

**S. P. Mandali's
RAMNARAIN RUIA AUTONOMOUS COLLEGE**



Syllabus for: T.Y.B.Sc. Applied Component- Marine Science
Program: B.Sc.
Course Code: ZOOLOGY (RUSACMS)

(Choice Based Credit System (CBCS) with effect from academic year 2019-2020)

Marine Science (Applied Component)
Syllabus (Credit Based Semester and Grading system).
T. Y. B. Sc. Zoology
Semester V (RUSACMS501)

Oceanography and Sustainable fishery

Theory				
Course	Unit	TOPIC	Credits	Lectures/Week
Theory RUSACMS501	1	Zonation in the sea and marine biodiversity	2	4
	2	Physical oceanography, Chemical oceanography and ocean related climatic changes		
	3	Sustainable fishery		
	4	Status of Marine science research, Protection and Conservation		
Practical				
Practical RUSACMSP501		Practicals based on RUSACMS501	2	4

Semester VI (RUSACMS601)

Aquaculture, Marine products, Processing and Fish Pathology [Theory]

Theory				
Course	Unit	TOPIC	Credits	Lectures/Week
Theory RUSACMS601	1	Introduction to commercial aquaculture	2	4
	2	Marine products		
	3	Introduction to quality control, preservation and processing		
	4	Fish pathology		
Practical				
Practical RUSACMSP601		Practicals based on RUSACMS601	2	4

T. Y. B. Sc. Zoology
Marine Science (Applied Component)
Semester V: Theory
Oceanography & Sustainable Fishery
Paper Code: RUSACMS501

Lectures 60

Objectives:

- To make learner acquire the knowledge about the geological distribution of sea and its relation to biodiversity.
- To make learner understand different physical and chemical factors of ocean and their role in bringing out climatic changes.
- To educate learner about the status in marine fish landings, different rules and regulations for sustainable fishery and various techniques used to collect related data.
- To expose learner to research vessels and Institutes, deep sea fishing vessels and the advancement in oceanographic research and conservation of Marine organisms.

Desired outcome:

Learner would understand different zones of sea (marine habitat) and their impact on biodiversity. Learner would get to know physical and chemical parameters of ocean during climate changes and their effect on marine organisms. Learner would become aware of different rules and regulations and the significance of sustainable fishery. Learner would get a basic idea of different techniques being used for sustainable fishery support. Learner will understand recent trends in oceanographic research which will motivate them to initiate research culture and make them aware about the conservation policies and status of Marine flora and fauna.

Unit 1: Zonation of the Sea and Marine Biodiversity

(15L)

- 1.1. Zonation of the Sea –Vertical and Horizontal
- 1.2. Plankton classification and adaptations
- 1.3. Nekton adaptations
- 1.4. Benthic adaptations (two examples of each group)
- 1.5. Inter-tidal organisms (rocky, muddy & sandy shores)
- 1.6. Deep sea organisms

Unit 2: Physical oceanography, Chemical oceanography and Ocean related climatic changes

(15L)

2.1. Physical parameters of the sea

- 2.1.1. Density
- 2.1.2. Illumination
- 2.1.3. Temperature
- 2.1.4. Pressure

2.2. Chemical parameters of the sea

- 2.2.1. Salinity
- 2.2.2. pH
- 2.2.3. Dissolved gases (oxygen and carbon dioxide)
- 2.2.4. **Nutrients in sea water**
 - Minor constituents (nitrates, phosphates and silicates)
 - Dissolved organic matter

2.3. Influence of the following water movements in sea

- 2.3.1. Currents – wind driven and Thermohaline circulation
- 2.3.2. Types of waves (including Tsunami)
- 2.3.3. Tides

2.4. Influence of the following climatic phenomena

- 2.4.1. Cyclone (including Phyan)
- 2.4.2. El Nino

Unit 3: Sustainable fishery

(15L)

- 3.1. Fishery acts and monitoring bodies
- 3.2. Remote sensing and forecasting
- 3.3. Geographical Information System (GIS): Concept and its application. Applications of GIS in aquatic Resource identification; Digital Image Processing (DIP): Different Methods and Approaches
- 3.4. Satellite Imagery for sustainable fishery support.
- 3.5. Time series analysis, understanding trend for forecasting
- 3.6. Global Positioning System (GPS), LIDAR, RADAR, SONAR- Concept and its Applications; Echo-sounders and its Applications

