AC - 11th May, 2017
Item No. 4.282

AC Item No.

UNIVERSITY OF MUMBAI

Program: B.Sc.

(Credit Based Semester and Grading System)

Course: Fishery Biology

(Applied Component)

Syllabus for Semester V & VI

(with effect from the academic year 2017-18)

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PREFACE

Applied Component was introduced for T. Y. B. Sc. class in the academic year 1979-80 with a view to enhance the essence for employability. The syllabus is a blend of concepts with four electives. It gives me immense pleasure to present these four applied component courses namely Marine Science, Fishery Biology, Economic Entomology and Environmental Science under the umbrella of BOS in Zoology.

In the syllabi of these applied components, applied topics having commercial propositions have been incorporated that further ads to the enhancement of entrepreneurial potential and skills amongst the learners. In the past our syllabus focused mainly on theory as a way of providing knowledge base and preparation for students. We have attempted to go beyond this tradition, while doing so, equal emphasis is laid on theory and corroborative practicals. From the academic year 2011-12, the University has introduced Credit Based Semester and Grading System (CBSGS). Accordingly the existing syllabi of these applied components were restructured to fit into the CBSGS pattern. The concept of flexi syllabus was introduced offering opportunity to learners to study any four out of a total of eight units in each course. Now that the syllabus is restructured and to be introduced from the academic year 2017-2018, we have included a novel concept of open unit and case studies. This approach, I'm sure will enhance the critical and analytical thinking abilities of the students.

I take this opportunity to thank the experts in various field for giving valuable, beneficial and constructive suggestions during framing of the syllabus. The syllabus committee under the convenorship of Mr. Vinayak Dalvie has done a commendable job of timely framing the syllabus with a highest degree of precision and accuracy. While appreciating the efforts, I also express my thanks and heartfelt gratitude to the entire team.

– Dr. Anita Jadhav
Chairperson
Ad-hoc, BOS in Zoology

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PREAMBLE

As a convener when I mooted the concept of flexi-syllabus, first of its kind, in the academic year 2009-10 it was grossly misconstrued. To add to it I also placed an idea of including case studies and introducing a new concept of "Open Unit". Both were rejected then. I had also proposed a new subject "Entrepreneurial and Industrial Biology" in place of the existing Applied Components usually offered by the students of Biological Sciences. 20 workshops in different districts with teachers and students of various subjects were conducted to explain these four concepts. A twenty one days refresher course for teachers, sponsored by UGC was also conducted in the new subject of "Entrepreneurial and Industrial Biology" which was much appreciated by the then Director of NAAC, Prof H. A. Ranganath, who is from Biological Sciences, understanding the potential of the subject. However, implementation was postponed for technical reasons thus permitting innovation limited to the flexi-syllabus, implemented in 2010-11, which has inherent capacity to cater to the diverse needs of the region and the industry by allowing students and teachers to choose a desired capsule of eight topics, with various permutations and combinations from the menu of sixteen based on the interest, resources, expertise and need. It took care of a range of students by also providing learners' space to high IQ students. Yet the possibility of exclusion of some important topics cannot be ruled out apart from some new avenues developed during the lag phase of revision of syllabi. Open unit will permit a good teacher to keep pace with the development and adopt latest topics instantly without waiting till it becomes obsolete in the gap of 5 years that the University generally takes to revise the syllabus. It may also allow students to learn the existing topic in more details and depth under the open unit thus making them specialized in need based areas enhancing employability. Assignments would add to their understanding of Government schemes, regulations and market, while projects will augment Business Sense or Scientific Acumen, as the case may be. Case studies and simulations, introduced for the first time in Zoology, would pose challenge for true application of knowledge to real life situations with thought provoking questions demanding analytical solutions. Pedagogy of such dynamic syllabus will range from use of ICT in the class to teaching directly in the field with a blend of participative and experiential learning with group dynamics gaining true knowledge apart from developing personality of the students and above all making them apply ‘Common Sense’ which is the essence of life. I am sure dedicated team of Zoologists which has placed the subject on top in the past 5 years is poised to make it a success in every college befitting the purpose of introducing applied component by the University in the academic year 1979-80.

– VINAYAK DALVIE
Convenor,
Syllabus Committee

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Pedagogy

Applied Component Syllabus of Fishery Biology is flexi-syllabus designed in such a way that students can carve their future in Fishery Biology. To understand the potential of this flexi-syllabus it is important to select four units in each semester systematically in such a way that they have relevance with each other. Different capsules may be developed through permutations and combinations and each capsule being a subject in itself. For example selecting units III, IV, VII and VIII in semester V and Units III, IV V and VII in semester VI will ensure specialization in Freshwater Fishery. Of course teacher is at liberty to choose any four units in each semester in consultation with students based on the need, expertise and resources available.

It is recommended to use ICT, films, YouTube clippings, etc., regularly in the classroom. However, field trips, study tours and industrial visits both short and long are recommended relevant to the units prescribed, whether selected for teaching or not, to provide desired outcome. It is highly recommended that units such as III and V in semester V and Unit VII of semester VI are to be taught in field for experiential learning and not in the classroom. Case studies are to be taught through group discussion, each group consisting of ten students for each case, which will be developed and presented by the teacher with thought provoking approach. The students are expected to do analytical thinking deriving solutions after critical evaluation in the group.

