

Resolution No.: _____

Approved in BOS dated on 6th June 2023 and to be implemented from the Year 2023-2024

Bharatiya Vidya Bhavan's

**M. M. College of Arts, N.M. Institute of Science, H.R.J.
College of Commerce. (Bhavan's College) Autonomous**

(Affiliated to University of Mumbai)



Proposed Syllabus for F. Y.

B.Sc. (MAJOR)

BH.US ZOO. MAJ

Program: B.Sc.

Zoology (Choice

based Credit System

With effect from the Academic year (2023–2024)

PREAMBLE

Zoology is a branch of biology that deals with major aspects of animal study. Zoology is a basic science that involves the knowledge and understanding of the animal phyla and their biochemical, immunological, physiological characteristics along with their interactions in the environment.

The Bachelors program provided by Bhavans college in the subject of Zoology is designed in a manner so as to aid the student to understand the various aspects of the subject and apply the knowledge gained in real life.

The revised curriculum is designed keeping in mind the increasing horizons of life sciences and the various developments taking place in the field of biology.

The revised curriculum has included topics like animal diversity, wherein the student will be introduced to the wide variety of animal species in the world.

Topics like evolution have been proposed so that the learner is aware of the varied mechanisms of evolution taking place. The study of ecology will fabricate the students to understand about the abundant interrelationships of an individual with the environment.

The revised syllabus has been outlined in a way that the student will also gain some technical skills and learn about laboratory practices which will help them in their future endeavors in research.

Zoology forms the backbone for many other subtopics. Basic life science topics like physiology, genetics, study of various diseases are also a part of the curriculum.

Field visits, excursions and study tours will give the learners a firsthand experience about the various features of zoology and at the same they will learn to apply the knowledge gained by them in situations outside their classrooms.

The FYBSC (Major) course is the base of the Bachelors degree in zoology and it will initiate the process of scientific reasoning and judgement in the students

PEDAGOGY

The First year of the B.S.c degree (Major) course forms the base for the subject and also acts as a turning point for the students to decide upon their future options, carving the path for their future in a specific field. The syllabus of Zoology for Bachelor's degree is designed keeping the benefit of students in mind. The revised syllabus will enable the student to understand the subject and apply the knowledge in real time situations.

The new revised syllabus encourages modern teaching methods of presentations, projects, seminars, use of the elaborate multimedia sources, leaving behind the traditional classroom teaching methods.

The best way to study and understand a natural science like zoology is by live hands on experience which is encouraged in the revised syllabus through the mode of field visits, excursions, study tours. This will enable students to apply their knowledge and get a true insight about the animal, its life processes and the interactions with the environment.

The new syllabus recommends topics like ecosystem, biodiversity, wildlife conservation and management with the aid of documentaries, case studies, live sessions with expert individuals.

The syllabus aims not only to increase the learners thirst for the subject of zoology but also focuses on inculcating values like scientific thinking, self awareness, sentiments of care and protection toward the animals and the environment.

Interaction with the officials of wildlife protection force and other experts is recommended so that the students are aware about the diverse animals, their endangerment and encroachment along with varied environments, its restoration and maintenance needed for survival of life.

The revised syllabus also encourages a multidisciplinary approach of teaching learning method. Interactions with various other departments like geology, history, geography, chemistry, psychology, medicine would bring about a multidimensional approach of learning concepts such as paleontological evidences, nucleic acids, physiological processes, biomolecules, holistic health and neurological and genetic diseases.

Topics like instrumentation and biotechnology will give an insight into academia- industry interface and should be edified in collaboration with expertise from relevant research institutes and industrial establishments and entrepreneurs by inviting them as guest speakers or through industrial visits, excursions for practical experience about the principle, working and application of the instruments for commercial use. Population ecology should be explained in the context of the census to enlighten pupils about the effect of diversity and dynamism of the human population on socio economic status of India. ICT enabled learning is the need of the hour and could include screening of documentaries, videos, animations, PPT's, and the use of social media such as Whatsapp, Instagram, Facebook be employed for impactful and continued learning. Facilitators can upload the teaching material,

videos of lectures, links to websites for not only enhancing but also focusing and developing the topics of interest by the learner by way of self-study. More importantly, the syllabus endeavours to develop life skills by discovering and honing entrepreneurial skills of the learner.

PROGRAM OUTCOMES

PO	PO Description
PO	A student completing Bachelor's Degree in Arts/commerce/science program will be able to:
PO 1	Create an awareness of the impact of biological science on the environment, society, and development outside the scientific Community .To make the learners acquaint about the Taxonomy,general character and adaptations of animals
PO 2	It helps to develop scientific temper and thus can prove to be more beneficial for the society as the scientific developments can make a nation or society to grow at a rapid pace.
PO 3	Awareness about environment and its conservation processes, pollution control and its importance and. Gain knowledge of protection of vulnerable and endangered species
PO 4	Articulate scientific concepts, place forth a hypothesis, style and execute testing tools and draw relevant inferences. Communicate

	the analysis adds acceptable scientific language.
	<p>Gain knowledge of protection of vulnerable and endangered species</p> <p>Information and skill of applied zoology including sericulture, apiculture, fisheries, poultry, vermiculture, agricultural pests and their control etc.</p> <p style="text-align: center;">PO 5</p>
PO 6	<p>After the completion of this course students have the option to go for higher studies i.e. M. Sc and then do some research for the welfare of mankind.</p> <p>After higher studies students can join as scientist and can even look for professional job oriented courses.</p>
PO 7	<p>Aware students about ethical principles and commit to professional ethics and responsibilities.</p> <p>Aware students about ethical principles and commit to professional ethics and responsibilities.</p>
PO 8	Demonstrate exhaustive understanding within the relevant science discipline. Recall, explain, extrapolate and organize abstract knowledge domain for execution and application and additionally to

	judge its connection.
PO 9	Use modern techniques, sophisticated equipment's and advanced software's to understand biological concepts.

Bhavan's college, (Autonomous) Andheri (W) Mumbai-58

Proposed Syllabus for FYBSc.
MAJOR ZOOLOGY
From academic year **2023-2024**

SEMESTER I

COURSE CODE	UNIT	TOPIC	CREDITS	TOTAL LECTURES
BH.US ZOO. MAJ 101	I	Animal Diversity- I	3	15
	II	Ecology I		15
	III	Biological laboratory techniques		15
BH.US ZOO. MAJ P1	Practical based on courses		1	

SEMESTER II

COURSE CODE	UNIT	TOPIC	CREDITS	TOTAL LECTURES
BH.US ZOO. MAJ 201	I	Animal Diversity- II/Chordata	3	15
	II	Public health and hygiene		15

	III	Biotechnology		15
BH.US ZOO. MAJ P2	Practical based on courses		1	

SYLLABUS F.Y.B.Sc. ZOOLOGY
UNIT WISE DISTRIBUTION

Semester I	Semester II
Course 1	Course 2
Unit 1 Animal Diversity- I	Unit 1 -Animal Diversity- II
Unit 2 Ecology	Unit2 Public health and hygiene
Unit 3 laboratory techniques	Unit 3 Biotechnology
Practical (BH.US ZOO. MAJ P1)	Practical (BH.US ZOO. MAJ P2)

Bhavan's college, (Autonomous) Andheri (W) Mumbai-58
FYBSc Zoology Syllabus
Semester – I (BH.US ZOO. MAJ 101)
Animal Diversity- I, and Ecology

Sr. no	BH.US ZOO. MAJ 101	No. of lectures allotted
	Unit 1: Animal Diversity- I	15 L
	<i>Objective: To introduce the principles of taxonomy and system of classification</i>	
	<i>Desired Outcome: Learners will understand the basic concept of classification. Learnrs will be able to identify the invertebrates by applying the knowledge of general characters.</i>	
1.1	<p>Non chordate Classification Phylum Protozoa –General characters</p> <p>Classification of Protozoa with distinguishing characters and examples.</p> <p style="padding-left: 20px;">Class Sarcodina - e.g.Amoeba Class Mastigophora eg Leishmania Class Ciliata -- e.g.Paramoecium Class Sporozoa –e.g. Plasmodium</p>	1L 1L
1.2	<p>Phylum Porifera -General characters</p> <p style="padding-left: 20px;">General characters Class Calcarea –e.g.Leucosolenia Class Hexactinellida -e.g.Hyalonema Class Demospongia –e.g.Euspongia</p>	1L
1.3	<p>Phylum Cnidaria</p> <p style="padding-left: 20px;">General characters Class Hydrozoa -e.g. Hydra Class Scyphozoa –e.g. Aurelia</p>	1L

	Class Anthozoa – e.g. Meandrian	
1.4	Phylum Platyhelminthes General characters Class Turbellaria –e.g. Planaria Class Trematoda - e.g.Liverfluke Class Cestoda –e.g Tapeworm	1L
1.5	Phylum Nematoda General characters Class Aphasmda e.g. Trichinella Class Phasmida –e.g. Ascaris	1L
1.6	Phylum Annelida General characters Class Polychaeta –e.g. Neries Class Oligochaeta –e.g.Earthworm Class Hirudinaria- .e.g. Leech	1L
1.7	Phylum Arthropoda General characters Class Crustacea- e.g Crab Class Arachnida –e.g. Spider Class Insecta - e.g. Cockroach Class Myriapoda – e.g.Centipede	3L
1.8	Phylum Mollusca General characters Class Aplacophora –e.g. Chaetoderma Class Polyplacophora–e.g. Chiton Class Monoplacophora –e.g. Neopilina Class Gastropoda – e.g. Pila Class Pepecypoda –e.g. Mytilus Class Scaphopoda –e.g.Dentalium Class Cephalopoda –e. g. Sepia	2L
1.9	Phylum Echinodermata General characters Class Asteroidea –e.g. Starfish Class Ophiuroidea –e.g. Brittlestar Class Echinoidea – e.g. Seaurchin Class Holothuroida—e.g.Holothuria	2L

	Class Crinoidea – e.g. Antedon	
1.10	Phylum Hemiochordata - General characters e.g. Balanoglossus	1L
	Unit 2: Ecology	15L
	<i>Objective: To impart knowledge of different components of ecosystem and educate about essentials of coexistence of organisms with nonliving components</i>	
	<i>Desired Outcome: Learners will grasp the concept of interdependence and interactions of physical, chemical and biological factors in the environment and will lead to better understanding about implication of loss of fauna specifically on human being, to understand the importance of conservation of all flora and fauna</i>	
2.1	Ecosystems	
	2.1.1 Definition, Concept and types of ecosystem	2L
	2.1.2 Energy flow through ecosystem, food chain and food web	3L
2.2	2.2.1 Biogeochemical cycles- water, carbon, oxygen, nitrogen, phosphorus cycle.	4L
	2.2.2 Anthropogenic activities affecting biogeochemical cycle.	2L
2.4	Animal interaction-symbiosis: mutualism, commensalism, parasitism and predation, antibiosis	4L

	UNIT 3 laboratory techniques	15
	Course objectives: <i>To provide all learners a complete insight into the structure and train them with operational skills of different instruments required in Zoology.</i>	
	Course outcomes: <i>Students will be skilled to select and operate suitable instruments for the studies of different components of Zoology of this course and also of higher classes including research.</i>	
	3.1: Introduction to good laboratory practices	1L
	3.2: Use of safety symbols: meaning, types of hazards and precautions	3L
	3.3: Units of measurements 3.3.1 : Calculations and related conversions of each: Metric system- length (meter to micrometer); weight (gram to kilogram); Volumetric (Cubic measures) 3.3.2 Temperature: Celsius, Fahrenheit, Kelvin 3.3.3 Concentrations: Percent solutions, ppt, ppm, ppb dilutions, Normality, Molarity and Molality.	5L
	3.4: Data Analysis 3.4.1 Introduction and Scope of Biostatistics. 3.4.2 Sampling Methods and its types 3.4.3 Central tendencies – Mean, Median, Mode 3.4.4 Tabulation and graphical representation of data. Histogram, Simple bar diagram, multiple bar diagram and Pie diagram	6L

SEMESTER I	
PRACTICAL I BH.US ZOO. MAJ P1	
1.	<p>Animal Diversity –Identification of</p> <p>Phylum Protozoa- Amoeba, Paramoecium, Leishmania, Plasmodium</p> <p>Phylum Porifera - Leucosolenia, Hyalonema, Euspongia</p> <p>Phylum Cnidaria- Hydra, Aurelia, Meandrina</p> <p>Phylum Platyhelminthes- Planaria, Liverfluke, Tapeworm</p> <p>Phylum Nematoda – Trichinella ,Ascaris</p> <p>Phylum Annelida – Neries, Earthworm, Leech</p> <p>Phylum Arthropoda- Crab, Spider , Cockroach, Centipede</p> <p>Phylum Mollusca- Chaetoderma , Chiton, Neopalina, Dentalium, pila , mytilus, Sepia</p> <p>Phylum Echinodermata - Starfish , Brittle star , Sea urchin, Holothuria, Antedon</p> <p>Phylum Hemiochordata – Balanoglossus</p>
2.	Estimation of salinity of water sample.
3	Estimation of CO ₂ from sample water

4.	Estimation of pH from water and soil sample
5.	Construction of food chain/food web using given information/data.
6.	Identification of common laboratory equipment (Instruments): Microscope, Colorimeter, pH meter, Centrifuge and Electrophoresis.(Vertical/Horizontal)
7.	Problem based on Normality, Molarity.
8.	Interpretation of safety symbols (toxic, corrosive, explosive, flammable, skin irritant, oxidizing, compressed gases, aspiration hazards and biohazardous infectious material}
9.	Preparation of solutions {Percent solutions, ppt, ppm, ppb dilutions}
10.	Problems on Data analysis.

