types of Statements – Basic Programme for Measures of Central Tendency.

Unit V **Hrs15**

MS Word : File Operations: New, Open, Save and Print – Editing: Cut, Copy, Paste, Find and Replace – Insert: Page numbers and Pictures – Format : Font, Bullet and Numbering, Paragraph and Background – Tools: Spelling and Grammar – Data: Sort – MS; EXCEL: Presentation of Biostatistical data using Excel: Autosum, Paste function, Chart Wizard, Sort function and Drawing – Use of Internet, Messenger and e-mail – Basic knowledge of Medical, transcription.

Unit VHrs15

MS Word : File Operations: New, Open, Save and Print – Editing: Cut, Copy, Paste, Find and Replace – Insert: Page numbers and Pictures – Format : Font, Bullet and Numbering, Paragraph and Background – Tools: Spelling and Grammar – Data: Sort – MS; EXCEL: Presentation of Biostatistical data using Excel: Autosum, Paste function, Chart Wizard, Sort function and Drawing – Use of Internet, Messenger and e-mail – Basic knowledge of Medical, transcription

Course outcomes

After completion of this course, students will be able to

- understand the basic statistical concepts and their applications in Biology
- develop skills in the measures of Central tendency.
- skills in the measures of Dispersion.
- know the basic idea about computer and their role in learning process and biology.

Reference

1. Balagurusamy, E., Programming in BASIC (3rd ed.), Tata McGraw Hill Publishing Co. Ltd.
2. Narasimhan, M., Learning with BASIC (Book I, II, III),Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1996.
3. Practical Statistics – S.P. Gupta.
4. Jerold, H. Zar, Biostatistical Analysis (2nd Edition), Prentice Hall of International edition, 1984 (Relevant portions).
5. Rangaswamy, R., A Text book of Agriculture Statistics, New Age International Publishers, 1995.
6. Gowtham Roy, Introduction to Computing and Computing lab and Cad (2002), Books and Allied (Pvt.) Ltd., Kolkatta.
7. Introduction of Computing Science and Programming in BASIC – Dr. S.K. Nag – Books and Allied (P) Ltd.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
VI	**20U6ZOEL4A**	**Major Elective – IV ANIMAL AND ENVIRONMENTAL BIOTECHNOLOGY**	**4**	**3**

Objectives:

- To study about techniques of animal tissue cultures, cryopreservation of sperms and embryo transformation.
- To study about the role of microbes in Bio-gas production, Ethanol production and conventional fuels, Bioleaching, Biomining and Biofertilizers.
- To study about the sewage treatment methods.

Unit I **Hrs 15**

Requirements of Animal cell culture lab: Essential equipment and requirement; Types of Culture media: Natural media – Artificial media – Complete culture media – Serum as culture medium – Serum free media – Explant preparation –Disaggregation methods – Proliferation – differentiation

Unit II **Hrs 15**

Animal cell culture – Types: Primary, Secondary, Continuous cell culture; Organ and Embryo Culture; Insect cell line - Stem cell cultures - Cryopreservation of animal cells – Embryo and gene Transfer technique –Transgenic animals: Fire flies, Fish, Mice, Cat, Goat, Cow.

Unit III **Hrs 15**

Bio-fertilizers – N_2 fixing microbes: Azolla, Azotobacter, Azospirillum and their uses in Agriculture – *A. tumifaciens* for crop improvement – Biocontrol agents – Biopesticides and Bioherbicides

Unit IV **Hrs 15**

Conventional fuel: Coal, Natural gas and Fire wood, and their impact on degradation of environment, Production of Biogas and ethanol.

Unit V **Hrs 15**

Application of Microbes in Environmental Pollution: Treatment of sewage by microbes – Treatment of industrial effluents and oil spills by microbes – Degradation of chemical pesticides by microbes – Bioleaching, Biomining, Xenobiotics.