For a creative teacher the open unit can be a most effective tool. The teacher can coin topics giving further in-depth knowledge on need-based topics covered in the syllabus. Teacher also has the liberty to include newly developed area or arriving need in the vicinity under open unit with consent of the Head and the Principal of the Institution.

This syllabus has a few theoretical topics, though most of the topics otherwise are applied.

With Fishery Biology Syllabus focused both on Freshwater and Marine fisheries, a student can choose his or her stream accordingly to ensure better prospects in the career.

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Co-Convenors,
Syllabus Committee.

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T. Y. B.Sc.

(Credit Based Semester and Grading System)
Fishery Biology (Applied Component)
(to be implemented from the Academic Year 2017-2018)

Semester V
Oceanography, Aquaculture Practices, Marketing and Finance

Theory (Any four units to be opted)				
Course	**Unit**	**TOPIC**	**Credits**	**L/Week**
USACFBIO501	1	Oceanography	2	4
	2	Crafts and Gear		
	3	Farming of Major Carps		
	4	Introduction to other Commercial Aquaculture Practices in Fresh Water		
	5	Culture of Shell fishes and Fin-Fish		
	6	Quality Control and Packaging		
	7	Marketing and Finance		
	8	Case Study and Simulation		
Practical				
USACFBIO5P1		Practicals based on Course **USACFBIO501**	2	4

Semester VI
Marine resources, Post-harvest and Farm Engineering

Theory (Any four units to be opted)				
Course	**Unit**	**TOPIC**	**Credits**	**L/Week**
USACFBIO601	1	Marine Fin-fish of India	2	4
	2	Marine Shellfish of India		
	3	Nutrition		
	4	Diseases		
	5	Preservation and Processing		
	6	Byproducts and Value added Products		
	7	Farm Engineering		
	8	Open Unit		
Practical				
USACFBIO6P1		Practicals based on Course **USACFBIO601**	2	4

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Semester V: Theory
Oceanography, Aquaculture Practices, Marketing and Finance
Course code: USACFBIO501

(Any four units to be opted)

Lectures 60
Credits 2

Unit 1: Oceanography

***Objective*:**

- *To study different instruments and equipments in navigation and oceanography*
- *To introduce physical, chemical and biological oceanography*

Desired *outcome:*

- *Learner shall understand and learn about the use of sea safety, navigational equipments and oceanographic instruments*
- *Learner shall understand basic physical, chemical and biological oceanography*

1.1 Navigational and sea safety equipments
i) Life saving devices
ii) Global Positioning System (GPS)
iii) Rudder
iv) Signaling devices

1.2 Oceanographic Instruments
i) Niskin water sampler
ii) Peterson's grab
iii) Dredges
iv) Fish finding instruments / Methods
v) Remote sensing

1.3 Introduction to basic physical, chemical and biological oceanography

Unit 2: Crafts and Gear

Objective:

- *To study the process of boat building, materials used and various types of diesel engines*
- *To study various types of nets used in fishery*

Desired *outcome:*

- *Learner shall comprehend boat building techniques and design of engines used in mechanized boats*
- *Learner shall understand the operations of various types of nets and fishing method*

2.1 Basic boat building (parts, design, material used), methods of protection from foulers and borers

2.2 Basic studies of marine engines:

i) Outboard and Inboard Engines
ii) Sectional View of 2-stroke and 4-stroke Diesel engines
iii) Winch and Deck Side Equipment

2.3 Operations:
i) Gill, Trawl, Purse seine Nets
ii) Hooks and Lines
iii) Non-conventional Fishing Methods such as
- Light Fishing
- Hose Pipe Fishing
- Electric Fishing

Unit 3: Farming of major carps

***Objective*:**
- *To study and develop skills in breeding techniques, hatchery, nursery and management of various carps*
- *To study and explore various techniques used in fishery and poly culture practices*

Desired *outcome*:
- *Learner will understand breeding techniques and skills for culture of major carps*
- *Learner will comprehend hatchery and nursery management of major carps*

3.1 Breeding techniques of major carps and common carp
3.2 Hatchery and nursery management of:
- Major carps:

i) IMCs: *Labeo rohita* (Rohu), *Catla catla* (Catla), *Cirrhinus mrigala* (Mrigal)
ii) Exotic carps: *Hypophthalmichthys molitrix* (Silver carp), *Ctenopharyngodon idella* (Grass carp)
iii) *Cyprinus carpio* (Common carp)

3.3 Mono-culture and polyculture practices:
i) Extensive
ii) Semi-intensive
iii) Intensive

Unit 4: Introduction to other commercial aquaculture practices in fresh water

***Objective*:**
- *To develop skills and understanding of breeding and rearing of sewage-fed fishery, Basa cat fish and Tilapia by novel ways*

Desired *outcome:*
- *Learner will be equipped to carry out entrepreneurial operations or gain confidence to work in freshwater prawn unit*
- *Learner will gain knowledge about how to breed and rear ornamental fishes and commercially viable fish species*