Unit 4: Status of Marine science research, Protection and Conservation

(15L)

- 4.1: NIO, CMFRI, CIFE, FSI, CIBA, MPEDA NIOT
- 4.2: Patterns and Valuing Marine Biodiversity
- 4.3: Endangered, Threatened and Vulnerable marine species
- 4.4: **Conservation strategies and legislations for marine species**
- 4.4.1: Marine protected areas (MPA)
- 4.4.2.: Marine parks and Biosphere reserves.
- 4.4.3. Conservation policy for marine species.
- 4.4.4. Application of Statistical Data Analysis in Marine Science Research

Practical based on Marine Science (Applied Component: RUSACMS501)

1. Chemical analysis of sea water: a) Silicates, b) Phosphates, c) Nitrites-Nitrogen and Nitrates-Nitrogen, d) Chlorides by Conductometry, e) Turbidity, f) Estimation of CTD (Conductivity, Temperature and Depth)

2. Estimation of heavy metals from the given water sample: Copper, Lead, Zinc

3. Study of oceanographic instruments:

- i. Niskin Water Sampler
- ii. Van-Veen Grab
- iii. Reversing Thermometer
- iv. Current Meter
- v. Secchi Disc
- vi. Standard Plankton Net
- vii. Echosounder
- viii. Corer

4. Ecological adaptations: Intertidal organisms

- i. Porifera: Sponge (*Sycon*)
- ii. Coelenterata: Sea anemone, Coral, Jelly fish
- iii. Annelida: *Nereis*, *Arenicola*
- iv. Arthropoda: Balanus, Hermit Crab
- v. Mollusca: Oyster, *Mytilus*, *Sepia*, *Loligo*, *Teredo*
- vi. Echinodermata: Starfish, Sea urchin

5. Coral fish: Clown Triggerfish, Queen Angelfish

6. Deep Sea Animals: Solefish (*Psettodes* and *Cynoglossus*), Angler Fish

7. Study of zooplanktons:

Copepod, Zoea, Mysis, Saggita, Fish egg, *Doliolaria* larva, *Lucifer* (Any five)

8. Endangered marine species:

Identification and reason for decline of Salmon, Sturgeon, Sea-lion, Seal and Whale

9. Identification and operation of traditional crafts and gear.

10. Photographic documentation of Marine Science related issues. Submission of soft & hard copy of 5 original photographs taken by the learner (Exif details required)

11. Assignment (may be submitted in a group not exceeding three students)

***Note-** The practicals may be conducted by using preserved specimens / permanent slides authorized by the wild life and such other regulating bodies though it is strongly recommended that the same should be taught by using photographs/audiovisual 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 practicals mentioned here-in above.

MODALITY OF ASSESSMENT – Semester V

A] Internal assessment - 40%

Sr. no.	Evaluation type	Marks
1.	One class test (Objective and Descriptive)	20
2.	Assignment/ Case study/ Research project/ Group Discussion/ Presentation/ Viva	20

B] External examination- 60%

Semester End Theory Assessment-60 Marks

(Duration – These examinations shall be of **two hours** duration for each paper.)

Theory Question Paper Pattern –

- There shall be three questions each of 20 marks.
- On each unit there will be one question.
- All questions shall be compulsory with internal choice within the questions.
- Question may be subdivided into sub-questions a, b, c... and the allocation of marks depend on the weightage of the topic.

Duration : 2 Hrs.

Total Marks: 60

Questions	Options	Marks	Questions on
Q.1) a, b, c, d	Any 3 out of 4	12	Unit I
Q.2) a, b, c, d	Any 3 out of 4	12	Unit II
Q.3) a, b, c, d	Any 3 out of 4	12	Unit III
Q.4) a, b, c, d	Any 3 out of 4	12	Unit III
Q.5) a, b, c, d	Any 3 out of 4	12	All Units

Practical Examination Pattern:

(A)

Internal Examination

Heading	Practical
Journal	05
Class Participation	05
Lab work/ Field report/ Presentation	30
Total	40

(B)

External (Semester end practical examination)

Particulars	Practical
Lab work and / or <i>Viva voce</i>	60
Total	60

T. Y. B. Sc. Zoology
Semester VI: Theory
Aquaculture, Marine products, Processing and Fish Pathology
Paper Code: RUSACMS601

Lectures 60

Objectives:

- To make learner acquire in-depth knowledge about marine aquaculture of commercially important fishes and crustaceans.
- To give learner an overview of various products that can be obtained from marine organisms.
- To make learner understand different methods of preservation and processing of marine products for maintaining its nutritional quality.
- To acquaint learner to fish diseases, causative agents, prevention techniques and treatment.