***Note - The practicals may be conducted by using specimens authorized by the wildlife and such other regulating authorities though it is strongly recommended that the same should be taught by using photographs/audio-visual aids/ simulations / models, etc. as recommended by the UGC and as envisaged in the regulations of the relevant monitoring bodies. No new specimens, however, shall be procured for the purpose of conducting practical's mentioned here-in-above.**

#There shall be at least one excursion/field trip.

REFERENCES AND SUGGESTED READINGS

1. Modern text book of Zoology - Invertebrates; Eleventh; Edition Professor R.L. Kotpal; Rastogi publication Invertebrate Zoology by E. L. Jordan & P. S. Verma Rev. edition, 2009, Chand publications Invertebrate Zoology by P. S. Verma, edition, 2009, Chand publications Zoology for degree students, Non chordates by V.K. Agarwal 2011, S. Chand Publication.
2. Invertebrate Zoology- Dhami P. S. and Dhami J. K., R. Chand and Co.
3. Biodiversity- S.V.S Rana- Prentice Hall Publications
4. Biodiversity- K.C. Agarwal- Agro Botanica Publications
5. Ecology and Environment- P. D. Sharma, R. K. Rastogi Publications
6. Fundamentals of Ecology- E. P. Odum, Sanders Publication.
7. Fundamentals of Ecology- M.C. Dash-2nd edition, Tata McGraw Hill.
8. Cell Biology, Genetics, Molecular Biology, Evolution And Ecology- by P. S. Verma And V.K. Agarwa
9. Biological instruments and methodology – Dr. P. K. Bajpai, S. Chand company Ltd.
10. Calculations in Molecular biology and Biotechnology - Frank H. Stephenson, Academic Press.
11. A Manual of Medical Laboratory Technology -A. H. Patel, Navneet Prakashan Ltd.
12. Bioinstrumentation – L. Veerakumari, (M.J.P. Publishers)
13. Principles and Techniques of Practical Biochemistry – Keith Wilson and John Walker, (Cambridge University Press)

FY BSc Zoology Semester I (Practical- I)

Course code BH.US ZOO.MAJ P1

PROPOSED SKELETON QUESTION PAPER FOR PRACTICAL EXAMINATION

DURATION: 2 Hrs

Marks : 50

SR.NO.	PRACTICAL	MARKS
Q1	Identify and describe : (any 1 from each)	12
a)	Protozoa/ Porifera/Cnidaria	
b)	Platyhelminthes /Nematoda/ Annelida	
c)	Arthropoda/Mollusca/Echinodermata	
d)	Hemichordata	
Q2	Identification of common laboratory equipment Microscope, Colorimeter, pH meter, Centrifuge and Electrophoresis.(Vertical/Horizontal) (ANY TWO) Identification of safety symbols toxic, corrosive, explosive, flammable, skin irritant, oxidizing, compressed gases, aspiration hazards and biohazardous infectious material}(ANY TWO)	12
Q3	Preparation of solutions {Percent solutions, ppt, ppm, ppb dilutions }	3
Q4	Estimation of CO ₂ from sample water OR	5
	Estimation of salinity from sample water	
Q5	Estimation of pH from water sample OR	4
Q5	Estimation of pH from soil sample	
Q6	Problem based on Normality, Molarity. ANY TWO OR	4
	Problems on Data analysis. ANY TWO	
Q7	Viva & Journal	10

Bhavan's college, (Autonomous) Andheri (W)

Mumbai-58FYBSc Zoology Syllabus

**Semester – II (BH.US ZOO MAJ
201)**

Animal Diversity- II, Public Health Hygiene ,Biotechnology

Sr. no	BH.US ZOO MAJ 201	No. of lectures allotted
	Unit 1: Animal Diversity- II.	15 L
	<i>Objective: To introduce classification of Protochordates and modern Chordates To understand the general characters of the organisms. To understand the concept of taxonomy in higher organisms</i>	
	<i>Desired Outcome: Learners will get an idea of basic characters of phylum's and the organisms. Learners will be able to identify the organisms based on their External features.</i>	
1.1	Chordate classification Phylum Chordata Group -Protochordata General characters Subphylum Urochordata— eg. Herdmania Subphylum Cephalochordata - eg. Amphioxus	1L 2L
1.2	Group -Euchordata Subphylum -Vertebrata General characters Division -Agnathostomata Class Myxinoidea -eg. Myxine Class -Petromyzontia - eg . Petromyzon	2L
1.3	Division - Gnathostomata Superclass - Pisces Class - Chondrichthyes eg. Shark Class -Osteichthyes - eg. Mackerel	2L
1.4	Superclass Tetrapoda –Genral features and classification Class Amphibia	2L

	Subclass Apoda –Caecilian Subclass Anura– Toad dSubclass Urodela – Salamander	
1.5	Superclass Tetrapoda Class Reptilia Order Chelonia -Turtle Order Crocodilia – Crocodile Order Ophidia- Cobra Order Lacertilia - Chamaeleon	2L
1.6	Superclass – Tetrapoda Class Aves Subclass Ratitae e.g. Ostrich Subclass Carinatae e.g. Kingfisher	2L
1.7	Superclass Tetrapoda Class Mammalia Subclass Prototheria e.g. Duckbilled Platypus Subclass Metatheria e.g. Kangaroo Subclass Eutheria e.g. –Bat	2L

	Unit 2:Public health and hygiene	
	Course objectives: <i>To provide all learners with a fundamental understanding of public health and hygiene and to make them aware of the concept of biotechnology. To impart knowledge about source, quantum and need for conservation of fast depleting water resource and essentials of maintaining proper sanitation, hygiene and optimizing use of electronic gadgets.</i>	
	Course outcomes: <i>Promoting optimum conservation of water, encouragement for maintaining adequate personal hygiene, optimum use of electronic gadgets, avoiding addiction, thus facilitating achievement of the goal of healthy young India in true sense</i>	
	2.1 : Health 2.1.1 : Definition of Health, the need for health education and health goal. 2.1.2 : Physical, psychological and Social health issues. 2.1.3 : WHO and its programmes - Polio, Small pox, Malaria and Leprosy (concept, brief accounts and outcome with respect to India). 2.1.4: effects of self-medication.	4L
2.2	2.2 : Water and water supply 2.2.1 : Sources and properties of water. 2.2.2 : Purification of water, small scale, medium scale and large scale (rapid sand filters) 2.2.3 : Water footprint (concept, brief accounts and significance).	3L
2.3	2.3 : Hygiene: 2.3.1 : Hygiene and health factors at home, personal hygiene, oral hygiene and sex hygiene.	2L
2.4	2.4 : Radiation risk: 2.4.1 : Mobile Cell tower and electronic gadgets (data of recommended level, effects and precaution).	3L
2.5	2.5: Blood bank – Concept and significance	2L

	Unit 3: <u>Biotechnology-I</u>	15
	3.1: Concept of biotechnology 3.1.1 : Definition 3.1.2 : An overview of achievements and scope	2L

	3.2 : Fundamentals of laboratory techniques in biotechnology 3.2.1: Safe handling of equipment 3.2.2: Sterilization techniques	5L
	3.3: Food biotechnology Lactic acid and Yeast Fermentation – yogurt, cheese, bread, beer, and wine.	3L
	3.4Enzyme biotechnology Enzymes as meat tenderizer Bio-detergents Enzyme immobilizationBioenzymes	5L

<u>SEMESTER II</u>	
<u>Practical I</u> BH.US ZOO. MAJ P2	
1.	Animal Diversity II –Identification of Subphylum Urochordata— Herdmania Subphylum Cephalochordata - Amphioxus Division Agnathostomata -Class –Cyclostomata Petromyzon, Division Gnathostomata , Superclass Pisces Class Chondrichthyes -Shark Class Osteichthyes – Mackerel Class Amphibia Subclass Apoda –Caecilian Subclass Anura– Toad Subclass Urodela – Salamander Class Reptilia Order Chelonia -Turtle Order Crocodilia – Crocodile Order Ophidia- Cobra Order Lacertilia - Chamaeleon Class Aves Subclass Ratitae - Ostrich Subclass Carinatae - Kingfisher Class Mammalia Subclass Prototheria -Duckbilled Platypus Subclass Metatheria -Kangaroo Subclass Eutheria –Bat
2.	Study of scales - Placoid, Cycloid , Ctenoid
3.	Food adulteration Test- (a) Milk adulterants (starch and glucose), methylene blue reduction Test (MBRT). (b) Adulterants in Cheese, Butter, Jaggery, Ghee, Honey, Iodized Salt.
4.	Types of beaks ,claws
5.	Effect of papain (raw papaya extract as a meat tenderizer).
6	Preparation of beads of calcium alginate for immobilization of enzyme amylase or yeast cells.
7	Demonstration of immobilized amylase or invertase from immobilized yeast cells by DNSA method. (Visual observation for comparative colour intensity in a test tube)
8	FIRST AID-Demonstration Practical Training
10	FIELD REPORT

REFERENCES AND SUGGESTED READINGS

1. Vertebrate Zoology Volume I- Jordan and Verma , S. Chand and Co.
2. Chordate Zoology- Dhami P. S. and Dhami J. K. , R. Chand and Co.
3. Introduction to Vertebrates- Moore Cambridge University- Low Priced Edition.
4. Zoology- Miller S. A. and Harley J. B., Tata McGraw Hill. 8. Modern Textbook of Zoology, Invertebrates,
5. Kotpal R. L
6. Biological Science, Taylor D.J., Stout G.W., Green N.P.O, Soper R.,Cambridg University Press.

7. Biodiversity- K.C.Agarwal- Agro Botanica Publications
8. Butterflies of India – Isaac Kehimkar- BNHS Publication

9. Biodiversity- S.V.S Rana- Prentice Hall Publications

10. Bioinstrumentation – L. Veerakumari, (M.J.P. Publishers)
11. Understanding biotechnology- Aluizio Borem ,David Bowe-Low price edition –Pearson Publication
12. A Textbook of Biotechnology – R. C. Dubey, S. Chand Publication.
13. A Manual of Medical Laboratory Technology -A. H. Patel, Navneet Prakashan Ltd.
14. Biological instruments and methodology – Dr. P. K. Bajpai, S. Chand company Ltd.
- Calculations in Molecular biology and Biotechnology - Frank H. Stephenson, Academic Press.