4.1 *Macrobrachium rosenbergii* (Freshwater prawn)

i) Breeding, life cycle, hatchery management
ii) Monoculture of *Macrobrachium rosenbergii*
iii) Composite culture of major carps and *Macrobrachium rosenbergii*

4.2 Ornamental fishes – breeding and rearing:

i) Egg layers:
- *Danio spp.* (Danio)
- *Pterophyllum spp.* (Angel)
- *Symphysodon spp.* (Discus)
- *Paracheirodon innesi* (Neon tetra)
- Flower horn (Hybrid variety)
- *Betta splendens* (Siamese fighter)

ii) Live bearers:
- *Poecilia reticulate* (Guppy)
- *Xiphophorus hellerii* (Swordtail)
- *Poecilia velifera* (Tangerine)
- *Poecilia sphenops* (Molly)
- *Xiphophorus maculatus* (Platy)

4.3 Breeding and rearing of:

- Sewage-fed fishery of air breathing fish: *Pangasianodon hypophthalmus* (Striped catfish), *Clarius spp.*, *Heteropneustes spp.* and *Anabas spp.*
- *Pangasius bocourti* (Basa Catfish)
- All meal (Less bones) *Tilapia* – GIFT (Genetically Improved Farmed *Tilapia)*

Unit 5: Culture of shell fishes and fin-fish

***Objective*:**

- *To study breeding techniques, hatchery and management of fin-fish and shell fishes*
- *To study rearing practices of fin-fish and shell fishes*
- *To study culture of brackish water shrimp*

Desired *outcome:*

- *Learner shall understand breeding techniques, hatchery and management of fin-fish and shell fishes*
- *Learner shall understand the rearing techniques*

5.1 Breeding, hatchery, nursery management and rearing (extensive, semi-intensive, intensive)

i) Fin-fish – *Lates calcarifer* (Sea bass)
ii) *Litopenaeus vannamei* (Brackish water prawn or Pacific white shrimp)
iii) *Scylla serrata* (Giant mud Crab)
iv) *Pinctada vulgaris* (Pearl)

Unit 6: Quality control and packaging

***Objective*:**

- *To comprehend various aspects of quality control and packaging involved in fish processing and marketing*

Desired *outcome:*

- *Learner will be oriented towards understanding the various stages of quality control*
- *Learner will gain knowledge about the postmortem changes, spoilage mechanisms and methods involved in evaluating the freshness and quality of fishes and prawns / shrimps*
- *Learner shall comprehend the value of maintaining and taking sanitary precautions during the processing and packaging operations*

6.1 Post mortem changes and mechanism of spoilage:

i) Hyperaemia
ii) Rigor mortis
iii) Autolysis
iv) Rancidity

6.2 Brief methods for evaluating freshness and quality of fish and prawns / shrimps

i) Organoleptic
ii) Microbial
iii) Chemical

6.3 Sanitary operations

i) Maintenance of hygiene of food contact surfaces, storage and equipment
ii) Water quality, ice, sewage and waste water disposal and effluent treatment plant

6.4 Various packaging materials used in freezing and canning industry

i) Polyolefin
ii) Wax duplex carton
iii) Master carton
iv) Can
v) Lacquered can
vi) Retort
vii) Freezing procedures including hygienic washing, dressing

6.5 Quality Policy and Quality Analysis: ISO 22000/HACCP/ BRC/IFS

Unit 7: Marketing and finance

***Objective*:**

- *To acquaint and instill knowledge of the fundamentals of marketing and finance required for entrepreneurship in fishery related enterprises and co-operatives*

Desired outcome:

- *Learner shall acquire knowledge about traditional marketing practices and role of co-operatives in selling fish*
- *Learner shall be exposed to the avenues and procedure for raising funds for*

fishery related entrepreneurial practices

7.1 Traditional marketing vis-a-vis role of fishery co-operatives with reference to operations at Satpati, Sasoon dock and Karanja
7.2 Global marketing and Export-Import procedures and role of Marine Products Exports Development Authority (MPEDA)
7.3 i) Fund raising:

- Financial institutions
- Schemes and subsidies
- Basic accounting
- Costing and feasibility report

ii) Role of NABARD (National Bank for Agriculture and Rural Development) for refinancing and NFDB (National Fishery Development Board, Hyderabad) for funding through the State Government

Unit 8: Case Study and Simulation

Case Study and Simulation is one of the eight units and hence may or may not be opted by the college. If opted, teachers in consultation with the students shall select the case studies for this unit every year, if required, and shall seek endorsement of the Head and the Principal.
Colleges/ Institutes have to select the topics as per their needs and available resources. It is pertinent to note that the case studies and simulations shall be operational and available in the syllabus only till it comes under the scope of internal assessment.