Desired outcome:

Learner will take the first step to become entrepreneur in the field of culture fishery with basic knowledge of marine aquaculture. Learner would be acquainted with various marine products, their nutritional values and economic significance. Learner would acquire knowledge of specific methods of preservation and processing for enhancing the shelf life and commercial value of seafood. Learner would be able to identify causative agents, symptoms and treatment for different fish diseases.

Unit 1: Introduction to commercial aquaculture (15L)

- 1.1. Objectives, Benefits and Scope of Aquaculture.
- 1.2. Selection of Site and Species for Aquaculture and Construction of a typical Aquaculture farm, Feed formulation in Aquaculture.
- 1.3. Aquaculture systems: Extensive, semi-intensive and intensive culture of prawn, Monoculture, Polyculture, composite fish culture.
- 1.4. Brackish water aquaculture of *Litopenaeus vannamei* (Pacific White Shrimp)
- 1.5. Types of Culture Systems in Aquaculture: Pond Culture, Cage Culture, Pen Culture, Raceway Culture Systems.
- 1.6. *Lates calcarifer* (Asian Sea Bass) culture in race ways.
- 1.7. Cage farming of *Rachycentron canadum* (Cobia)
- 1.8. Culture of brackish water crustaceans
- 1.9. Economic evaluation of Aquaculture practices
- 1.10. Impact of Aquaculture on Environment

UNIT 2: Marine Products (15L)

- 2.1. Biochemical composition of raw and preserved fish.
- 2.2. Fish protein concentrate, fish maws, isinglass, oils (body and liver), chitin, chitosan, Fish/ Prawn pickle and chutney, fish wafers, surimi, imitation products.
- 2.3. Bioactive Compounds
 - a) Sea as treasure house of new chemicals
 - b) Bioactive metabolites from sponges and bacteria
 - c) Bioactive toxins and eutrophication
- 2.4. Commercial uses of sea weeds
 - a) Uses of sea weeds as food: Nori (*Porphyra*), Kombu (*Laminaria*), Arame (*Eisenia*), Dulse (*Palmaria*)
 - b) Liquid Seaweed Fertilizer

- c) Seaweed as source of Bio-fuel
- d) Seaweed in cosmetics

Unit 3: Introduction to quality control, preservation and processing (15L)

- 3.1 Methods of evaluating freshness and quality of fish and prawn (Organoleptic, Microbial and Chemical)
- 3.2 Mechanisms of spoilage (Hyperemia, rigor mortis, Autolysis, Rancidity)
- 3.3 Methods of preservation– Icing, Drying, Salting, Canning, Pickling, Freezing

Unit 4: Fish pathology (15L)

4.1 Fish diseases caused by:

- a) Protozoan
- b) Bacteria
- c) Fungi
- d) Worms
- e) Crustaceans
- f) Non parasitic diseases
- g) Fish tumour

4.2 Symptoms and Treatment of the above diseases

4.3. Disease diagnostics tools: Histopathological methods, tools used in PCR and its applications.

4.4. Prevention techniques: Crop Rotation, Immune Stimulants, Genetic Improvement

Practical based on Marine Science (Applied Component: RUSACMS601)

Credits02

1. a) Estimation of primary productivity
- b) Estimation of Biological Oxygen Demand (BOD)
- c) Estimation of Chemical Oxygen Demand (COD)
2. **Extraction of Chitosan and Chitin from Prawn shell waste.**
3. **Extraction of Gelatin**
4. **Mounting and Identification of Foraminiferan shells**
5. **Identification of Common edible marine fauna:**
 - a) Fish: *Polynemus spp*, *Lates calcarifer*, *Pampus argenteus*, *Parastromateus niger*, *Rastrelliger kanagurta*, *Cybium guttatum*, *Harpodon nehereus*, *Sardinella longiceps*
 - b) Molluscs: Oyster, *Sepia*, *Loligo*
 - c) Crustaceans: Shrimp, Lobster, Crab
6. **Identification of molluscan shells:** *Trochus*, *Umbonium*, *Oliva*, *Conus*, *Conch* shell, *Telescopium*, *Mytilus*, *Donax*, *Katelysia*.
7. Identification of marine algae: *Ulva*, *Sargassum*, *Padina*, *Fucus*, *Polysiphonia*, *Laminaria*.
8. Fish diseases: Identification from photograph / specimen.
 - a) Protozoan
 - b) Bacteria
 - c) Fungi