Course outcomes

After completion of this course, students will be able to

- understand the requirements of Animal cell culture lab
- gain an insight into the concepts and techniques of animal and environmental biotechnology and its wide industrial and medicinal applications
- realize the techniques in animal cell culture
- skills in Bio-fertilizers
- Identify the problems related to environment and the Environment Protection Acts and Legislations.
- aware on Conventional fuel

knowledge on the role of microbes in Environmental Pollution**.**

References:

1. Purohit, S.S. – Biotechnology
2. Agarwal, K.C. – Fundamentals of Molecular Biology and Biotechnology.
3. Jagdand, S.N. – Environmental Biotechnology.
4. Rang, M. – Animal Biotechnology.
5. Trevan, M.D., Boofey, S. – Biotechnology.
6. Sathyanarayana, U. – Biotechnology.

Web Link:

1.https://biology.columbia.edu/courses/biotechnology-11 (Columbia University)
2.https://biology.columbia.edu/courses/cell-signaling-0 (Columbia University)
3.https://biology.columbia.edu/courses/developmental-biology-13 (Columbia University)
4.https://biology.columbia.edu/courses/genes-and-development-6 (Columbia University)
5.https://ocw.mit.edu/courses/biology/7-342-pluripotent-stem-cells-and-genome-engineering-for-modeling-human-diseases-spring-2015/syllabus/
6.https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-89-environmental-microbiology-fall-2004/syllabus/ -

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
VI	**20U6ZOEL4B**	**Major Elective – IV POULTRY SCIENCE**	**4**	**3**

Unit I **Hrs15**

Poultry production in Tropics and India, Economic importants of Poultry production, Egg production trends in India, demand and supply pattern.

Unit II **Hrs15**

Common breeds of poultry – American class, English class, Medieterranean class, Asiatic class - Indian class. Important characters of modern breeds of poultry.

Unit III **Hrs15**

Incubation and hatchery management: Selection and care of eggs for incubation, Hatchery hygiene and prevention of hatchery borne diseases. Management of young birds, brooding conditions; farm operations during brooding period. Lighting, vaccination, ,coccidiosis control.

Unit IV **Hrs15**

Management of growers: Culling, optimal-crowding, feeding.
Management of layers: Light, culling by distinction of non-layers, Deep Littre Management, Housing and equipments, , feeders and waters.
Feed composition and nutrients: Grower and layer feeds.

Unit V **Hrs15**

Marketing: Problems, quality of eggs, grading of eggs and meat.
Prevention and control of diseases: Common bacterial, fungal, viral and protozoan diseases.
Parasites: Nematode.
Arthropod pests: Ticks, mites and their control. Marketing problems: quality of eggs, grading of eggs and meat.

Course outcome

After completion of this course, students will be able to

- gain the information on Poultry production in India
- knowledge on breeds of poultry
- understand hatchery management
- develop skills in Management of growers and layers.
- aware on bacterial, fungal, viral and protozoan diseases of poultry

References:

1. Harbansingh and Moore (1982) – Livestock and Poultry Production, Prentice Hall of India Private Ltd., New Delhi 110 001.
2. N.S.R. Sastry, C.K. Thomas and R.A. Singh – Farm animal management and poultry production, Vikas Publishing House Private Ltd., Delhi.

Web Link:

1.https://www.ed.ac.uk/studying/postgraduate/degrees/index.php?r=site/view&edition=2020&id=963&gclid=Cj0KCQjwupD4BRD4ARIsABJMmZ_XpKfi8gbeMI9vcZHVbaEQGPFO6m6VShUoeMIfidyCiNbSo4utM8caAoUVEALw_wcB (The University of Edindurgh)

2.http://catalog.sfasu.edu/preview_program.php?catoid=1&poid=349&returnto=31 (Stephen F. Austin University, Texas)

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
VI	**20U6ZOCO6**	**CORE – OPTION – BIODIVERSITY**	**-**	**-**

Objectives:

1. To study the diversity of genes, species of eco system.
2. To study the Loss, uses, values, of conservation of Bio-diverting.

