AC/II (20-21).2.RUS19

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

Syllabus for Applied component: Marine Science

Program: B.Sc.

Program Code: Zoology (RUSACMS)

(Credit Based Semester and Grading System for the academic year 2020–2021)

GRADUATES ATTRIBUTES

GA	GA Description **A student completing Bachelor's Degree in Science program will be able to:**
GA 1	Recall and explain acquired scientific knowledge in a comprehensive manner and apply the skills acquired in their chosen discipline. Interpret scientific ideas and relate its interconnectedness to various fields in science.
GA 2	Evaluate scientific ideas critically, analyse problems, explore options for practical demonstrations, illustrate work plans and execute them, organise data and draw inferences.
GA 3	Explore and evaluate digital information and use it for knowledge upgradation. Apply relevant information so gathered for analysis and communication using appropriate digital tools.
GA 4	Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyse results.
GA 5	Take complex challenges, work responsibly and independently, as well as in cohesion with a team for completion of a task. Communicate effectively, convincingly and in an articulate manner.
GA 6	Apply scientific information with sensitivity to values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society.
GA 7	Follow ethical practices at work place and be unbiased and critical in interpretation of scientific data. Understand the environmental issues and explore sustainable solutions for it.
GA 8	Keep abreast with current scientific developments in the specific discipline and adapt to technological advancements for better application of scientific knowledge as a lifelong learner.

PROGRAM OUTCOMES

PO	Description **A student completing Bachelor's Degree in Science program in the subject of Marine Science (Applied component) will be able to:**
PO 1	Gain comprehensive knowledge about sustainable fisheries, Zonation of sea, ocean and current systems, Marine products.
PO 2	Interrelate the concepts of ocean currents, tidal currents with climate change.
PO 3	Interpret and relate the various adaptations of intertidal, benthic and deep-sea organisms with their environment.
PO 4	Correlate the concepts of Salinity, Temperature, Density and Pressure with each other and deduce a meaningful explanation.
PO 5	Understand the aspects of areas such as in Physical oceanography, Physical oceanography, Emerging trends in fisheries, Aquaculture.
PO 6	Demonstrate proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization within Marine Science.
PO 7	Get a flavour of research by working on project. It will further enable the students to think and interpret individually.
PO 8	Apply their knowledge in problem solving and future course of their career development in higher education and research.
PO 9	Develop skills, concept and experience in the vast field of oceanography research.

PROGRAM OUTLINE

YEAR	SEM	COURSE CODE	COURSE TITLE	CREDITS
T. Y. B. Sc.	V	**RUSACMS501**	Marine Science - I	**2**
	V	**RUSACMSP501**	Practical based on semester V paper	**2**
	VI	**RUSACMS601**	Marine Science - II	**2**
	VI	**RUSACMSP601**	Practical based on semester V paper	**2**

Course Code: RUSACMS501

Course Title: Marine Science - I

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION After successfully completing the course, the students will be able to:
CO 1	Understand different zones of sea (marine habitat) and their impact on biodiversity.
CO 2	Understand the physical and chemical parameters of ocean during climate changes and would be able to and analyse their effect on marine organisms.
CO 3	Comprehend different rules and regulations and the significance of sustainable fishery.
CO 4	Compare and analyse different techniques used for sustainable fishery support.
CO 5	Develop an ability to analyze recent trends in oceanographic research which will motivate them to initiate research culture.
CO 6	Make them aware about the conservation policies and status of Marine flora and fauna.