- d) Worms
- e) Crustaceans
- f) Non-parasitic diseases
- 9. Identification of mangrove plants- *Avicenia*, *Exoecorea*, *Sonnertia*, *Rhizophora*.
- 10. Visit to any of the research institutes, fishery industry, landing centres, boat building industry, research vessel, fish market, fishery co-operative societies, funding agencies office and processing units and submission of report.
- 9. Project and submission of report (Project report may be submitted in a group not exceeding three students).

***Note- The practicals may be conducted by using preserved specimens / permanent slides authorized by the wild life and such other regulating bodies though it is strongly recommended that the same should be taught by using photographs/audiovisual 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 practicals mentioned here-in above.**

References

RUSACMS501&RUSACMS601

1. A Textbook of Marine Ecology – Nair, N.B. &Thumpty, D.H., the Macmillan Book Company of India Ltd.
2. Biology of intertidal animals - Newell, R.C., Lagos Press.
3. Crafts and Gear of India– Y. Shrikrishna&Latha Shenoy – ICAR Publication
4. Data site: data.gov.in.
5. Ecological Methods for Field and Laboratory Investigations – P.Michael. •Course Material in Fishing Technology – LathaShenoy, CIFE, Versova, Mumbai.
6. Elementary Statistics - Yule & Kendell, Charless Griffin & Co. London.
7. Fisheries Biology, Assessment and Management – Michael King – Fishing New Publishers, 1995.
8. Fisheries Bioeconomics – Theory, Modeling and Management – FAO Fisheries Technical Paper 368 – FAO, 2001.
9. Fish and Fisheries – Chandy, National Book Trust.
- 10.Financial Management – Prasanna Chandra, 7th Edition.
- 11.Financial Management – Khan & Jain.
- 12.Financial Management –I .M. Pandey.
- 13.Fish and fisheries of India, Jhingran J.S. Hindustan Publication.
- 14.Fish handling & Processing – Aitikin A: 2nd edition, min. Agr. Fish and Food U.K.
- 15.Fundamentals of Applied Statistics - Gupta S. C. &. Kapoor V. K., Fourth edition, Sultan Chand & Sons.
- 16.Glimpses of the Indian Ocean – S.Z. Qasim, University Press (India Ltd. 1998).
- 17.Handbook Fish Biology and Fisheries, Ed. J.B. Hart & John Reynold.
- 18.History Of Marine Sciences in India – Dr. B.F. Chhapgar Centenary issue BNHS.
- 19.Introductory Oceanography – 8 thEdn. Harold Thurman, Prentice Hall.
- 20.Introduction to Physics and Biological Oceanography, King C.A.H, ELBS Ltd. Lo
- 21.Marine Ecology – Tait.
- 22.Marine Fisheries of India – D.V. Bal and K.V. Rao, Tata McGraw – Hill Publishing Co. Ltd., New Delhi.
- 23.Modern Fishing Gear Technology – N. Shahul Hameed, Boopendranath – Daya Publishing House, 2000).

24. Marketing Management – Philip Kotler.
25. Operations Research Theory and Application, Third edition, Sharma J. K.: Macmillan India Ltd.
26. Pollution and Toxicology, Venugopalan, V.K.: CAS in Marine Biology.
27. Prawn and Prawn Fisheries – Kurian & Sebastian.
28. Project Management – Prasanna Chandra.
29. Refrigeration by Arora.
30. Textbook of Marine Pollution - Prakesh P.
31. The Oceans – Svedrup, H.V. et al, Asian Publishing House.
32. The Book of Indian Shells – Deepak Apte, Oxford University Press.
33. Text book of fish biology and Indian Fisheries by Dr. R.P. Parihar, Central Publication House, Allhabad.
34. Understanding The Sea – Dr. B.F. Chhapgar, Oxford University Press.
35. Wealth of India: Vol. 4 CSIR Publication. For additional and latest information on the topics, various websites can be visited.