FY BSc Zoology Semester II (Practical- I)

Course code BH.US ZOO.MAJ P2

PROPOSED SKELETON QUESTION PAPER FOR PRACTICAL EXAMINATION

DURATION: 2Hrs

Marks : 50

SR.NO.	PRACTICAL	MARKS
Q.1	Identify and describe: Any one from	12
a)	Protochordata	
b)	Cyclostomata /Chondrichthyes /Osteichthyes	
c)	Amphibia	
d)	Reptilia	
e)	Aves	
f)	Mammalia	
Q.2	Study of scales - Placoid, Cycloid , Ctenoid (any 2)	05
Q.3	Identify and describe -beaks ,claws	04
Q.4	Detect adulterants present in the given milk and food sample (ANY TWO)	06
Q.5	Interpretation of immobilized amylase or invertase from immobilized yeast cells by DNSA method	05
Q.6	Effect of papain (raw papaya extract as a meat tenderizer).	06
Q.7	Journal and <i>Viva voce</i>	07
Q.8	Report on First AID	05

EVALUATION PATTERN:

SCHEME OF EXAMINATION:

- (a) Internal assessment of forty (40) marks per course per semester should be conducted as Continuous Internal assessment
 - 1) (CIA 1) of 20 marks of Objective type including multiple choice etc.
 - 2) (CIA 2)20 marks of assignments type.
- (b) External assessment of sixty (60) marks per course per semester should be conducted as per the following skeleton question paper pattern.
- (c) One practical examination of fifty (50) marks per course each should be conducted at the end of every semester.

SKELETON- EXAMINATION PATTERN FOR THE ABOVE SYLLABUS

All Questions are compulsory Figures to the right indicate full marks

Time: 2.5 hours

Total marks: 60

Questions	Marks
Q1-A) Unit 1 – a) 10 marks (descriptive) OR b) 10 marks	10
Q1-B) Unit 1- a) 10 marks (descriptive) OR b) i) short notes 5 marks and b- ii) 5 marks	10
Q2-A) Unit 2 – a) 10 marks (descriptive) OR b) 10 marks	10
Q2-B) Unit 2- a) 10 marks (descriptive) OR b)-i) short notes 5 marks and b- ii) 5 marks	10
Q5) Answer any 4 out of 8 short notes (4 from each unit)	20

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Bharatiya Vidya Bhavan's

**M. M. College of Arts, N.M. Institute of Science, H.R.J.
College of Commerce. (Bhavan's College) Autonomous**

(Affiliated to University of Mumbai)



Proposed Syllabus for

F. Y.B.Sc. (MINOR)

BH.US ZOO. MIN

Program: B.Sc.

Zoology (Choice

based Credit System

With effect from the Academic year 2023-24

PREAMBLE

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The revised curriculum is designed keeping in mind the increasing horizons of life sciences and the various developments taking place in the field of biology.

The revised curriculum has included topics like animal diversity, wherein the student will be introduced to the wide variety of animal species in the world.

Topics like evolution have been proposed so that the learner is aware of the varied mechanisms of evolution taking place. The study of ecology will fabricate the students to understand about the abundant interrelationships of an individual with the environment.

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Zoology forms the backbone for many other subtopics. Basic life science topics like physiology, genetics, and study of various diseases are also a part of the curriculum.

Field visits, excursions and study tours will give the learners a firsthand experience about the various features of zoology and at the same they will learn to apply the knowledge gained by them in situations outside their classrooms.

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The syllabus aims not only to increase the learners thirst for the subject of zoology but also focuses on inculcating values like scientific thinking, self-awareness, sentiments of care and protection toward the animals and the environment.

Interaction with the officials of wildlife protection force and other experts is recommended so that the students are aware about the diverse animals, their endangerment and encroachment along with varied environments, its restoration and maintenance needed for survival of life.

The revised syllabus also encourages a multidisciplinary approach of teaching learning method. Interactions with various other departments like geology, history, geography, chemistry, psychology, medicine would bring about a multidimensional approach of learning concepts such as paleontological evidences, nucleic acids, physiological processes, biomolecules, holistic health and neurological and genetic diseases.

Topics like instrumentation and biotechnology will give an insight into academia- industry

interface and should be edified in collaboration with expertise from relevant research institutes and industrial establishments and entrepreneurs by inviting them as guest speakers or through industrial visits, excursions for practical experience about the principle, working and application of the instruments for commercial use. Population ecology should be explained in the context of the census to enlighten pupils about the effect of diversity and dynamism of the human population on socio economic status of India.

ICT enabled learning is the need of the hour and could include screening of documentaries, videos, animations, PPT's, and the use of social media such as WhatsApp, Instagram, Facebook be employed for impactful and continued learning. Facilitators can upload the teaching material, videos of lectures, links to websites for not only enhancing but also focusing and developing the topics of interest by the learner by way of self-study. More importantly, the syllabus endeavors to develop life skills by discovering and honing entrepreneurial skills of the learner.

PROGRAM OUTCOMES

PO	PO Description
PO 1	A student completing Bachelor's Degree in Arts/commerce/science program will be able to: Create an awareness of the impact of biological science on the environment, society, and development outside the scientific Community. To make the learners acquaint about the taxonomy, general characters and adaptations of animals.
PO 2	It helps to develop scientific temper and thus can prove to be more beneficial for the society as the scientific developments can make a nation or society to grow at a rapid pace.
PO 3	Awareness about environment and its conservation processes, pollution control and its importance and. Gain knowledge of protection of vulnerable and endangered species
PO 4	Articulate scientific concepts, place forth a hypothesis, style and execute testing tools and draw relevant inferences. Communicate

	the analysis adds acceptable scientific language.
PO 5	<p>Gain knowledge of protection of vulnerable and endangered species</p> <p>Information and skill of applied zoology including sericulture, apiculture, fisheries, poultry, vermiculture, agricultural pests and their control etc.</p>
PO 6	<p>After the completion of this course students have the option to go for higher studies i.e. M. Sc and then do some research for the welfare of mankind.</p> <p>After higher studies students can join as scientist and can even look for professional job oriented courses.</p>
PO 7	<p>Aware students about ethical principles and commit to professional ethics and responsibilities.</p> <p>Aware students about ethical principles and commit to professional ethics and responsibilities.</p>
PO 8	<p>Demonstrate exhaustive understanding within the relevant science discipline. Recall, explain, extrapolate and organize abstract knowledge domain for execution and application and additionally to judge its connection</p>

PO 9	Use modern techniques, sophisticated equipment's and advanced software's to understand biological concepts.
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Bhavan's college, (Autonomous) Andheri (W) Mumbai-58

Proposed Syllabus for

F. Y. B.Sc.

Course – ZOOLOGY

From academic year **2023-2024**

SEMESTER I

COURSE CODE	UNIT	TOPIC	CREDITS	TOTAL LECTURES
BH.US ZOO. MIN 101	I	Wonders of animal kingdom I (invertebrates)	3	15
	II	Cell Biology		15
	III	Basics of animal physiology		15
BH.US ZOO. MIN P1	Practical based on courses		1	

SEMESTER II

COURSE CODE	UNIT	TOPIC	CREDITS	TOTAL LECTURES
BH.US MINOR ZO 201	I	Wonders of animal kingdom II (vertebrates)	3	15
	II	Public health and hygiene		15
	III	Biotechnology		15
BH.US MINOR ZO P2	Practical based on courses		1	

SYLLABUS F.Y.B.Sc. ZOOLOGY

UNIT WISE DISTRIBUTION

Semester I	Semester II
Unit 1 Wonders of Animal Kingdom I (invertebrates)	Unit 2 Wonders of Animal Kingdom II (vertebrates)
Unit 2 Cell biology	Unit 2 Public health and hygiene
Unit 3 Basics of animal physiology	Unit 3 Biotechnology
Practical (BH.US ZOO. MIN P1)	Practical (BH.US ZOO. MIN P2)

Bhavan's college, (Autonomous) Andheri (W) Mumbai-58
FYBSc Zoology Syllabus
Semester – I (BH.US ZOO. MIN 101)

Wonders of animal Kingdom I, Cell Biology & Animal Physiology

	BH.US ZOO. MIN 101	No. of lectures allotted
Unit 1:	Wonders of animal kingdom I (invertebrates)	15
	<i>Objective: To understand some unique characteristic features of some invertebrates as an adaptation to their surroundings and according to their life cycle.</i>	
	<i>Desired Outcome: To make the learners acquaint about the fascinating world of animal kingdom and to make them understand about their adaptations for survival.</i>	
1.1	Reproduction in Protozoa – Binary fission, Conjugation.	1L
1.2	Spicules in Sponge and canal systems in Sponge (Ascon , Sycon & Leucon type)	3L
1.3	Polymorphism in Obelia	1L
1.4	Morphology of Ascaris and Taenia w.r.t. parasitic adaptations	2L
1.5	Mouth parts in insects (Biting & chewing, Piercing & sucking, Sponging & lapping, Siphoning type) w.r.t. feeding habit.	2L
1.6	Social behavior in honey bee and Termites (Casts and function)	3L
1.7	Shells in Mollusca & formation of pearl in Bivalves	2L
1.8	Water vascular system in Starfish	1L
Unit 2:	Cell biology	15
	<i>Objective: To understand the cellular components of the cell along with its functions.</i>	

	<i>Desired Outcome: Learners will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially membranes and organelles.</i>	
2.1	Introduction to cell biology.	1L
2.2	Prokaryotic and Eukaryotic cell 2.2.1: Structure of prokaryotic and eukaryotic cell.	3L
2.3	Types of cell division Mitosis and meiosis.	3L
2.4	Chromatin, Chromosomes, and the Cell Nucleus 2.3.1: Chromatin, Structure of chromosomes, Classification and its types 2.3.2: Structure of nucleus.	5L
2.5	Cell cycle	3L
Unit 3:	Basics of animal physiology	15
	<i>Objective: To make the students to understand the physiological process of animals.</i>	
	<i>Desired Outcome: Learners would understand the different physiological process of animals.</i>	
3.1	Digestion physiology 3.1.1 : Intracellular and extracellular digestion 3.1.2 Mechanical process in digestion 3.1.3: Chemical process in digestion 3.1.4: Absorption of food	5L
3.2	Circulation physiology 3.2.1 : Open and closed type of circulation 3.2.2 : Circulatory organs (Heart and blood vessels) 3.2.3: Types of heart (neurogenic and myogenic) 3.2.4: Typical pattern of circulation 3.2.5: Composition and function of blood	6L
3.3	Reproductive physiology 3.3.1: Hormones regulation involved in reproduction. 3.3.2: Menstrual cycle and estrous cycle	4L

SEMESTER I	
PRACTICAL I BH.US ZOO. MIN P1	
1.	Study of reproduction in Protozoa (Binary fission & conjugation)
2.	Observation and Study of Polymorphism in Obelia
3.	Study of Canal systems in sponge- Ascon, Sycon & Leucon type
4.	Observation and Study of Scolex and Proglottid in Taenia
5.	Mounting of mouth parts of insect (Biting & chewing, Piercing & sucking, Sponging & lapping, Siphoning type)
6.	Study of shells in Mollusca (Internal ,External , Absent)
7.	Study of nutritional apparatus (Amoeba, Hydra, Earthworm, Pigeon and Ruminant stomach)
8.	Study of permanant slides on Reproduction: a. T.S of mammalian testis b. T.S of mammalian ovary
9.	Types of heart Myogenic and Neurogenic
10.	Chromosome morphology
11.	Study of mitosis-temporary squash preparation of onion root tip
12.	Study of permeability of cell through plasma membrane. (osmosis in blood cells)

#There shall be at least one excursion/field trip.

REFERENCES AND SUGGESTED READINGS

1. Modern text book of Zoology - Invertebrates; Eleventh; Edition Professor R.L. Kotpal; Rastogi publication
2. Invertebrate Zoology by E. L. Jordan & P. S. Verma Rev. edition, 2009, Chand publications
3. Invertebrate Zoology by P. S. Verma, edition, 2009, Chand publications Zoology for degree students,
4. Non chordates by V.K. Agarwal 2011, S. Chand Publication.
5. Invertebrate Zoology- Dhama P. S. and Dhama J. K., R. Chand and Co.
6. Cell Biology, Genetics, Molecular Biology, Evolution And Ecology- by P. S. Verma And V.K. Agarwal
7. Cell biology by B. Albert
8. A textbook of Animal Physiology by K.A.Goel and K.V.Shastri
9. Experimental physiology by S.C. Rastogi.