Detailed syllabus

RUSACMS501	Title: Marine Science	Credits- 02
Unit I	**Zonation of the Sea and Marine Biodiversity**	**15 lectures**
	Zonation of the Sea –Vertical and Horizontal	
	Plankton classification and adaptations	
	Nekton adaptations	
	Benthic adaptations (two examples of each group)	
	Inter-tidal organisms (rocky, muddy & sandy shores)	
	Deep sea organisms	
Unit II	**Physical and Chemical oceanography and Ocean related climatic changes**	**15 lectures**
	Physical parameters of the sea • Density • Illumination • Temperature • Pressure	
	Chemical parameters of the sea • Salinity • pH • Dissolved gases (oxygen and carbon dioxide) • **Nutrients in sea water:** Minor constituents (nitrates, phosphates and silicates) • Dissolved organic matter	
	Influence of the following water movements in sea • Currents – wind driven and Thermohaline circulation • Types of waves (including Tsunami) • Tides	
	Influence of the following climatic phenomena • Cyclone (including Phyan) • El Nino	
Unit III	**Sustainable fishery**	**15 Lectures**
	Fishery acts and monitoring bodies	
	Remote sensing and forecasting	
	Geographical Information System (GIS): • Concept • Applications of GIS in aquatic Resource	

	identification	
	Digital Image Processing (DIP): Different Methods and Approaches	
	Satellite Imagery for sustainable fishery support.	
	Time series analysis, understanding trend for forecasting	
	Global Positioning System (GPS), LIDAR, RADAR, SONAR- Concept and its Applications; Echo-sounders and its Applications.	
Unit IV	**Status of Marine science research, Protection and Conservation**	**15 Lectures**
	NIO, CMFRI, CIFE, FSI, CIBA, MPEDA NIOT	
	Patterns and Valuing Marine Biodiversity	
	Endangered, Threatened and Vulnerable marine species	
	Conservation strategies and legislations for marine species • Marine protected areas (MPA) • Marine parks and Biosphere reserves. • Conservation policy for marine species. • Application of Statistical Data Analysis in Marine Science Research	
RUSACMSP501	**PRACTICALS**	**Credits-02**
	MARINE SCIENCE	
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**: a) Niskin Water Sampler b) Van-Veen Grab c) Reversing Thermometer d) Current Meter e) Secchi Disc f) Standard Plankton Net g) Echosounder h) Corer i) ACDP (Acoustic Doppler Colour Profiler) j) CTD (Conductivity Temperature Depth)	

4.	**Ecological adaptations: Intertidal organisms** a) Porifera: Sponge (*Sycon*) b) Coelenterata: Sea anemone, Coral, Jelly fish c) Annelida: *Nereis, Arenicola* d) Arthropoda: Balanus, Hermit Crab e) Mollusca: Oyster, *Mytilus*, *Sepia, Loligo, Teredo* f) 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.	**Identification and operation of traditional crafts and gear**.	
9.	**Endangered marine species:** Identification and reason for decline of Salmon, Sturgeon, Sea-lion, Seal and Whale	
10.	**Study of telemetry tracking instruments for marine endangered species**	
11.	**Photographic documentation** of Marine Science related issues. Submission of soft & hard copy of 5 original photographs taken by the learner (Exact Detaileds required)	
	Field visit to any Marine Research Institute or Marine Biodiversity park/ shore and submission of report	
	***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:

- Nair, N.B and Thumpy D. H; (1980), A Textbook of Marine Ecology, Macmillan Book Company of India Ltd.
- Newell, R. C; (1979), Biology of intertidal animals, 3rd Edition, Lagos Press.
- Shrikrishna, Y and Shenoy, Latha; (2001), Crafts and Gear of India, ICAR Publication.