Objective:

- *To inculcate entrepreneurial abilities and skills so as to make the learner confident and prepare them to raise new projects and venture in the realm of fishery biology*
- *To understand the concepts and to develop the acumen of the learner in a better way*
- *To assess varying dimensions while taking decisions in fishery biology*

Desired outcome:

- *Learner will gain technical and financial knowledge in fishery biology business ventures*
- *Learner will develop better acumen so as to take wise and necessary decisions while participating in fishery biology related projects*

(Any eight from suggested below or more, developed by teacher)

a) Sawantwadi New Fish Market developed through NFDB funding
b) Trilok foods, an RTE industry established as PPP through DST funding
c) Sewage-fed fishery; Kolkata model
d) Pancham Aquaculture
e) Naik Oceanic
f) Aquaponics, Hydroponics
g) Mahseer Ranching at Dehu

h) Integrated fish farm goatery, piggery, poultry, dairy, etc.
i) Juchandra Village

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Semester V Practicals
Course code: USACFBIO5P1

2 Credits

1) Identification and functioning of oceanographic instruments:
   - Niskin water sampler
   - Peterson's Grab
   - Dredge

2) Layout of fishing vessels and sectional view of 2 stroke and 4 stroke diesel engines, lifesaving equipment, winch and deck side equipment.

3) Identification of various stages of development of carps and study of sexual dimorphism in adults.
   Indian major carps:
   - *Labeo rohita* (Rohu)
   - *Catla catla* (Catla)
   - *Cirrhinus mrigala* (Mrigal)

   Exotic carps:
   - *Cyprinus carpio* (Common Carp)
   - *Hypophthalmichthys molitrix* (Silver Carp)
   - *Ctenopharyngodon idella* (Grass Carp)

4) a) Identification of *Litopenaeus vannamei* (Pacific white shrimp) and *Macrobrachium rosenbergii* (Freshwater prawn)
   b) Study of sexual dimorphism in adults.

5) Identification of fishes:
   - *Anabas testudineus* (Climbing perch)
   - *Clarius batrachus* (Walking catfish)
   - *Boleophthalmus spp.* (Mudskipper)
   - *Pangasianodon hypophthalmus* (Iridescent shark)
   - *Pangasius bocourti* (Basa catfish)
   - *Tilapia*(GIFT)

6) Identification of:
   A) Ornamental fishes:
      - *Pterophyllum spp.* (Angel)
      - *Xiphophorus hellerii* (Swordtail)
      - *Paracheirodon innesi* (Neon tetra)
      - *Betta splendens* (Siamese fighter)
      - *Danio spp.* (Danio)
      - *Symphysodon spp.* (Discus)

- Flower Horn (Hybrid variety)

B) Aquatic plants:
- Ludwigia
- Cabomba
- Corkscrew *Vallisneria*
- Aquarose
- Amazon Sword plant

C) Aquarium accessories:
- Aerator
- Under Gravel Filter
- Internal Filter
- External / Canister Filter
- Food dispensers

7) Study of models and functioning of D 81 hatchery, Shirgur's hatcheries and Chinese hatchery.

8) Microbial studies:
   i. Dilution of sample
   ii. Gram staining technique
   iii. Identification of Bacilli, Cocci, Vibrio bacteria

9) Organoleptic tests for fish and prawn / shrimp

10) Total Plate Count (TPC) of bacteria from fish.

11) Identification of packaging materials:
- Waxed duplex carton
- Master carton
- Simple cans
- Coated [Lacquered] cans
- Polyolefin
- Retort

12) Estimation of toxins and moulting retardant
- H_2S (qualitative)
- Ammonia (qualitative)
- Ca (quantitative)
- Mg (quantitative)

13) Photographic documentation of fishery biology related topics.

Submission of ~~5~~ hard and soft copies of 5 original photographs taken by the learner (exif details required).

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

Please refer the Annexure I for the suggested topics for assignment for Course code USACFBIO5P1.

***Note – The practicals may be conducted by using specimens authorized by the wild life 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 regulation of the relevant monitoring bodies. No new specimens, however, shall be procured for the purpose of conducting practicals mentioned here-in above.**

N.B:

I) It is pertinent to note that we have to adhere strictly to the directions as given in the UGC Circular F14-4/2006 (CPP-II).

II) Apart from the Institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority / Body from time to time, every college should constitute the following Committees:

1) A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and

2) A Dissection Monitoring Committee (DMC) to ensure that no dissections or mountings are done using animals.

Composition of DMC shall be as follows:

i) Head of the Concerned Department (Convener / Chairperson)
ii) Two Senior Faculty Members of the concerned Department
iii) One Faculty of related department from the same College
iv) One or two members of related department from neighbouring colleges.

USE OF ANIMALS FOR ANY EXPERIMENT /DISSECTION /MOUNTING IS BANNED. SIMULATIONS, AUTHORIZED PERMANENT SPECIMENS/SLIDES, CHARTS, MODELS AND OTHER INNOVATIVE METHODS ARE ENCOURAGED.