FY BSc Zoology Semester I (Practical- I)

Course code BH.US ZOO.MIN P1

PROPOSED SKELETON QUESTION PAPER FOR PRACTICAL EXAMINATION

DURATION: 2Hrs

Marks: 50

SR.NO.	PRACTICAL	MARKS
Q1	Identify and describe w.r.t. it's special features :	18
a)	Reproduction in Protozoa / Canal system in sponge.	
b)	Polymorphism in Obelia / Scolex or Proglottid of Taenia	
c)	Shell in Mollusca (Internal or external)	
d)	Nutritional apparatus	
e)	Reproduction	
f)	Circulation	
Q2	Study of mitosis-temporary squash preparation of onion root tip	12
	OR	
Q2	Study of permeability of cell through plasma membrane. (osmosis in blood cells)	
Q3	Chromosome morphology	5
	OR	
Q3	Mounting of mouth parts in insects and explanation with the help of diagram	
Q4	Field visit report	5
Q5	Viva voce	5
Q6	Journal	5

Bhavan's college, (Autonomous) Andheri (W) Mumbai-58

FYBSc Zoology Syllabus

Semester II (BH.US ZOO. MIN 201)

Wonders of Animal Kingdom II, Public health and Hygiene & Biotechnology

	BH.US ZOO. MIN 201	No. of lectures allotted
Unit 1:	Wonders of animal kingdom II (vertebrates)	15
	<i>Objective: To understand some unique characteristic features of some vertebrates as an adaptation to their surroundings and according to their life cycle.</i>	
	<i>Desired Outcome: To make the learners acquaint about the fascinating world of animal kingdom and to make them understand about their adaptations for survival.</i>	
1.1	Migration in fish Parental care	2L
1.2	Parental care in amphibia (Midwife toad , Darwin's frog)	1L
1.3	Camouflage in vertebrates (Chameleon , Owl)	1L
1.4	Adaptive features in dessert animals (Phrynosoma, Camel)	2L
1.5	Venomous and non-venomous snakes	2L
1.6	Migration in birds	2L
1.7	Echolocation in Mammals (Bat , Cetaceans -Whale, Dolphin)	2L
1.8	Adaptations in Marsupials ,Duckbilled Platypus and Pangolin	2L
1.9	Herding animals (Elephant , Sheep)	1L
Unit 2:	Public health and hygiene	15

	<i>Objectives: To impart knowledge about source, quantum and need for conservation of fast depleting water resource and essentials of maintaining proper sanitation, hygiene and optimizing use of electronic gadgets.</i>	
	<i>Desired outcome: Promoting optimum conservation of water, encouragement for maintaining adequate personal hygiene, optimum use of electronic gadgets, avoiding addiction, thus facilitating achievement of the goal of healthy young India in true sense.</i>	
2.1	Health 2.1.1 : Definition of Health, the need for health education and health goal. 2.1.2 : Physical, psychological and Social health issues. 2.1.3 : WHO and its programmes - Polio, Small pox, Malaria and Leprosy (concept, brief accounts and outcome with respect to India). 2.1.4 : effects of self-medication	4L
2.2	Water and water supply 2.2.1 : Sources and properties of water. 2.2.2 : Purification of water, small scale, medium scale and large scale (rapid sand filters) 2.2.3 : Water footprint (concept, brief accounts and significance).	4L
2.3	Hygiene 2.3.1 : Hygiene and health factors at home, personal hygiene, oral hygiene and sex hygiene.	2L
2.4	Radiation risk: 2.4.1 : Mobile Cell tower and electronic gadgets (data of recommended level, effects and precaution).	3L
2.5	Blood bank – Concept and significance.	2L
Unit 3:	Biotechnology	15
	<i>Objectives: To impart knowledge and understanding of the basics of biotechnology</i>	
	<i>Desired outcome: Learners would understand the various techniques used in biotechnology along with its applications</i>	
3.1	Concept of biotechnology 3.1.1 : Definition 3.1.2 : An overview of achievements and scope	2L

3.2	Fundamentals of laboratory techniques in biotechnology 3.2.1: Safe handling of equipment 3.2.2: Sterilization techniques	5L
3.3	Food biotechnology 3.3.1: Lactic acid and Yeast Fermentation – yogurt, cheese, bread, beer, and wine.	3L
3.4	Enzyme biotechnology 3.4.1: Enzymes as meat tenderizer 3.4.2: Bio-detergents 3.4.3 : Enzyme immobilization 3.4.4 : Bioenzymes	5L

SEMESTER II	
PRACTICAL I BH.US ZOO. MIN P2	
1.	Parental care in amphibia (Midwife toad , Darwin’s frog)
2.	Camouflage in vertebrates (Chameleon , Owl)
3.	Adaptive features in desert Mammals. (Phrynosoma, Camel)
4.	Venomous and non-venomous snakes
5.	Echolocation in Mammals (Bat , Cetaceans -Whale, Dolphin)
6.	Adaptations in Marsupials ,Duckbilled Platypus and Pangolin
7.	Herding animals (Elephant , Sheep)
8.	FIRST AID-Demonstration Practical Training
9.	Effect of papain (raw papaya extract as a meat tenderizer).
10.	Demonstration of preparation of beads of calcium alginate for immobilization of enzyme amylase or yeast cells.
11.	Demonstration of immobilized amylase or invertase from immobilized yeast cells by DNSA method. (Visual observation for comparative colour intensity in a test tube)
12.	Demonstration of sterilization of apparatus/working between two burners, Packing of glassware and technique aseptic transfer of liquids.
13.	Identification of instruments: (Autoclave, Cold centrifuge, Laminar Air Flow, Incubator, Homogenizer, Hot air oven)

REFERENCES AND SUGGESTED READINGS

1. Vertebrate Zoology Volume I- Jordan and Verma , S. Chand and Co.
2. Chordate Zoology- Dhami P. S. and Dhami J. K. , R. Chand and Co.
3. Introduction to Vertebrates- Moore Cambridge University- Low Priced Edition.
4. Zoology- Miller S. A. and Harley J. B., Tata McGraw Hill. 8.
Modern Textbook of Zoology, Invertebrates,
5. Understanding biotechnology- Aluizio Borem ,David Bove-Low price edition –
Pearson Publication
6. A Textbook of Biotechnology – R. C. Dubey, S. Chand Publication.
7. A Manual of Medical Laboratory Technology -A. H. Patel, Navneet Prakashan Ltd.
14. Biological instruments and methodology – Dr. P. K. Bajpai, S. Chand company
Ltd. Calculations in Molecular biology and Biotechnology - Frank H. Stephenson,
Academic Press.

FY BSc Zoology Semester I (Practical- II)

Course code BH.US ZOO.MIN P2

PROPOSED SKELETON QUESTION PAPER FOR PRACTICAL EXAMINATION

DURATION: 2Hrs

Marks : 50

SR.NO.	PRACTICAL	MARKS
Q1	Identify and comment on the mode of migration	05
Q2	Identify and describe	15
a)	Parental care in amphibia / Camouflage	
b)	Adaptive features in desert animals / venomous or non-venomous snake	
c)	Echolocation	
d)	Adaptations in mammals /Herding animals	
e)	Biotechnology Instruments	
Q3	Interpretation of immobilized amylase or invertase from immobilized yeast cells by DNSA method.	08
Q4	Demonstration of sterilization of apparatus/working between two burners, Packing of glassware and technique aseptic transfer of liquids.	06
	OR	
Q5	Effect of papain (raw papaya extract as a meat tenderizer).	
Q6	Report on First Aid.	06
Q7	Viva voce	05
Q8	Journal	05

EVALUATION PATTERN:

SCHEME OF EXAMINATION:

- (a) Internal assessment of forty (40) marks per course per semester should be conducted as Continuous Internal assessment
- 1) (CIA 1) of 20 marks of Objective type including multiple choice etc.
 - 2) (CIA 2) 20 marks of assignments type.
- (b) External assessment of sixty (60) marks per course per semester should be conducted as per the following skeleton question paper pattern.
- (c) One practical examination of fifty (50) marks per course each should be conducted at the end of every semester.

SKELETON- EXAMINATION PATTERN FOR THE ABOVE SYLLABUS

All Questions are compulsory Figures to the right indicate full marks

Time: 2.5 hours

Total marks: 60

Questions	Marks
Q1-A) Unit 1 – a) 10 marks (descriptive) OR b) 10 marks	10
Q1-B) Unit 1- a) 10 marks (descriptive) OR b) i) short notes 5 marks and b- ii) 5 marks	10
Q2-A) Unit 2 – a) 10 marks (descriptive) OR b) 10 marks	10
Q2-B) Unit 2- a) 10 marks (descriptive) OR b)-i) short notes 5 marks and b- ii) 5 marks	10
Q5) Answer any 4 out of 8 short notes (4 from each unit)	20



Resolution No.: _____

Approved in BOS dated on 6th June 2023 and to be implemented from the Year 2023-2024

Bharatiya Vidya Bhavan's

**M. M. College of Arts, N.M. Institute of Science, H.R.J.
College of Commerce. (Bhavan's College) Autonomous**

(Affiliated to University of Mumbai)



Proposed Syllabus for F. Y.

**B.Sc. (OPEN
ELECTIVE)**

BH. US ZOO. OE

Program: B.Sc.

Zoology (Choice based Credit System

With effect from the Academic year (2023–2024)



PROGRAM OUTCOMES

PO	PO Description A student completing Bachelor's Degree in Arts/commerce/science program will be able to:
PO 1	Create an awareness of the benefits of an aquarium
PO 2	It helps to develop scientific temper and thus can prove to be more beneficial for the society as it provides an alternative job skills
PO 3	Develop entrepreneurship skills
PO 4	Articulate scientific concepts, place forth a hypothesis, style and execute testing tools and draw relevant inferences. Communicate the analysis adds acceptable scientific language.
PO 5	Gain knowledge of various types of fish, their breeding, rearing and marketing
PO 6	After the completion of this course students have the option to start their own fish aquarium breeding business
PO 7	Aware students about ethical principles and commit to professional ethics and responsibilities.
PO 8	Recall, explain, extrapolate and organize abstract knowledge domain for execution and application and additionally to judge its connection.
PO 9	Use modern techniques, sophisticated equipment's and advanced software's



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PROGRAM SPECIFIC OUTCOMES

PSO	Description
	A student completing Bachelor's Degree in <u>B.SC.</u> program in the subject of <u>ZOOLOGY</u> will be able to:
PSO 1	To acquire the knowledge and skills necessary to effectively manage aquariums, including maintaining proper water quality, monitoring and controlling temperature and lighting, and managing fish populations
PSO 2	To understand and apply ethical considerations in aquarium management, such as ensuring the well-being and welfare of aquatic organisms, promoting conservation efforts, and adhering to responsible sourcing and breeding practices.
PSO 3	To exhibit professional conduct, effective teamwork, and collaboration skills when working in aquarium environments, including interactions with colleagues, visitors, and volunteers, to ensure efficient and harmonious operations
PSO 4	To Identify signs of common diseases, parasites, and abnormalities in aquarium fish and to Apply appropriate treatment protocols and preventative measures to maintain the health and well-being of aquatic organisms
PSO 5	Understand recent advances their applications for developing their own commercial business and setups
PSO 6	To apply their knowledge how to apply for funding from government and private agencies to start their own commercial setup
PSO 7	To get an idea of basic characters of phylum's and the organisms. And to identify the organisms based on their External features.



PROGRAM OUTLINE

YEAR	SEMESTER	COURSE CODE	COURSE TITLE	CREDITS
FYBSC	I	BH.US ZOO.OE 101	Aquarium Construction & Maintenance I	3
		BH.US ZOO.OE P1	Practicals based on Aquarium Construction & Maintenance I	1
			TOTAL	4
FYBSC	II	BH.US ZOO.OE 201	Aquarium Construction & Maintenance II	3
		BH.US ZOO.OE P2	Practicals based on Aquarium Construction & Maintenance II	1
			TOTAL	4



DETAILED SYLLABUS – SEMESTER I and II

PREAMBLE

The syllabus on aquarium practices is designed to provide students with a comprehensive understanding of the principles, techniques, and skills necessary for successful aquarium management. With the growing popularity of aquariums for educational, recreational, and aesthetic purposes, there is an increasing demand for knowledgeable professionals who can ensure the well-being of aquatic organisms and create captivating aquatic environments.

This syllabus aims to equip learners with a broad range of knowledge in areas such as aquaria design and set-up, water quality control, fish and invertebrate care, breeding and reproduction, health and disease management, and conservation and environmental stewardship. By exploring these topics, students will develop a solid foundation in the science and art of aquarium practices.