- Michael, P. and Shenoy Latha; Ecological Methods for Field and Laboratory Investigations –Course Material in Fishing Technology, CIFE, Versova, Mumbai.
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- Michael King; Fisheries Biology (1995), Assessment and Management, Fishing New Publishers.
- Fisheries Bio-economics – Theory (2001), Modeling and Management – FAO Fisheries Technical Paper 368 – FAO.
- Chandy M., Fishes, (1970), National Book Trust of India.
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- Jhingran J.S, Fish and fisheries of India (1991), 3rd Edition, Hindustan Publication.
- Akintin, A.; Fish handling & Processing, 2nd edition, min. Agr. Fish and Food U.K.
- Gupta S. C. &. Kapoor V. K., Fundamentals of Applied Statistics –10th edition (2002), Sultan Chand & Sons.
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- Dr. B.F. Chhapgar, History of Marine Sciences in India –Centenary issue BNHS.
- Thurman, H; Introductory Oceanography – 8th Edition. (1997) Prentice Hall.
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- Tait, R.V; Elements of Marine Ecology (1998), 4th edition, Butterworths.
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- Kurian & Sebastian; Prawn and Prawn Fisheries (1976), Hindustan Publishing corporation.
- Chandra Prasanna; Project Management, (2009), 7th edition, McGraw Hill Education.
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- Svedrup, H.U*et al.,* The Oceans: Their Physics, Chemistry and General biology, (1942), Prentice-Hall, Inc., *New York*
- Apte Deepak; The Book of Indian Shells (2015), 2nd Edition, Oxford University Press.
- Dr. Parihar, R. P; Text book of fish biology and Indian Fisheries, (1994), Central Publication House, Allhabad.
- Dr. Chhapgar, B.F; Understanding the Sea, (2014), Oxford University Press.
- Wealth of India: A dictionary of Indian Raw Materials and Industrial Products, (1948), Vol. 4, CSIR Publication.
- Data site: data.gov.in.

For additional and latest information on the topics, various websites can be visited.

MODALITY OF ASSESSMENT
(T.Y.B.Sc. Applied component)

A] Internal assessment - 40%: 40 marks

Sr. no.	Evaluation type	Marks
1.	One class test (Multiple choice questions)	20
2.	Two Assignments/ Case study/ Group Discussion	20
	TOTAL	**40**

B] External examination - 60%

- **Semester End Theory Assessment = 60 Marks**
  - Duration – These examinations shall be of **two hours** each paper.
  - Paper Pattern: All questions shall be compulsory with internal choice within the questions.

Questions	Options	Marks	Questions on
Q.1) A, B, C	Any 2 out of 3	12	Unit I
Q.2) A, B, C	Any 2 out of 3	12	Unit II
Q.3) A, B, C	Any 2 out of 3	12	Unit III
Q.4) A, B, C	Any 2 out of 3	12	Unit IV
Q.5) a, b, c, d, e	Any 3 out of 5	12	All Units
	TOTAL	**60**	

Practical Examination Pattern:

(A) Internal Examination

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

(B) External (Semester end practical examination)

Particulars	Practical
Lab work and / or *Viva voce*	60
Total	**60**

PRACTICAL BOOK/JOURNAL

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Co-ordinator / In charge of the department; failing which the student will not be allowed to appear for the practical examination.

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Course Code: RUSACMS601

Course Title: Marine Science - II

Academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION After successfully completing the course, the students will be able to:
CO 1	Explore methods of preservation and processing for enhancing the shelf life and commercial value of seafood.
CO 2	Critically analyse and evaluate various marine products, their nutritional values and their economic significance.
CO 3	Compare and contrast between types of culture systems in aquaculture.
CO 4	Formulate the course of treatment for different fish diseases.
CO 5	Identify causative agents, symptoms of different fish diseases.
CO 6	Develop employable skills to become entrepreneur in the field of culture fishery with basic knowledge of marine aquaculture.