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Semester VI: Theory
Marine resources, Post-harvest and Farm Engineering
Course code: USACFBIO601

(Any four units to be opted)

Lectures 60
Credits 2

Unit 1: Marine Fin-fish of India

***Objective*:**

- *To study coastal and deep sea fishes*
- *To study commercial potential and major landing centres*

Desired *outcome:*

- *Learner shall understand deep sea and coastal fishes.*
- *Learner shall understand commercial potential and know about the major landing centres of the fishes*

1.1 Coastal fisheries:

i) *Stromateus cinereus* (Silver pomfret)
ii) *Stromateus niger* (Black pomfret)
iii) *Polynemus tetradactylus* (Threadfin)
iv) *Pseudosciaena diacanthus* (Two-spined Jewfish or Ghol)
v) *Synagris japonicus* (Blackmouth splitfin)
vi) *Scomber microlepidotus* (Mackerel)
vii) *Cybium guttatum* (Seerfish or Surmai)
viii) *Sardinellal ongiceps* Indian Oil Sardine

1.2 Deep sea fisheries (more than 45 fathoms) of Indian exclusive economic zone

- *Thunnus alalunga* (Longfin tuna)
- *Sarda orientalis* (Striped bonito)

1.3 Commercial potential and major landing centres of the above fishes

Unit 2: Marine shell fish of India

***Objective*:**

- *To develop an in-depth understanding of crustacean and molluscan fisheries*

Desired outcome:

- *Learner shall understand crustacean and molluscan fisheries*
- *Learner shall understand the performance of landing centres of above fisheries*

2.1 Crustacean fisheries

i) *Penaeus monodon* (Giant tiger prawn)
ii) *Penaeusn ndicus* (Indian prawn)
iii) *Metapenaeus affinis* (Jinga shrimp)
iv) *Parapenaeopsis stylifera* (Kiddi shrimp)

v) Acetes indicus (Jawala paste shrimp)
vi) Panulirus polyphagus (Mud spiny lobster)
vii) Scylla serrata (Giant mud crab)

2.2 Molluscan fisheries
i) Crassostrea spp. (Oyster)
ii) Sepia pharaonis (Pharaoh cuttlefish)
iii) Loligo duvaucelii (Indian squid)

2.3 Commercial potential and major landing centres of the above shell fishes

Unit 3: Nutrition

***Objective*:**

- *To study, acquaint and discover the growing market for fish nutrition*

Desired *outcome:*

- *Learner will get acquainted with basics of nutritional requirements at various developmental stages of fish and crustaceans*

3.1 Nutritional requirements at various stages of development of fish and crustaceans
3.2 Culture of natural feed:
i) *Chaetoceros*
ii) *Infusoria*
iii) Artemia
iv) Brachionus
v) Daphnia / *Moina spp.*
3.3 Algology – Identification and culture of commercially important nutritious algae and its products
3.4 Formulated / Pelleted feed – Understanding the composition and use of formulated feed for fish and prawns / shrimps at various stages

Unit 4: Diseases

***Objective*:**

- *To acquire knowledge of the various aspects of diseases affecting fishes*

Desired *outcome:*

- *Learner will be oriented towards understanding causes, pathogenicity, prophylaxis and preventive measures of various fish diseases and physiological disorders*

4.1 Viral diseases, prophylaxis and preventive measures
4.2 Bacterial, fungal, protozoan infections and treatment
4.3 Crustacean infections and treatment
4.4 Physiological disorders (Dropsy) / diseases and treatment

Unit 5: Preservation and Processing

***Objective*:**

- *To derive knowledge about various fish preservation and processing methods*

Desired *outcome:*

- *Learners will acquire the knowledge and would put in to practice the preservation and processing techniques for commercial ventures*

5.1 Traditional methods and their modifications:
i) Icing
ii) Drying
iii) Salting
5.2 i) Introduction to refrigeration: Types and properties of refrigerants
i) Types of freezers:
a. Brine
b. Air blast
c. Tunnel
d. Contact plate
e. Cryo-quick
f. IQF: Individual Quick Freezing
ii) Freezing Procedures:
a. PUD (Peeled and Un-deveined)
b. DV (Deveined)
5.3 Principle and steps involved in can reform and canning of fish and shrimp in various media.
5.4 Equipment and utensils used in seafood processing

Unit 6: By-products and Value Added Products

***Objective*:**

- *To acquire knowledge of fish by-products, value-added products and good manufacturing practices*

Desired *outcome:*

- *Learner will gain sound knowledge about the fish by-products and value-added products*
- *Learner will explore good manufacturing practices while manufacturing these products*

6.1 Proximate composition of fish meat and products
6.2 Introduction to by-products
i) Fish protein concentrate
ii) Fish maws / Isinglass
iii) Fish hydrolysates
iv) Chitin, Chitosan
v) Glucosamine hydrochloride
vi) Gelatin
vii) Fish silage

viii) Surimi and imitation products
ix) Pearl essence

6.3 Different types of value added products from fish and shell fish
i) Fish / Prawn / Shrimp pickle
ii) Fish wafers
iii) *Acetes indicus* (Prawn) chutney
iv) Fish soup powder
v) Fish / Crab steaks
vi) RTE (Ready To Eat)
vii) Battered and breaded products
viii) Marinated tandoori prawns
ix) Prawn curry

6.4 Good manufacturing practices: Health and training of personnel, hygiene

Unit 7: Farm engineering

***Objective*:**

- *To acquire knowledge about farm engineering and novel fish culture practices*

Desired *outcome:*

- *Learner will understand the selection process of hatchery sites and various types of designs and construction of aquaculture farm practices*
- *Learners will comprehend the uses of equipment and accessories involved in aquaculture farms*

7.1 Site selection, designing and construction of hatchery and farms for extensive, semi-intensive and intensive freshwater / brackish-water aquaculture

7.2 i) Raft culture
ii) Rope culture
iii) Pen culture
iv) Cage culture with special reference to *Rachycentron canadum* (Cobia)

7.3 Equipment and accessories used in various aqua farms

Unit 8: Open Unit

Open unit is one of the eight units which may or may not be opted by the college. Teachers in consultation with the students shall define syllabus under this unit every year, if required, and shall seek endorsement of the Head and the Principal.