The syllabus emphasizes a hands-on approach, enabling students to gain practical skills through laboratory work, field trips, and experiential learning. They will learn to monitor and maintain optimal water quality parameters, understand the specific needs of different aquatic species, implement effective feeding protocols, and diagnose and treat common diseases. Additionally, students will explore the ethical considerations and sustainability practices associated with aquarium management, promoting responsible sourcing, conservation efforts, and public education.

Furthermore, the syllabus incorporates aspects of communication, teamwork, and professionalism, recognizing the importance of effective collaboration and communication skills in aquarium settings. Students will develop the ability to convey information about aquarium management to diverse audiences, including visitors, stakeholders, and fellow professionals.

Upon completion of this syllabus, graduates will possess the necessary knowledge and skills to excel in various roles within the aquarium industry, including aquarium curators, aquarists, educators, and consultants. They will contribute to the growth and advancement of the field, ensuring the welfare of aquatic organisms, promoting conservation efforts, and providing engaging and educational experiences for aquarium enthusiasts and the general public.



Programme: Science				Semester: I		
Course: Aquarium Construction & Maintenance I				Course Code: BH.US ZOO.OE 101		
Teaching Scheme				Evaluation Scheme (Theory)		
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)		End Semester Examination (ESE)
03	02	NIL	3+1=4	20	20	60
Pre-requisites: 40 % PASSING						
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> To understand the educational, recreational, and aesthetic uses of aquariums and to identify the key considerations for managing an aquarium To develop practical knowledge about setting up an aquarium To identify different types of fresh water fish species. 						
COURSE OUTCOMES:						
<ul style="list-style-type: none"> The learner will understand the various purposes and benefits of aquariums and will be able to recognize the importance of proper management of aquariums The learner will develop knowledge about the various types equipments used in an aquarium setup. The learner will be able to identify different types of fresh water fish species that can be reared in an aquarium. 						
INDEX						
Unit	Description					Periods
1	Scope and Nature of Aquaria					15
2	Equipment and setting up an Aquarium					15
3	Types of Fish					15
	Total					45



	Detailed Syllabus	Lectures
Unit 1	Scope and Nature of Aquaria	3L
1.1	Aquarium use and management	2L
1.2	The categories of aquariums	2L
1.3	Aquariums for fish communities	3L
1.4	Aquaria Size and Complexity	2L
1.5	Water quality control	3L
1.6	Types of Equipment	3L
Unit 2	Equipment and setting up an Aquarium	
2.1	Water Quality and management <ul style="list-style-type: none"> • Tank capacity/Tank size • Maintaining a Balanced Nitrogen Cycle • Aquarium Cycling • Changing the Water • Vacuuming • Algae Removal • How to avoid Overfeeding • Water Conditions • Water Temperature • Water Hardness • Water pH • Salinity 	6L
2.2	Equipment and design <ul style="list-style-type: none"> • Aquarium Tank • Filtration • Aeration • Light System • Aquarium Light Timer (optional) • Tank Cover • Heaters and Thermometers • Gravel • Plants and Decorations • pH meters • Refractometers/Hydrometers • Water and Other Additives • Adding the Fish 	8L
Unit 3	Types of Fish	15



3.1	Freshwater fish types	1L
3.2	Live bearers <ul style="list-style-type: none"> • Guppy • Molly • Platy • Sword tail 	2L
3.3	Egg layers <p>3.3.1 Cyprinids</p> <ul style="list-style-type: none"> • Gold fish • Koi • Danio • Loaches • Barbs <p>3.3.2 Cichlids</p> <ul style="list-style-type: none"> • Angel • Discus • Flower hporn • Rainbow • Oscar <p>3.3.3 Characins and anabantoids</p> <ul style="list-style-type: none"> • Tetras • Hatchefish • Gourami • Betta • Perch <p>3.3.4 Other ornamental fish</p> <ul style="list-style-type: none"> • Dragon fish • Catfish • Cleaner fish 	<p>3L</p> <p>4L</p> <p>3L</p> <p>2L</p>

Text books

1. The Complete Book of Aquarium Keeping by Madan Subramanian
2. Handbook of Aquarium Fishes by Nandini Sharma
3. Aquarium Fish Keeping by Dr. P. Madhusoodanan
4. Practical Guide to Freshwater Aquariums by Indranil Bhattacharya
5. The Simple Guide to Marine Aquariums by Jeffrey Kurtz
6. The Complete Aquarium Guide: Fish, Plants, and Accessories for Your Aquarium by Peter Hiscock
7. Aquarium Fish Breeding by V.R. Khade and V.V. Kulkarni
8. Aquarium Fish Culture by P.K. Panda and B.K. Das
9. Aquarium Keeping and Maintenance by C.M. Ramakrishnan
10. Aquarium Plants by S.K. Das and A. Mukherjee


Self-study topics
PRACTICALS: BH.US ZOO.OE P1

1. To test and monitor water quality parameters like pH, salinity, temperature, ammonia, nitrite and nitrate levels.
2. To test and monitor fish behaviour under different light conditions: white, blue, yellow and red light.
3. To construct water purification filter.
4. To identify the different equipments used to set up an aquarium.
5. To set up an aquarium.
6. Removal of algae and dead fish
7. Cycling of water
8. To identify different types of fish: Fresh water, Live bearers and egg layers.

Details of Conduct of Practical Examination (Evaluation Scheme):

PRACTICAL EXAMINATION
BH.US ZOO.OE P1

Time: 10 am to 2 pm
Total Marks: 50

Q. Test water quality parameters: pH/ salinity/ temperature/ ammonia/ nitrite/ nitrate levels and write a report on it. (Any two)	10M
Q.2 Observe and describe the behaviour of fish in White/ Blue/ Yellow/ Red light.	08M
Q.3 Identify and Describe (2 marks each)	12M
a) Fresh water fish (any 1)	
b) Live bearers (any 1)	
c) Egg layers (any 2)	
d) Equipment (any 2)	
Q4. Demonstrate the technique to remove algae from the fish tank.	10M
OR	
Q4. Change the water of the given fish tank.	10 M



Q.6 Viva-voce.

05 M



Q.7 Journal.	05 M
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Programme: Science				Semester: II		
Course: Aquarium construction & maintenance II				Course Code: BH.US ZOO.OE 201		
Teaching Scheme				Evaluation Scheme (Theory)		
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)		End Semester Examination (ESE)
03	02	NIL	3+1=4	20	20	60
Pre-requisites: 40 % PASSING						
COURSE OBJECTIVES						
<ol style="list-style-type: none"> 1. To gain knowledge and skills on maintaining an aquarium 2. To learn about the various types of diseases and other paramerts that affect the health of fish 3. To develop entrepreneurship skills for commercial use. 						
COURSE OUTCOMES						
<ul style="list-style-type: none"> • The learner will be able to set up an aquarium and learn to maintain it. • The learner will develop knowledge about the diseases and other factors that can affect the health of the fish in an aquarium. • The learner will develop knowledge about the different techniques involved in fish breeding and its marketing to become self independent. 						
INDEX						
Unit	Description					Periods
1	Maintenance					15
2	Diseases : Diagnosis and management					15
3	Breeding and Commercialization					
	Total					45



	Detailed Syllabus	Lectures
Unit 1	Maintenance	3L
1.1	Correct Tank Set-Up Maintenance	1L
1.2	Lighting and temperature	1L
1.3	Filter Maintenance	2L
1.4	Checking and Maintaining Water Quality	3L
1.5	Fish Observation	1L
1.6	Plant Maintenance	1L
1.7	Regular vacuuming and water changes	1L
1.8	Algal removal	2L
1.9	Preventive measures	3L
Unit 2	Diseases : Diagnosis and management	
2.1	Diseases Caused by Water Quality and Chemistry Problems <ul style="list-style-type: none"> • Oxygen • Ammonia toxicity • Nitrite toxicity • Acidosis and alkalosis 	3 L
2.2	Fish Diet Related Problems	1L
2.3	Viral Diseases <ul style="list-style-type: none"> • Lymphocytosis • Fish pox 	1L
2.4	Bacterial Diseases <ul style="list-style-type: none"> • Columnaris • Mycobacteriosis • Mouth fungus • Tail rot/ fin rot 	3L
2.5	Fungal diseases Saprolegniasis Branchiomycosis	2L
2.6	Parasite infection <ul style="list-style-type: none"> • Protozoa: White spot disease • Platyhelminthes: Monogenean and digenean trematodes • Parasitic crustaceans: Anchor worm and fish louse (<i>Argulus</i>) 	3L



2.7	Indefinite aetiology: Pop eye and Dropsy	2L
Unit 3	Breeding and Commercialization	10
3.1	Freshwater fish types	
3.1	Breeding	
	3.1.1 Fish Reproduction and Behaviour	2L
	3.1.2 Live Bearers	1L
	3.1.3 Egg layers	1L
	3.1.4 Early Stages – Selecting and Conditioning the Pair and Triggering Breeding	2L
	3.1.5 Hatching the Raising Fry	2L
3.2	Commercialization	
	3.2.1 Trade	2L
	3.2.2 Pre investment	1L
	3.2.3 Marketing strategies	2L
	3.2.4 Consumer preference	1L
	3.2.5 AMC (Annual Maintenance contract)	1L
Text books		
Self-study topics		
PRACTICALS: BH.US ZOO.OE P2		
<ol style="list-style-type: none"> 1. To assess the health of fish in the aquarium by observing their behavior, appearance, and feeding habits. 2. To perform routine maintenance tasks 3. Identify and describe food and its Types 4. Aquarium fish diseases 5. Prepare a funding proposal 6. Visit to a aquaculture breeding lab 		
Details of Conduct of Practical Examination (Evaluation Scheme):		



PRACTICAL EXAMINATION	
BH.US ZOO.OE P2	
Time: 10 am to 2 pm	Total Marks: 50
Q1. Assess the health of fish in the aquarium by observing their behavior, appearance and feeding habits.	10M
OR	
Q 1. Discuss the breeding of fish	10M
Q.3 Identify and Describe (2 marks each)	
a) Diseases (any 4)	08 M
b) feed types (Any 1)	02 M
Q4. Preapare a funding proposal	10 M
Q 6. Report and viva of a visit to an aquarium setup	10M
Q.6 Viva-voce.	05 M
Q.7 Journal.	05 M

MODALITY OF ASSESSMENT: SEMESTER I and II

A) Internal Assessment- 40%: 40 marks

SR. NO.	CONTENT	MARKS
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1.	Test (CIA 1)	20 M
2.	Assignment (CIA 2)	20 M

Assignment types can include:

- a. Surveys
- b. Case studies
- c. Model making
- d. Seminar Presentation
- e. Self-study assignments
- f. Small Research Projects
- g. Societal Subject related venture (Kitchen waste composting, safe water drinking, hygiene of orphan homes, old-age homes etc).

B) External examination: 60%

a) Semester End Theory Assessment- 60%: 60 Marks

i) Duration – These examinations shall be of two and a half hours duration for each paper.

ii) Theory Question Paper Pattern:

- Each unit will carry a total of 20 marks.

The theory paper is divided as follows

Subjective Questions Based (45 marks)	Each unit will contribute 15 marks. There shall be one question consisting of two parts: A) I- 8 marks and II- 7 marks questions OR B) Three questions of 5 marks. The learner has to attempt either A or B.
Subjective Questions Based (short notes only- 15marks)	Each unit will contribute 5 marks. There shall be two questions of 5 marks from each unit. The learner has to attempt either one 5 marks question from each unit.

b) Practical: 50 Marks

Paper Pattern:(Semester end Examination I & II)

MARKS: 60

DURATION: 2.5 HOURS.