Detailed syllabus

RUSACMS601	Title: Marine Science	Credits-02
Unit I	**Introduction to commercial aquaculture**	**15 lectures**
	Objectives, Benefits and Scope of Aquaculture.	
	Selection of Site and Species for Aquaculture and Construction of a typical Aquaculture farm, Feed formulation in Aquaculture.	
	Aquaculture systems: Extensive, semi-intensive and intensive culture of prawn, Monoculture, Polyculture, composite fish culture.	
	Brackish water aquaculture of *Litopenaeus vannamei*(Pacific White Shrimp)	
	Types of Culture Systems in Aquaculture: Pond Culture, Cage Culture, Pen Culture, Raceway Culture Systems.	
	Lates calcarifer (Asian Sea Bass) culture in race ways.	
	Cage farming of *Rachycentron canadum* (Cobia)	
	Culture of brackish water crustaceans	
	Economic evaluation of Aquaculture practices	
	Impact of Aquaculture on Environment	
Unit II	**Marine Products**	**15 lectures**
	Biochemical composition of raw and preserved fish.	
	Fish protein concentrate, fish maws, isinglass, oils (body and liver), chitin, chitosan, Fish/ Prawn pickle and chutney, fish wafers, surimi, imitation products.	
	Bioactive Compounds • Sea as treasure house of new chemicals • Bioactive metabolites from sponges and bacteria • Bioactive toxins and eutrophication	
	Commercial uses of sea weeds • Uses of sea weeds as food: Nori (*Porphyra*), Kombu (*Laminaria*), Arame (*Eisenia*), Dulse (*Palmaria*) • Liquid Seaweed Fertilizer • Seaweed as source of Bio-fuel • Seaweed in cosmetics	
Unit III	**Introduction to quality control, preservation and processing**	**15 Lectures**
	Methods of evaluating freshness and quality of	

	fish and prawn (Organoleptic, Microbial and Chemical)	
	Mechanisms of spoilage (Hyperemia, rigor mortis, Autolysis, Rancidity)	
	Methods of preservation– Icing, Drying, Salting, Canning, Pickling, Freezing	
Unit IV	**Fish pathology**	**15 Lectures**
	Fish diseases caused by: • Protozoan • Bacteria • Fungi • Worms • Crustaceans • Non parasitic diseases • Fish tumour	
	Symptoms and Treatment of the above diseases	
	Disease diagnostics tools: Histopathological methods, tools used in PCR and its applications.	
	Prevention techniques: Crop Rotation, Immune Stimulants, Genetic Improvement	
RUSACMSP601	**PRACTICALS**	**Credits-02**
MARINE SCIENCE		
1.	Estimation of primary productivity	
2.	Estimation of Biological Oxygen Demand (BOD)	
3.	Estimation of Chemical Oxygen Demand (COD)	
4.	**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	
5.	**Identification of molluscan shells**: Trochus, Umbonium, Oliva, Conus, Conch shell, Telescopium, Mytilus, Donax, Katelysia.	
6.	**Identification of marine algae**: Ulva, Sargassum, Padina, Fucus, Polysiphonia, Laminaria	
7.	**Identification of mangrove plants**- Avicenia, Exoecorea, Sonnertia, Rhizophora.	
8.	Mounting and Identification of Foraminiferan shells	

9.	Extraction of Chitosan and Chitin from Prawn shell waste.	
10.	Extraction of Gelatin	
11.	**Microbial studies**: (From fish samples) a) Gram staining technique b) Identification of Bacilli, Cocci and Vibrio bacteria	
12.	**Traditional method of preservation of Fish or prawn**: Preparation of Prawn pickle	
13.	**Fish diseases: Identification from photograph / specimen.** a) Protozoan b) Bacteria c) Fungi d) Worms e) Crustaceans f) Non-parasitic diseases	
14.	Study of fish egg development. **(Activity based)**	
	Visit to any of the fish market /fishery industry /fish processing unit / landing centers / boat building industry / research vessel and submission of report.	

References:

- Jhingran J.S, Fish and fisheries of India (1991), 3rd Edition, Hindustan Publication.
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(T.Y.B.Sc. Applied component)

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Q.3) A, B, C	Any 2 out of 3	12	Unit III
Q.4) A, B, C	Any 2 out of 3	12	Unit IV
Q.5) a, b, c, d, e	Any 3 out of 5	12	All Units
	TOTAL	**60**	

Practical Examination Pattern:

(C) Internal Examination

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

(D) External (Semester end practical examination)

Particulars	Practical
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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	100	40	60	100	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.**

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