Colleges/institutes have to select the topics as per their needs and available resources. It is pertinent to note that the open unit shall be operational and available in the syllabus only till it comes under the scope of internal assessment.

Objective:

- *To teach any one of the units prescribed in the syllabus with more details and in-depth knowledge leading to specialization in the capsule of units selected.*
- *To incorporate the topics of special need of the area which are otherwise not covered in the syllabus.*

- *To give scope to creativity and wisdom of a teacher who wants to deal with the latest developments in the subject without waiting for the university to revise the syllabus.*

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Semester VI Practicals
Course code: USACFBIO6P1

Credits 2

1) Identification of marine fishes.
    - *Stromateus cinereus* (Silver pomfret)
    - *Stromateus niger* (Black pomfret)
    - *Polynemus tetradactylus* (Threadfin)
    - *Pseudosciaena diacanthus* (Two-spinned jewfish or Ghol)
    - *Trichiurus haumela* (Ribbon fish)
    - *Synagris japonicus* (Blackmouth splitfin)
    - *Scomber microlepeidotus* (Mackerel)
    - *Cybium guttatum* (Seerfish or Surmai)
    - *Sardinella longiceps* (Indian Oil Sardine)
    - *Thunnus alalunga* (Longfin tuna)

2) Identification of Crustaceans and Molluscs.
    - *Penaeus monodon* (Giant Tiger Prawn)
    - *Metapenaeus affinis* (Jinga shrimp)
    - *Parapenaeopsis stylifera* (Kiddi shrimp)
    - *Acetes indicus* (Jawala paste shrimp)
    - *Panulirus polyphagus* (Mud spiny lobster)
    - *Scylla serrata* (Giant mud crab)
    - *Crassostrea spp.* (Oyster)
    - *Sepia pharaonis* (Pharaoh cuttlefish)
    - *Loligo duvaucelii* (Indian squid)

3) Preparation of formulated feed for fish and prawn.

4) Identification of parasitic infections in aquatic organisms.
    - Fungal – Dermatomycosis
    - Bacterial – Fin/Tail rot and Dropsy
    - Protozoan – Costiasisand White Spot
    - Crustacean – Argulosis

5) Fish dressing, filleting, prawn peeling – PUD, DV and grading.

6) Fish morphometry – Length weight relationship of a suitable fish.

7) Preparation of Surimi, Fish protein concentrate.

8) Preparations of fish burger, fish fingers, fish/prawn pickle, fish chutney, fish curry.

9) Preparation of Chitin – Chitosan, Pearl essence.

10) Identification of various farm equipment such as:
- Feeding cups / Trays
- Paddle wheel aerator
- Fountains
- Sluice gate models
- Elbow pipe outlets

11) Study of models of raft, pen, cage culture and materials used in rope culture.

12) Project – Feasibility / Scientific.

13) Field Visit Report.

Please refer the Annexure II for the suggested field visits and Annexure – III for suggested topics for projects for Course code USACFBIO6P1.

***Note – The practicals may be conducted by using specimens authorized by the wild life 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 regulation of the relevant monitoring bodies. No new specimens, however, shall be procured for the purpose of conducting practical mentioned here-in above.**

N.B:
I) It is pertinent to note that we have to adhere strictly to the directions as given in the UGC Circular F14-4/2006 (CPP-II).
II) Apart from the Institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority / Body from time to time, every college should constitute the following Committees:

1) A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and
2) A Dissection Monitoring Committee (DMC) to ensure that no dissections or mountings are done using animals.

Composition of DMC shall be as follows:

i) Head of the Concerned Department (Convener / Chairperson)
ii) Two Senior Faculty Members of the concerned Department
iii) One Faculty of related department from the same College
iv) One or two members of related department from neighbouring colleges.

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USE OF ANIMALS FOR ANY EXPERIMENT /DISSECTION /MOUNTING IS BANNED. SIMULATIONS, AUTHORIZED PERMANENT SPECIMENS/SLIDES, CHARTS, MODELS AND OTHER INNOVATIVE METHODS ARE ENCOURAGED.