Question	Options	Marks	Questions based on	Nature of questions
Q1.	Either A (8+ 7) or B (3Q x 5)	15	unit 1	Subjective
Q2.	Either A (8+7) or B (3Q x 5)	15	unit 1	Subjective
Q3.	Either A(8+ 7 or B (3Q x 5)	15		Subjective
Q4	Compulsory 3Q.	15	all 3 units	Subjective
	Total	60		

Overall Examination & Marks Distribution Pattern

Semester I & II

Course	BH.UZO101			BH.UZO102			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200

Rubrics of evaluation for ESE

Unit	Knowledge	Understanding	Analysis & critical thinking	Total marks/unit
1	03	06	06	15
2	03	06	06	15
3	03	06	06	15
4	03	06	06	15
Total per objective	12	24	24	60
% weightage	20	40	40	100

Rubrics of evaluation for CIA-2 assignment

Class: _____ Roll No _____ Topic _____

Parameters	Max Marks	80 – 100% Excellent	60 -80% Good	40 – 60% Satisfactory	20 – 40% Poor	0-20% very poor
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CONTENT	10					
Content: Introduction –	02					
Content: Development	03					
Content:– Conclusion -	03					
Content: - Bibliography	02					
Effective Research Skills	10					
Language, Style and Structure;	05					
Aids	05					
Total	20					

Name of evaluator _____







Resolution No.: _____

Approved in BOS dated on 6th June 2023 and to be implemented from the Year
2023-2024

Bharatiya Vidya Bhavan's

**M. M. College of Arts, N.M. Institute of Science, H.R.J.
College of Commerce. (Bhavan's College) Autonomous**

(Affiliated to University of Mumbai)



Syllabus for: F.Y BSc

**Program: BSc.
BH.US ZOO.IKS**

**Choice Based Credit System (CBCS)-
UNDER NEP IKS**

Understanding Zoology through Indian Knowledge System

with effect from academic year 2023-24



PROGRAM OUTCOMES

	PO Description
PO	A student completing Bachelor’s Degree in Arts/commerce/science program will be able to:
PO 1	Create an awareness of the impact of biological science on the environment, society, and development outside the scientific community
PO 2	It helps to develop scientific temper and thus can prove to be more beneficial for the society as the scientific developments can make a nation or society to grow at a rapid pace.
PO 3	Awareness about environment and its conservation processes, pollution control and its importance and. Gain knowledge of protection of vulnerable and endangered Species
PO 4	Articulate scientific concepts, place forth a hypothesis, style and execute testing tools and draw relevant inferences. Communicate the analysis adds acceptable scientific language.
PO 5	Gain knowledge of protection of vulnerable and endangered species Information and skill of applied zoology including sericulture, apiculture, fisheries, poultry, vermiculture, agricultural pests and their control etc.
PO 6	After the completion of this course students have the option to go for higher studies i.e. M. Sc and then do some research for the welfare of mankind. After higher studies students can join as scientist and can even look for professional job oriented courses.



PO 7	Aware students about ethical principles and commit to professional ethics and responsibilities. Aware students about ethical principles and commit to professional ethics and responsibilities.
PO 8	
	Demonstrate exhaustive understanding within the relevant science discipline. Recall, explain, extrapolate and organize abstract knowledge domain for execution and application and additionally to judge its connection.
PO 9	Use modern techniques, sophisticated equipment's and advanced software's to understand biological concepts.



PROGRAM SPECIFIC OUTCOMES

PSO	Description
	A student completing Bachelor’s Degree in B.SC. program
	in the subject of ZOOLOGY will be able to:
PSO 1	To gain the knowledge the basic concept of classification and they will be able to identify the invertebrates by applying the knowledge of general characters.
PSO 2	
	To study treasure of Biodiversity, its importance and to create awareness about its conservation
PSO 3	To grasp the concept of interdependence and interactions of physical, chemical and biological factors in the environment and lead to better understanding about implication of loss of fauna specifically on human being, to understand the importance of conservation of all flora and fauna
PSO 4	To understand the increasing complexity of respiratory, locomotory and nutritional physiology in evolutionary hierarchy. and also be able to correlate the habit and habitat with respiratory, locomotory and nutritional structures
PSO 5	Understand recent advances in the subject and their applications for the betterment of mankind; and that the young minds would be tuned to think out of the box.
PSO 6	To apply their knowledge how to work safely in the laboratory and avoid occurrence of accidents (mishaps) which will boost their scholastic performance and economy in use of materials/chemicals during practical sessions.
PSO 7	To get an idea of basic characters of phylum’s and the organisms.



	And to identify the organisms based on their External features.
PSO 8	To get an idea about the origin of life and to get acquainted with various theories put forth.
PSO 9	To get an idea about the developmental process through evolutionary evidences.
PSO 10	To understand the increasing complexity of excretory, osmoregulatory and reproductive physiology in evolutionary hierarch and to correlate the habit and habitat with excretory, osmoregulatory and reproductive structures.
PSO 11	Understand and apply the principles of inheritance, concept of multiple alleles, linkage and crossing over.
	To select and operate suitable instruments for the studies of different components of Zoology of this course and also of higher classes including research.
PSO 12	



PROGRAM OUTLINE

YEAR	SEMESTER	COURSE	COURSE TITLE	CREDITS
		CODE		
FYBSC	I	BH. US ZOO.IKS 101	Understanding Zoology through Indian Knowledge System	2
			TOTAL	2



DETAILED SYLLABUS – SEMESTER I**PREAMBLE**

Zoology is a branch of biology that deals with major aspects of animal study. Zoology is a basic science that involves the knowledge and understanding of the animal phyla and their biochemical, immunological, physiological characteristics along with their interactions in the environment.

The Bachelors program provided by Bhavans college in the subject of Zoology is designed in a manner so as to aid the student to understand the various aspects of the subject and apply the knowledge gained in real life. The revised curriculum is designed keeping in mind the increasing horizons of life sciences and the various developments taking place in the field of biology.

The revised curriculum has included topics like animal diversity, wherein the student will be introduced to the wide variety of animal species in the world.

Topics like evolution have been proposed so that the learner is aware of the varied mechanisms of evolution taking place. The study of ecology will fabricate the students to understand about the abundant interrelationships of an individual with the environment.

The revised syllabus has been outlined in a way that the student will also gain some technical skills and learn about laboratory practices which will help them in their future endeavors in research.

Zoology forms the backbone for many other subtopics. Basic life science topics like physiology, genetics, study of various diseases are also a part of the curriculum.

Field visits, excursions and study tours will give the learners a firsthand experience about the various features of zoology and at the same they will learn to apply the knowledge gained by them in situations outside their classrooms.

The FYBSc course is the base of the Bachelor's degree in zoology and it will initiate the process of scientific reasoning and judgement in the students

Course Code BH. US ZOO.IKS 101	Course Title – INDIAN KNOWLEDGE SYSTEM
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Course Objectives

This course is designed:-

1. To introduce the concept the Indian Knowledge system to the students
2. To understand the water management system in historical sites
3. Understand zoology through holistic approach through Indian knowledge system.

Course Outcomes

After completing this course, the learner will be able to:-

4. Comprehend different water management systems in historical sites
5. Understand and explain the various terminologies and concepts related to Indian traditions.
6. Understand the contributions of Zoology in the Indian Knowledge System.

COURSE CREDITS – 2

CATEGORY – IKS

PAPER - 101		Paper Title – INTRODUCTION TO INDIAN KNOWLEDGE SYSTEM	
PAPER CREDITS - 2		BH. US ZOO.IKS 101	No of Lec – 30L
UNIT	SUB-UNIT	TOPICS	No of Lec
I		Overview of IKS	15L
	1.1	Survey of IKS Domains: A broad overview of disciplines included in the IKS, and historical developments.	15L
	1.2	Sources of IKS knowledge, classification of IKS texts, a survey of available primary texts, translated primary texts, and secondary resource materials. Differences between a sutra, bhashya, karika, and vartika texts. Fourteen / eighteen vidyasthanas, tantrayukti.	
	1.3	Vocabulary of IKS: Introduction to Panchamahabhutas, concept of a sutra, introduction to the concepts of non-translatables (Ex. Dharma, punya, aatma, karma, yagna, shakti, varna, jaati, moksha, loka, daana, itihaasa, puraana etc.) and importance of using the proper terminology. Terms such as praja, janata, loktantra, prajatantra, ganatantra, swarjya, suraiya, rashtra, desh.	
2		Contributions of Zoology in IKS	
	2.1	Pre scientific Zoology Ancient Scriptures and Mythology 19th Century developments	5L
	2.2	Scientists and their contribution in Zoology	3L
	2.3	Evidences of Zoological concepts in various literature in the Indian knowledge system.	3L
	2.4	Medicinal Zoology	2L
	2.5	Archaeological structures: step wells	2L

MODALITY OF ASSESSMENT: SEMESTER I and II

A) Internal Assessment- 40%: 40 marks

SR. NO.	CONTENT	MARKS
1.	Test (CIA 1)	20 M
2.	Assignment (CIA 2)	20 M

Assignment types can include:

- a. Surveys
- b. Case studies
- c. Model making
- d. Seminar Presentation
- e. Self-study assignments
- f. Small Research Projects
- g. Societal Subject related venture (Kitchen waste composting, safe water drinking, hygiene of orphan homes, old-age homes etc).

B) External examination: 60%

a) Semester End Theory Assessment- 60%: 60 Marks

i) Duration – These examinations shall be of two and a half hours duration for each paper.

ii) Theory Question Paper Pattern:

- Each unit will carry a total of 20 marks.

The theory paper is divided as follows

Subjective Based Questions (45 marks)	Each unit will contribute 15 marks. There shall be one question consisting of two parts: A) I- 8 marks and II- 7 marks questions OR B) Three questions of 5 marks. The learner has to attempt either A or B.
Subjective Based Questions (short notes only- 15 marks)	Each unit will contribute 5 marks. There shall be two questions of 5 marks from each unit. The learner has to attempt either one 5 marks question from each unit.

Question	Options	Marks	Questions based on	Nature of questions
Q1.	Either A (8+ 7) or B (3Q x 5)	15	unit 1	Subjective
Q2.	Either A (8+7) or B (3Q x 5)	15	unit 1	Subjective

Q3.	Either A(8+ 7 or B (3Q x 5)	15		Subjective
Q4	Compulsory 3Q.	15	all 3 units	Subjective
	Total	60		

Overall Examination & Marks Distribution Pattern

Semester I & II

Rubrics of evaluation for ESE

Unit	Knowledge	Understanding	Analysis & critical thinking	Total marks/unit
1	03	06	06	15
2	03	06	06	15
3	03	06	06	15
4	03	06	06	15
Total per objective	12	24	24	60
% weightage	20	40	40	100

Rubrics of evaluation for CIA-2 assignment

Class: _____ Roll No _____ Topic _____

Parameters	Max Marks	80 – 100% Excellent	60 -80% Good	40 – 60% Satisfactory	20 – 40% Poor	0-20% very poor
CONTENT	10					
Content: Introduction –	02					
Content: Development	03					
Content:– Conclusion -	03					
Content: - Bibliography	02					
Effective Research Skills	10					
Language, Style and Structure;	05					
Aids	05					

Total	20					

Name of evaluator _____

Resolution No.: _____

Approved in BOS dated on 6th June 2023 and to be implemented from the Year 2023-2024

Bharatiya Vidya Bhavan's

M. M. College of Arts, N.M. Institute of Science, H.R.J. College of Commerce.

(Bhavan's College) Autonomous

(Affiliated to University of Mumbai)



Proposed Syllabus for F. Y.B.Sc. (VEC)

BH.US ZOO. VEC

Program: B.Sc.

Zoology (Choice based

Credit System

With effect from the Academic year (2023–2024)

Bhavan's college, (Autonomous) Andheri (W) Mumbai-58

Proposed Syllabus for
F. Y. B.Sc.