UNIT-I **Hrs18**

Biodiversity-Definition-Types-Diversity of Genes (genetic diversity) species (species diversity) and ecosystems (ecosystem diversity). Genetic diversity-Nature and origin of genetic variation- The need for preservation of wild relatives of domestic animals. Centres of origin of domesticated animals. Species diversity- Measurement, concepts, richness and turnover. Species - area relationships - Global distribution of richness - Centres of species diversity- Mega diversity centres- Hot spot analysis.

UNIT-II **Hrs18**

Loss of biodiversity- Species extinction- Fundamental causes- Deterministic and stochastic processes- Current and future extinction rates-Methods of estimating loss of biodiversity- Threatened species- The IUCN threat categories (Extinct, Endangered, Vulnerable, Rare, Intermediate, and Insufficiently known). The threat factors (Habitat loss, Over exploitation for uses, introduction of exotics, Diseases, Habitat fragmentation etc.,) Common threat animal taxa of India- Red data books.

UNIT- III **Hrs18**

Uses and values of Biodiversity- Uses of bio resources- animal uses; food animals (terrestrial and aquatic), non-food uses of animals, domestic livestock. Values of Biodiversity- Instrumental (Goods, Services, Information and Psycho spiritual values) and inherent or intrinsic values, ethical and aesthetic values- An outline account on methods of valuing biodiversity.

UNIT -IV **Hrs18**

Conservation and sustainable management of Biodiversity and Bioresources- Nationalpolicies and instrument relating the production of the wild / domesticated fauna as well as habitats- International policies and Instruments- A general account on multilateral treaties – the role of CBD, IUCN, IBPGR, NBPGR, WWF, FAO, UNESCO, AND CITES- bioresources. Biotechnology and intellectual Property Rights: An elementary account on WTO, GATT, and TRIPs, Bio prospecting and IKS, Bio-pyracy rights of farmers, breeders, and indigenous people- An elementary account on biodiversity/ bio resources data.

UNIT -V **Hrs18**

Conservation of biodiversity- Why conservation biology? Current practices in conservation- Habitat or ecosystem approaches- Species based approaches- Social approaches- Chipko movement- In situ (Afforestration, Social forestry, Agro forestry, Zoos, Biosphere reserves, National parks, Sanctuaries), and ex situ (Cryopreservation, Gene banks, Sperm banks, DNA banks, Tissue culture and Biotechnological strategies). Eco restoration, environmental and biodiversity laws, environmental education.

REFERENCES:

1. Primack, R. B. 1993. Essentials of Conservation Biology, Sinauer Associates, USA
2. Meffe,. G. K. and C. R. Carroll. 1994. Principles of Conservation Biology, Sinauer Associates, USA.
3. Groom bridge, B. 1992. Global Biodiversity. Status of the Earth's Living Resources. Chapman and Hall, London.
4. Mittermeier, R. A., N. Meyers, P.R. Gil and C. G. Mittermeier 2000. Hotspots: Earth's Biologically richest and most endangered Terrestrial Ecoregions. Cemex. Conservation International, USA
5. Mittermeier, R. A., P.R. Gil and C. G. Mittermeier 1997. Megadiversity: Earth's Biologicals Wealthiest Nations, Cemex, SA

Web Link:

1.https://www.earth.columbia.edu/sitefiles/file/SDEV%20Syllabi/EEEB%20W1001%20Biodiversity.pdf (Columbia University)
2.http://www.columbia.edu/itc/cerc/danoff-burg/Islands_syllabus.html (Columbia University)
3.https://www.earth.columbia.edu/sitefiles/file/SDEV%20Syllabi/EEEB%20W2001%20Environmental%20Biology%20I.pdf (Columbia University)
4.https://www.brown.edu/Research/Sax_Research_Lab/Documents/Syllabus/Revised_Course_Syllabus_-_Biol_1470_-_Fall_2009%5B2%5D.pdf