References and Additional Reading
USACFBIO501 & USACFBIO601

1) A Text Book of Marine Ecology by Nair M.B. and Thumpy D.H. – Tata MacGraw Hill Pub. – New Delhi.
2) An Introduction to Fishes by Khanna S.S. – Central Book Depot, Allahabad (1993).
3) Aquaculture, Principles and Practices by Pillay T.V.R. – Fishing New Books (1988).
4) Course Manual in Fishing Technology by Latha Shenoy, CIFE, Versova, Mumbai.
5) Crafts and Gear of India by Y. Shrikrishnan and Latha Shenoy – ICAR Pub.
6) Ecological Methods for Field and Laboratory Investigations by P. Michael. The Oceans By Svedrup H.V. – et.al. - Asian Pub. House.
7) Financial management by Prasanna Chandra- Seventh Edition.
8) Financial management by Khan and Jain.
9) Financial management by I. M. Pandey.
10) Fish Biology by C.B.C. Srivastava – Narendra Pub. House.
11) Fish and Fisheries by Chandy – National Book Trust.
12) Fish and Fisheries in India – by Jhingran V.G. – Hindustan Pub. Corporation – New Delhi.
13) Fisheries Biology, Assessment and Management by Michael King – Fishing News Publishers (1995).
14) Fishery Science by Samtharam R. – Daya Pub. House – 1990.
15) Fisheries Bioeconomics – Theory, Modelling and Management – FAO Fisheries Technical Paper 368 – FAO, 2001.
16) General and Applied Ichthyology by Gupta and Gupta, S Chand Publishers.
17) Handbook of Fish Biology and Fisheries Edited By J.B. Hart and John Reynold.
18) Hand Book of Fresh Water Fishes of India by Beaven C.R. – Narendra Pub. House.
19) Introductory Oceanography by Harold Thurman – Printis Hall Pub. London – 8th Edition.
20) Marine Ecology by Tait R.B. – Oxford Press.
21) Marine Fish and Fisheries by Dr. D. V. Bal and K.V. Rao - Tata MacGraw Hill Pub. – New Delhi.
22) Marketing Management by Philip Kotler.
23) Modern Fishing Gear Technology by N. Shahul Hameed, Boopendranath – Daya Pub. House – 2000.
24) Prawn and Prawn Fisheries by Kurian and Sebestian.
25) Project Management by Prasanna Chandra.
26) Refrigeration and air conditioning By C. P. Arora published in 1981.
27) Technology for forming of Pacific White Shrimp *Litopenaeus vannamei* in inland saline soils using ground saline water by Lakra, Reddy and Harikrishna, CIFE and ICAR.
28) Text Book of Fish Biology and Indian Fisheries by Dr. R. P. Parihar, Central Pub. House, Allahabad.
29) The Book of Indian Shells by Deepak Apte – Oxford Uni. Press.
30) Wealth of India – Vol. IV – CSIR Pub.

For Additional and Latest Information on the topics, various Web Sites can be visited.

SCHEME OF EXAMINATION (THEORY & PRACTICAL)

a) Internal assessment of twenty five (25) marks per course per semester should be conducted according to the guidelines given by University of Mumbai vide circular number UG/04 of 2014 Dated 5th June 2014 to be implemented from academic year 2014-15.

b) External assessment of seventy five (75) marks per course per semester should be conducted as per the following skeleton question paper pattern.

c) One practical examination of one hundred (100) marks per course each should be conducted at the end of every semester.

Modality of Assessment:
Theory Examination Pattern:

A) Internal Assessment - 25% **25 marks**
Internal Assessment: Theory 25 marks

Sr No	Evaluation type	Marks
1	Class test to be conducted as per following pattern a) Match the column/Fill in the blanks/Multiple Choice Questions(1/2 mark each) (5 marks) b) Five questions of answer in 1 or 2 lines(Concept based questions) (5 marks) c) Answer in brief (Attempt any 2 out of the 3) (10 marks)	20
2	Overall conduct as a responsible student, manners, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	05

B) External examination - 75 %
Semester End Theory Assessment - 75% **75 marks**

1) Duration - These examinations shall be of two and half hours duration.
2) Theory question paper pattern:
   i. Q. 1 shall comprises 16 short notes (14 if case studies/open unit is not opted) representing all the units in the syllabus equally, of which students are expected to solve any five.
   ii. All questions carry equal marks i.e. 15 marks each with an internal option of 30 marks.
   iii. Each question from Q2 to Q9 (Q8 if case studies/ open unit is not opted) shall have the following pattern.

Q2 to Q9 A) **(15)**

OR

Q2 to Q9 B)
i) **(7)**
ii) **(8)**

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Practical Skeleton Paper Course code: USACFBIO5P1

Time: 4 hours **Total Marks: 100**

Q. 1 Identification **20**

Identify spots 'a' to 'e' as per instructions

a) Identify and describe the oceanographic instrument / 2-stroke / 4-stroke engine.
b) Identify and describe lifesaving equipment / deck side equipment
c) Identify and describe accessory respiratory organ / ornamental fish / aquarium plant.
d) Identify and describe the aquarium accessory.
e) Identify and describe the packaging material.

Major Experiment

Q. 2 Perform organoleptic tests to differentiate fresh and stale fish and prawn. **25**

Minor Experiment

Q. 3 Prepare various dilutions of the given sample of bacteria. **15**
OR
Q. 3 Quantitative estimation of Calcium / Magnesium from the given water sample. **15**
OR
Q. 3 Qualitative estimation of NH_3 and H_2S from the given water sample. **15**
OR
Q. 3 Identify the given bacteria with the help of Gram's Staining technique. **15**

Q. 4 a. Submission of five photographs on relevant topics of fishery biology. **10**
b. Submission of assignment and viva based on it. **20**

Q. 5 Certified journal. **10**

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Practical Skeleton Paper Course code: USACFBIO6P1

Time: 4 Hours **Total Marks: 100**

Q.1Identification **20**

Identify spots ‘a’ to ‘e’ as per instructions

a) Identify and describe the given fish w.r.t. fishery
b) Identify and describe the given crustacean / mollusc w.r.t. fishery
c) Identify and describe the pathogen and its prevention and treatment of the given specimen.
d) Identify and describe farm equipment / model / material.
e) Identify and describe byproducts chitosan / chitin / pearl essence.