Course – ZOOLOGY (**VALUE EDUCATION COURSE**)

From academic year **2023-2024**

SEMESTER I

COURSE CODE	UNIT	TOPIC	CREDITS	LECTURES/WEEK
BH. US ZOO. VEC 101	I	Introduction to Biodiversity	2	1
	II	Biodiversity & Conservation I		1

SEMESTER II

COURSE CODE	UNIT	TOPIC	CREDITS	LECTURES/WEEK
BH. US ZOO. VEC 201	I	National parks and sanctuaries	2	1
	II	Biodiversity & Conservation II		1

SYLLABUS F.Y.B.Sc. VEC ZOOLOGY

UNIT WISE DISTRIBUTION

Semester I	Semester II
Course 1	Course 2

UNIT 1 Introduction to Biodiversity	UNIT 1 National parks and sanctuaries
UNIT 2 Biodiversity & Conservation I	UNIT 2 Biodiversity & Conservation II

**Bhavan's college, (Autonomous) Andheri (W) Mumbai-58
 FYBSc VEC Zoology Syllabus
 Semester – I**

Sr. no	BH. US ZOO. VEC 101	No. of lectures allotted
		15 L
	<i>Objective: To orient learners about Biodiversity of India and make them understand mega diversity of nation.</i>	
	<i>Desired Outcome: Learners would appreciate Biodiversity importance and their hotspots.</i>	

1.1	Unit 1 Introduction to Biodiversity	3L
	Introduction- Definition, Concept, Scope and Significance Types of Diversity –genetic and species, Value Of Biodiversity-Consumptive use value, Productive use value, Social value, Ethical and moral values, Aesthetic value	
1.2	India as a Megabiodiversity nation Climate change finger print on Biodiversity	2L
1.3	Endemic Species of India, Criteria for Hotspots of biodiversity; Importance of hotspots; Biodiversity hotspots in the world; characteristics of Biodiversity hotspot in India	2L 2L 2L 2L 1L
	Unit 2 Biodiversity & Conservation I	
	<i>Objective: To orient learners about rich heritage of Biodiversity of India and make them understand significance of its conservation</i>	
	<i>Desired Outcome: Learners would appreciate treasure of Biodiversity, its importance and hence would contribute their best for its conservation</i>	
2.1	Threats to Biodiversity - Habitat loss and Man-Wildlife conflict Biodiversity conservation and management	2L
2.2	Conservation strategies: <i>in situ</i> , ex-situ, National parks, Sanctuaries and Biosphere reserves.	2L
2.3	Introduction to International efforts : Convention on Biological Diversity (CBD), International Union for Conservation of Nature and Natural resources (IUCN), United nations environment program World Conservation Monitoring Centre (UNEP-WCMC).	4L
2.4	National Biodiversity Action Plan, 2002	2L
2.5	Introduction to Indian Wildlife (Protection) Act, 1972 and Convention for International Trade of endangered species	3L

Bhavan's college, (Autonomous) Andheri (W) Mumbai-58
FYBSc VEC Zoology Syllabus
Semester – II

Sr. no	BH. US ZOO. VEC 101	No. of lectures allotted
	<i>Objective: To orient learners about rich heritage of Biodiversity of India and make them understand significance of its conservation</i>	15 L
	<i>Desired Outcome: Learners would appreciate treasure of Biodiversity, its importance and hence would contribute their best for its conservation</i>	
1.1	Unit 1 National parks and Sanctuaries Unit 1: Wildlife parks, wildlife reserves, Privately owned wildlife reserves & Biosphere reserves	2L 2L 2L 2L
1.2	People and conservation Traditional knowledge Traditions & cultures Women in conservation Traditional Societies (e.g. Bishnois)	2L 2L 2L 1L
1.3	Biodiversity At Global, National And Local Levels	2L
	Unit 2 Biodiversity & Conservation II	
2.1	Conservation of biodiversity: In-situ and Ex-situ In-situ conservation Ex-situ conservation	2L
2.2	Threats to biodiversity: habitat loss, poaching of wildlife, Man-wildlife conflicts	4L
2.3	Eco-tourism Scope of Eco tourism in India Hospitality & Logistics in Eco-tourism Planning and executing Eco-tourism Customized Eco-tours (e.g. Bird watching, Adventure Tourism, Agro-tourism)	2L 1L 2L
2.4	Case studies of success stories: (e.g. Ranthambor, Periyar, Lakswadweep, Van samitis, Kailadevi Wildlife Sanctuary – Sawai Madhopur, Rajashtan, Kokkare Bellure – Karnataka: Co-existence (Man and Wildlife), Orissa – Olive Ridley Turtles, Beej Bachao Andolan (Save the Seeds Movement)	4L



Resolution No.: _____

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Bharatiya Vidya Bhavan's

M. M. College of Arts, N.M. Institute of Science, H.R.J. College of Commerce. (Bhavan's College) Autonomous

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Syllabus for: F.Y BSc

Program: BSc.

Program Code: BH. B.Sc

Course Code: BH. US ZOO. VSEC

**Choice Based Credit System (CBCS)-
UNDER NEP MINOR**

With effect from academic year 2023-24



PROGRAM OUTCOMES

PO	PO Description A student completing Bachelor's Degree in Arts/commerce/science program will be able to:
PO 1	Comprehensive understanding of the principles, concepts, and applications of vermitechnology in sustainable agriculture, waste management, and environmental conservation.
PO 2	acquire the necessary technical skills and knowledge to effectively implement vermicomposting techniques, manage earthworm populations, and assess the quality and nutrient value of vermicomposts
PO 3	develop a strong awareness of the ecological importance of earthworms, their role in soil health and nutrient cycling, and their potential as indicators of environmental contamination.
PO 4	Demonstrate an understanding of pearl marketing and sales strategies, including valuation, pricing, and legal and ethical considerations in the pearl trade.
PO 5	Stay updated with emerging trends and future prospects in the field of pearl culture
PO 6	After the completion of this course students have the option to start their own fish aquarium breeding business





PROGRAM SPECIFIC OUTCOMES

PSO	Description
	A student completing Bachelor's Degree in <u>B.SC.</u> program in the subject of <u>ZOOLOGY</u> will be able to:
PSO 1	To demonstrate expertise in vermiculture, including the selection of suitable earthworm species, preparation of vermicomposting materials, and implementation of effective vermicomposting techniques for small-scale and large-scale applications.
PSO 2	To apply vermicomposting practices to organic farming and horticulture, understanding the beneficial effects of vermicompost on plant growth, soil structure, and nutrient availability.
PSO 3	To utilize earthworms in the management of municipal organic solid wastes, recognizing the value of vermicastings as a nutrient-rich soil amendment and the potential of vermicomposting in waste reduction and resource recovery.
PSO 4	To assess the health of soil ecosystems through the study of soil organisms, evaluate the impact of earthworms on soil structure and nutrient cycling, and contribute to environmental conservation efforts through the use of vermiculture.
PSO 5	To gain knowledge of the economic opportunities associated with vermiculture and vermicomposting, including marketing vermicomposting products, interacting with relevant stakeholders, and accessing financial support for vermiculture initiatives.



PROGRAM OUTLINE

YEAR	SEMESTER	COURSE CODE	COURSE TITLE	CREDITS
FYBSC	I	BH.US ZOO.VSEC 101	Vermiculture	3
		BH.US ZOO.VSEC P1	Practicals based on Vermiculture	1
			TOTAL	4



DETAILED SYLLABUS – SEMESTER I

PREAMBLE

Preamble:

The syllabus on pearl culture is designed to provide comprehensive knowledge and practical skills in the art and science of pearl cultivation. Pearl culture, a specialized field within the aquaculture industry, encompasses the techniques and practices involved in producing high-quality pearls. This syllabus aims to equip learners with a deep understanding of the biological, ecological, and technological aspects of pearl culture, enabling them to contribute to the sustainable growth of this industry.

Recognizing the economic value and global demand for pearls, this syllabus emphasizes the development of practical skills essential for successful pearl farming. It covers a wide range of topics, including the biology and physiology of pearl-producing organisms, the selection and preparation of suitable oysters or mussels for pearl cultivation, farming techniques for optimal pearl production, and the principles of post-harvest processing and grading.

The syllabus also includes modules on environmental management, focusing on sustainable practices, conservation efforts, and the mitigation of potential environmental impacts associated with pearl culture operations. Additionally, learners will gain insights into the marketing and business aspects of the pearl industry, understanding market trends, consumer preferences, and value chain management.

Through a combination of theoretical knowledge and hands-on practical training, this syllabus aims to produce skilled professionals capable of managing and operating pearl culture farms with expertise, efficiency, and a commitment to sustainability. Graduates of this program will be well-prepared to contribute to the growth of the pearl culture industry, promoting economic development, employment generation, and the preservation of precious natural resources.



Programme: Science				Semester: I		
Course: Vermiculture				Course Code: BH.US ZOO. VSEC 101		
Teaching Scheme				Evaluation Scheme (Theory)		
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)	Examination
03	02	NIL	3+1=4	20	20	60
Pre-requisites: 40 % PASSING						
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> To understand the concept of vermiculture and its applications in organic waste management.. To gain knowledge and skills of the techniques and requirements for vermicomposting, including suitable species, materials, moisture, pH, temperature, and food supply To explore the applications of vermiculture in organic farming and horticulture, as well as the use of earthworms in managing municipal organic solid wastes. 						
COURSE OUTCOMES:						
<ul style="list-style-type: none"> The learner will be able to comprehend and explain the scope and importance of vermitechnology in sustainable agriculture and environmental conservation. The learner will be develop hands on skills and will be familiar with the techniques and requirements for vermicomposting, including suitable species, materials, moisture, pH, temperature, and food supply The learner will be able to evaluate the effect of vermicompost on plant growth and understand the role of earthworms in nutrient cycling, soil structure improvement, and as indicators of environmental contamination. 						
INDEX						
Unit	Description					Periods
1	Introduction to Vermiculture and Earthworm Anatomy					15
2	Soil Organisms, Decomposition, and Nutrient Cycling					15
3	Applications of Vermitechnology and Economic Importance					15



	Total	45
	Detailed Syllabus	Lectures
Unit 1	Introduction to Vermiculture and Earthworm Anatomy	15L
1.1	Vermitechnology: Definition, scope, and importance	1L
1.2	Earthworm morphology and anatomy	1L
1.3	Life cycle of <i>Lampito mauritii</i> , <i>Eudrilus eugeniae</i> and <i>Eisenia fetida</i>	3L
1.4	Ecological classification of earthworms	1L
1.5	Introduction to vermicomposting	1L
1.6	Vermicomposting techniques and methods	4L
1.7	Moisture, pH and temperature requirements in vermicomposting	3L
1.8	Food supply in small-scale vermicomposting and large-scale vermicomposting.	2L
Unit 2	Soil Organisms, Decomposition, and Nutrient Cycling	15L
2.1	Soil organisms and their role in the living community	1L
2.2	Organic matter decomposition: cellulose, hemicellulose and lignin	3L
2.3	Role of earthworms in decomposition processes	1L
2.4	Nutrient cycling: Carbon cycle, Nitrogen cycle and Phosphorus cycle	3L
2.5	Effects of earthworms on soil structure and their role as indicators of environmental contamination	1L
2.6	Humic substances and their importance	1L
2.7	Vermiwash collection and composition and its utilization in agriculture	2L
2.8	Utilization of vermiwash in agriculture	1L
2.9	Use of vermicastings in organic farming and horticulture	1L



2.10	Nutrient value of worm cast/vermicompost	1L
Unit 3	Applications of Vermitechnology and Economic Importance	15L
3.1	Applications of vermiculture in organic farming and horticulture	1L
3.2	Earthworms for management of municipal organic solid wastes	1L
3.3	Effect of vermicompost on plant growth and productivity	3L
3.4	Therapeutic values of earthworms	2L
3.5	Interaction of earthworms with other organisms	1L
3.6	Influence of chemical inputs on earthworm activity	2L
3.7	Economic importance of earthworms	1L
3.8	Marketing of vermicomposting products	2L
3.9	Financial support for vermiculture by governments and NGOs	2L
Text books		
<ol style="list-style-type: none"> 1. Vermitechnology: Earthworms, Organic Wastes, and Environmental Management by P. S. Ramakrishnan and R. K. Sinha 2. Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management by V. C. Shukla and P. S. Ramakrishnan 3. Vermiculture and Vermicomposting: Principles and Practices by R. S. Mehrotra and V. C. Gupta 4. Vermiculture Technology: A Comprehensive Guide by B. C. Vyas and T. V. Deshmukh 5. Vermiculture and Sustainable Agriculture by A. N. Sinha and M. S. Chauhan 6. The Earth Moved: On the Remarkable Achievements of Earthworms by Amy Stewart 7. The Art of the Shim: Low-Alcohol Cocktails to Keep You Level by Dinah Sanders 8. The Worm Book: The Complete Guide to Gardening and Composting with Worms by Loren Nancarrow and Janet Hogan Taylor 9. Worms Eat My Garbage: How to Set Up and Maintain a Worm Composting System by Mary Appelhof 		
Self-study topics		



PRACTICALS:

1. Vermicomposting Setup and Maintenance
2. Earthworm Dissection and Identification
3. Earthworm Population Study
4. Vermicompost Quality Assessment
5. Vermicompost Application Trial
6. Study of Life stages & development of *Lampito mauritii*, *Eudrilus eugeniae* and *Eisenia fetida*
7. .3. Collection of wastes & their segregation & processing.
8. 4. Preparation vermibeds, maintenance of vermicompost & climatic conditions.
9. 5. Earthworm collection & application on beds Inspection of beds & watering
10. Vermicompost collection, Earthworms separation, Air drying of vermicompost, sieving & storing.
11. Vermiwash Collection and Analysis
12. visit to a vermicompost setup

Details of Conduct of Practical Examination (Evaluation Scheme):

**PRACTICAL EXAMINATION
BH.US ZOO. VSEC P1**

Time: 10 am to 2 pm

Total Marks: 50

Q1 Demosntrate a setup of vermicompost.	10M
OR	
Q1. Earthworm Dissection and Identification	10M
Q2. Earthworm Population Study	10M
Q 3. Vermicompost Quality Assessment (moisture content, pH, nutrient content, and microbial activity.) Any 2	10M
Q4. Report and viva on a visit to a vermicompost setup.	10M
Q.6 Viva-voce.	05 M
Q.7 Journal.	05 M



MODALITY OF ASSESSMENT: SEMESTER I and II

A) Internal Assessment- 40%: 40 marks

SR. NO.	CONTENT	MARKS
1.	Test (CIA 1)	20 M
2.	Assignment (CIA 2)	20 M

Assignment types can include:

- a. Surveys
- b. Case studies
- c. Model making
- d. Seminar Presentation
- e. Self-study assignments
- f. Small Research Projects
- g. Societal Subject related venture (Kitchen waste composting, safe water drinking, hygiene of orphan homes, old-age homes etc).