Ramnarain Ruia Autonomous College

MODALITY OF ASSESSMENT – Semester VI

A] Internal assessment - 40%

Sr. no.	Evaluation type	Marks
1.	One class test (Objective and Descriptive)	20
2.	Assignment/ Case study/ Research project/ Group Discussion/ Presentation/ Viva	20

B] External examination- 60%

Semester End Theory Assessment-60 Marks

Duration: 2 hrs

(Duration – These examinations shall be of **two hours** duration for each paper.)

Theory Question Paper Pattern –

- There shall be three questions each of 20 marks.
- On each unit there will be one question.
- All questions shall be compulsory with internal choice within the questions.
- Question may be subdivided into sub-questions a, b, c... and the allocation of marks depend on the weightage of the topic.

Questions	Options	Marks	Questions on
Q.1) a, b, c, d	Any 3 out of 4	12	Unit I
Q.2) a, b, c, d	Any 3 out of 4	12	Unit II
Q.3) a, b, c, d	Any 3 out of 4	12	Unit III
Q.4) a, b, c, d	Any 3 out of 4	12	Unit III
Q.5) a, b, c, d	Any 3 out of 4	12	All Units

Practical Examination Pattern:

(A) Internal Examination

Heading	Practical
Journal	05
Class Participation	05
Lab work/ Field report/ Presentation	30
Total	40

(B) External (Semester end practical examination)

Particulars	Practical
Lab work and / or <i>Viva voce</i>	60
Total	60

Overall Examination and Marks Distribution Pattern

Semester- V and VI

Course	501/601			502/602			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Practicals	40	60	40	60	40	60	200

ANNEXURES

Topics for assignment Semester V

(Teachers are expected to develop additional innovative topics, varying every year, to be assigned to the students)

1. Survey of frozen marine fish products on shelf in malls.
2. Survey of ready to eat fish food products on shelf in malls
3. Survey of ready to cook fish food products on shelf in malls.
4. Survey of prices of Marine Aquarium fishes
5. Survey of types and prices of Live Marine Aquarium fish food
6. Survey of types and prices of Marine Aquarium plants
7. Survey and listing of fishes and their prices from local market.
8. Survey of various aquarium equipments and their prices
9. Survey of fish by-products in cosmetic industry
10. Survey of fish by-products in pharmaceutical industry.
11. Knitting/ Preparing different fishery gear (nets).
12. Making models of different fishing crafts (boats) using biodegradable materials.

All topics mentioned above are suggestive, more creative and innovative topics are expected from the students, under the guidance of the concerned teacher, to suit the expertise, human resources, infrastructure and local needs as also the interest of the students. The assignment may be submitted in a group not exceeding three students.

Semester VI

Field Visits

- ☐ There shall be various short and long excursions / study tours / field visits / industrial visits in every semester, at least one of which shall be financially affordable to every student in the class; and that assessment and marks of field trips shall be solely based upon such where no student was restrained for financial limitations.
 - ☐ Field visits are to be organized to facilitate students to have firsthand experience & exposure to technology/production/functioning of organization/units or witness a relevant activity.
 - ☐ Each student must make at least 01 (one) such visit to the units/treatment plants/aquatic or terrestrial habitat organized by the College.
 - ☐ The list is suggestive and not exhaustive.
1. Visit to net manufacturing industry
 2. Visit to boat building industry
 3. Visit to fish preservation/ processing industries
 4. Visit to local fish markets
 5. Visit to fish landing centre
 6. Visit to shore for studying important intertidal organisms
 7. Visit to research institutes
 8. Visit to Government and Semi-Government organizations like fishery departments, MPEDA and financial institutions
 9. Visit to hatcheries and/or farms
 10. Visit to fishery co- operative societies

Topics for Projects*

(Teachers are expected to develop additional innovative topics, varying every year, to be assigned to the students)

1. Prepare feasibility report for setting up an aquarium shop on small/large scale.

2. Prepare feasibility report for setting up an industry for manufacturing any one or more fish by-products.
 3. Prepare feasibility report for setting up a fish culture unit.
 4. Prepare feasibility report for building up a prawn culture unit.
 5. Prepare feasibility report for various aspects of cold storage.
 6. Prepare feasibility report for fish preservation unit.
 7. Study of seasonal variation in nutrient content of marine water of any coast (silicates, phosphates, nitrates).
 8. Analysis of marine water samples collected from different beaches.
(DO/BOD/COD/Salinity/pH)
 9. Study of Mangroves of coastal region.
- * **The project is mandatory and has to be submitted individually.**

Ramnarain Ruia Autonomous College