B) External examination: 60%

a) Semester End Theory Assessment- 60%: 60 Marks

i) Duration – These examinations shall be of two and a half hours duration for each paper.

ii) Theory Question Paper Pattern:

- Each unit will carry a total of 20 marks.

The theory paper is divided as follows



Subjective Questions (45 marks)	Based (45)	Each unit will contribute 15 marks. There shall be one question consisting of two parts: A) I- 8 marks and II- 7 marks questions OR B) Three questions of 5 marks. The learner has to attempt either A or B.
Subjective Questions (short notes only- 15marks)	Based (short)	Each unit will contribute 5 marks. There shall be two questions of 5 marks from each unit. The learner has to attempt either one 5 marks question from each unit.

b) Practical: 50 Marks

Paper Pattern:(Semester end Examination I & II)

MARKS: 60

DURATION: 2.5 HOURS.

Question	Options	Marks	Questions based on	Nature of questions
Q1.	Either A (8+ 7) or B (3Q x 5)	15	unit 1	Subjective
Q2.	Either A (8+7) or B (3Q x 5)	15	unit 1	Subjective
Q3.	Either A(8+ 7 or B (3Q x 5)	15		Subjective
Q4	Compulsory 3Q.	15	all 3 units	Subjective
	Total	60		

Overall Examination & Marks Distribution Pattern

Semester I & II

Course	BH.UZO101			BH.UZO102			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200

Rubrics of evaluation for ESE

Unit	Knowledge	Understanding	Analysis & critical	Total marks/unit
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			thinking	
1	03	06	06	15
2	03	06	06	15
3	03	06	06	15
4	03	06	06	15
Total per objective	12	24	24	60
% weightage	20	40	40	100

Rubrics of evaluation for CIA-2 assignment

Class: _____ Roll No _____ Topic _____

Parameters	Max Marks	80 – 100% Excellent	60 -80% Good	40 – 60% Satisfactory	20 – 40% Poor	0-20% very poor
CONTENT	10					
Content: Introduction –	02					
Content: Development	03					
Content:– Conclusion -	03					
Content: - Bibliography	02					
Effective Research Skills	10					
Language, Style and Structure;	05					
Aids	05					
Total	20					

Name of evaluator _____







PROGRAM OUTLINE

YEAR	SEMESTER	COURSE CODE	COURSE TITLE	CREDITS
FYBSC	II	BH.US ZOO.VSEC 201	Pearl Culture	3
		BH.US ZOO.VSEC P2	Practicals based on Pearl Culture	1
			TOTAL	4



DETAILED SYLLABUS – SEMESTER II

PREAMBLE

Preamble:

The syllabus on pearl culture is designed to provide comprehensive knowledge and practical skills in the art and science of pearl cultivation. Pearl culture, a specialized field within the aquaculture industry, encompasses the techniques and practices involved in producing high-quality pearls. This syllabus aims to equip learners with a deep understanding of the biological, ecological, and technological aspects of pearl culture, enabling them to contribute to the sustainable growth of this industry.

Recognizing the economic value and global demand for pearls, this syllabus emphasizes the development of practical skills essential for successful pearl farming. It covers a wide range of topics, including the biology and physiology of pearl-producing organisms, the selection and preparation of suitable oysters or mussels for pearl cultivation, farming techniques for optimal pearl production, and the principles of post-harvest processing and grading.

The syllabus also includes modules on environmental management, focusing on sustainable practices, conservation efforts, and the mitigation of potential environmental impacts associated with pearl culture operations. Additionally, learners will gain insights into the marketing and business aspects of the pearl industry, understanding market trends, consumer preferences, and value chain management.

Through a combination of theoretical knowledge and hands-on practical training, this syllabus aims to produce skilled professionals capable of managing and operating pearl culture farms with expertise, efficiency, and a commitment to sustainability. Graduates of this program will be well-prepared to contribute to the growth of the pearl culture industry, promoting economic development, employment generation, and the preservation of precious natural resources.



Programme: Science				Semester: II		
Course: Pearl Culture				Course Code: BH.US ZOO.VSEC 201		
Teaching Scheme				Evaluation Scheme (Theory)		
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)		End Semester Examination (ESE)
03	02	NIL	3+1=4	20	20	60
Pre-requisites: 40 % PASSING						
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> To understand the techniques and procedures involved in pearl cultivation, from seed oyster collection to pearl harvest and post-harvest handling. To gain knowledge of the key factors :in site selection, water quality, disease and pest management strategies and the feeding and nutrition requirements of pearl oysters for successful pearl farm management. To understand and apply the various techniques involved in pearl culture management, including bleaching, collection of pearls, and cleaning of pearls. 						
COURSE OUTCOMES:						
<ul style="list-style-type: none"> The learner will be able to describe the life cycle of pearl oysters and explain the key biological processes involved in their growth and reproduction. The learner will acquire the knowledge and skills to successfully carry out the techniques involved in pearl cultivation, including grafting, oyster handling, and caring for oysters during the growth period. The learner will be able to identify common diseases and pests that affect pearl oysters, analyze their impact on pearl cultivation, and propose preventive measures and treatment options to mitigate their effects. 						
INDEX						
Unit	Description					Periods
1	Introduction to Pearl Culture					15
2	Pearl Farm Management					15
3	Pearl Industry and Marketing					15
	Total					45



	Detailed Syllabus	Lectures
Unit 1	Introduction to Pearl Culture	3L
1.1	Introduction to Pearl culture	1L
1.2	History and development of pearl culture	1L
1.3	Overview of pearl types and their characteristics	1L
1.4	Anatomy and biology of pearl-producing oysters	2L
1.5	Pearl formation process and factors influencing pearl quality	1L
1.6	Pearl farming techniques and infrastructure	2L
1.7	Seed oyster collection and preparation	2L
1.8	Oyster husbandry and maintenance	1L
1.9	Pearl cultivation methods: Bead nucleation and grafting	2L
1.10	Pearl harvest and post-harvest procedures	2L
Unit 2	Pearl Farm Management	
2.1	Pearl farm site selection and environmental considerations	3L
2.2	Water quality management in pearl farming	3L
2.3	Disease and pest management in pearl oysters	4L
2.4	Feeding and nutrition of pearl oysters	3L
2.5	Monitoring and record-keeping in pearl farm management	2L
Unit 3	Pearl Quality Evaluation and Marketing	15
3.1	Pearl grading and classification systems	3L



3.2	Evaluating pearl color, luster, shape, and size	2L
3.3	Quality control measures for pearl production	1L
3.4	Pearl treatment techniques and their effects	2L
3.5	Introduction to pearl market and industry	2L
3.6	Pearl valuation and pricing	1L
3.7	Pearl marketing and sales strategies	2L
3.8	Legal and ethical considerations in pearl trade	1L
3.9	Emerging trends and future prospects in pearl culture	1L

Text books

1. Pearl Farming: A Technical Manual by F.M. Pillay and R.W. Wills
2. Pearl Culture: Biology, Ecology, and Management" by P. Subramanian
3. Pearl Production and Assessment by R. A. Wahle
4. Pearl Farming: A Manual by P. Chandrasekharan Nair
5. Pearl Oysters and Their Culture by U. R. N. Murthy and S. C. James
6. Pearl: The History of the World's Most Coveted Gem by Jack Lynch
7. Pearls: Their Origin, Treatment, and Imitation" by Peter Bancroft
8. Pearls and Pearling Life by Kunz G.F.
9. The Pearl Book: The Definitive Buying Guide by Antoinette Matlins and Eric E. Braunwart
10. Pearl Buying Guide: How to Identify and Evaluate Pearls & Pearl Jewelry by Renée Newman

Self-study topics

PRACTICALS:

1. To test the water quality to assess parameters such as temperature, salinity, and dissolved oxygen levels. Analyze the results and make recommendations for maintaining optimal water conditions
2. Culture technique of microorganism for pond maintenance. Surgical Techniques
3. Graft tissue preparation, implantation techniques, post operation care
4. Identify common diseases and pests that affect pearl oysters, and propose preventive measures and treatment options to mitigate their impact.
5. Designed pearl culture techniques, bleaching, collection of pearls, cleaning of pearls



6. To assess the quality and value of pearls based on criteria such as size, shape, color, luster, and surface quality.
7. Pearl cleaning and polishing demonstration
8. Set up a small-scale pearl cultivation experiment in a controlled environment, such as an aquarium or a tank
9. Hands-on demonstration of the techniques used in pearl cultivation, such as oyster handling, grafting, and caring for the oysters during the growth period.
10. Visit a pearl farm or hatchery to observe the process of pearl cultivation

Details of Conduct of Practical Examination (Evaluation Scheme):

PRACTICAL EXAMINATION

BH.US ZOO.VSEC P2

Time: 10 am to 2 pm

Total Marks: 50

Q1 Set up a small-scale pearl cultivation experiment using oysters in a controlled environment (aquarium or tank).	14M
OR	
Q1. Demonstrate any one technique of pearl culture/ Demonstrate the steps involved in graft tissue preparation for pearl oyster implantation	14M
Q2. Test water quality parameters: salinity/ temperature/ DO	06M
Q 3. Demonstrate pearl cleaning and polishing techniques	08M
OR	
Q3. Conduct a pearl quality assessment based on criteria such as size, shape, Color, luster, and surface quality.	08M
To identify and describe the diseases associated with pearl culturing (any 2)	04M
Q4. Report and viva on a visit to a pearl culture farm.	08M
Q.6 Viva-voce.	05 M
Q.7 Journal.	05 M



MODALITY OF ASSESSMENT: SEMESTER I and II
A) Internal Assessment- 40%: 40 marks

SR. NO.	CONTENT	MARKS
1.	Test (CIA 1)	20 M
2.	Assignment (CIA 2)	20 M

Assignment types can include:

- a. Surveys
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- f. Small Research Projects
- g. Societal Subject related venture (Kitchen waste composting, safe water drinking, hygiene of orphan homes, old-age homes etc).

B) External examination: 60%
a) Semester End Theory Assessment- 60%: 60 Marks

i) Duration – These examinations shall be of two and a half hours duration for each paper.

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	The learner has to attempt either A or B.
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b) Practical: 50 Marks

Paper Pattern:(Semester end Examination I & II)

MARKS: 60

DURATION: 2.5 HOURS.

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	Total	60		

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Semester I & II

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2	03	06	06	15



3	03	06	06	15
4	03	06	06	15
Total per objective	12	24	24	60
% weightage	20	40	40	100

Rubrics of evaluation for CIA-2 assignment

Class: _____ Roll No _____ Topic _____

Parameters	Max Marks	80 – 100% Excellent	60 -80% Good	40 – 60% Satisfactory	20 – 40% Poor	0-20% very poor
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Content: Introduction –	02					
Content: Development	03					
Content:– Conclusion -	03					
Content: - Bibliography	02					
Effective Research Skills	10					
Language, Style and Structure;	05					
Aids	05					
Total	20					

Name of evaluator _____