Major Experiment

Q. 2 Prepare the marked by-product / value-added product with suitable method: Surimi / Fish Protein Concentrate / Fish Burger / Fish or Shrimp Pickle / Chitin / Chitosan. **25**

Minor Experiment

Q. 3 Determine the fish morphometry – Length weight relationship of a suitable fish. **15**

OR

Q. 3 Demonstrate the technique of fish dressing and filleting. **15**

Q. 4 Project and viva based on it. **20**

Q. 5 Field report **10**

Q. 6 Certified journal **10**

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Annexures
Annexure -I

Suggested Topics for Assignment USACFBIO5P1 (Teachers are expected to develop additional innovative topics, varying every year, to be assigned to the students)

1) Market survey for various preserved and processed fish / prawns.
2) Observation on handling of fish on board, at landing centre, in secondary market and at consumer level.
3) Survey of the local market for the availability of various by-products / value added products and its price.
4) Comparative study of the shelf life of various fishes / fish by-products / value added products in relation to their cost.
5) Study of economics of brackish water pond culture.
6) Study of working of fisheries co-operative societies in your area.
7) Study of cost of construction of fishing vessel and subsidies available for the same.
8) Study of cost of gear manufacturing with different materials and subsidies available for the same.
9) Study of cost and profit analysis of any one of the following methods – Trawler / Gill netter / Purse seiner /hooks and lines and Non-mechanized fishing units.
10) Survey of various packaging materials used in fish processing industries.
11) Survey of various feeds used in local aqua farms.
12) Study of economics of pond culture from nearby area.
13) Comparative cost analysis of fingerlings of major carps from your area.
14) Setting up of marine / fresh water aquarium with various accessories and its costing.
15) Survey of costing of aquaria of different sizes and shape.
16) Study of various courses run by Institutes in your area in relation to fisheries.
17) Survey of aquarium shops to compare the costs of various aquarium fishes.
18) Study of economics involved in breeding / rearing of aquarium fishes.
19) Review of different marketing strategy (w.r.t. attracting target clients) used by manufacturers of fish products / byproducts / value added products.

20) Survey of target clients of manufacturers of fish products / byproducts / value added products.
21) Study of working of financial institutions involved in funding fishing industry.
22) Review of export import procedures followed by the fishing industry in your area.

All the topics mentioned above are suggestive in nature and more creative and innovative topics are expected from the students under the able guidance of concerned teachers, 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.

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Annexure - II

Suggested Field Visits USACFBIO6P1

- 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 and exposure to technology / production / functioning of an organization / unit or witness a relevant activity.

- Each student must make at least 01 (one) such visits to the units/markets/sea shores out of 2 to 3 such visits organized by the college.

- **The list is suggestive and not exhaustive**

I) Visit to one of the units with one or multiple activities such as:
- Ornamental / Brackish water / Fresh water fish farm / hatchery

II) Visit to witness one of the activities such as
- Fish angling / trawling / purse seining / gill netting
- Fish finding operations, etc. (Echo Sounder / Sonar / Fish Magnifier)

III) Visit any production units such as
- Food / Fish processing and preservation
- Ornamental articles

IV) Hi-tech and multinational total export oriented units such as
- IQF plant
- Surimi plant
- Fishery plant
- Microbiological units
- Hi–tech fish / prawn / chick hatcheries
- Fish consumer product industries

V) Others –
- Self-Sale Groups
- Co-operative Societies

VI) Govt. Offices such as
- Fishery Department
- MPEDA
- Wild-life Authority

- CITES
- JDEI (Jt. Director-Export and Import)
- Sales Tax
- Income Tax
- Excise Department
- Customs Authority of India
- Local Self Govt. (BMC)
- Clearing Agencies / Agents
- FDA
- ISI
- Agmark, etc.

VII) Visit any ancillary unit such as

- Ice plant
- Can reforming
- Packaging
- Cold storage

VIII) Visit to National Laboratories, National Research Labs and Training Institutes such as NIO, CIFE, CMFRI, CIFT, FSI, IFP, CIFI, CIFNET, NBFGR, etc.

IX) Following places may be considered for short/long excursions:

MUMBAI DISTRICT:

- Versova Beach/Fish landing centre
- Girgaum Chowpatty
- Sassoon Dock, Colaba
- Ferry Wharf (Bhaucha Dhakka)
- Taraporevala Marine Biological Research Station, Bandra (East)
- Manori beach

THANE DISTRICT:

- Uttan

PALGHAR DISTRICT:

- Arnala Beach and Fishermen co-op. society
- Satpati (also multipurpose fisherman co-operative society)
- Kelwa beach (Datiware / Tembhi)
- Rangaon fish landing centre (Vasai)
- Dahanu (Narpad / Varor fish landing centre)

RAIGAD DISTRICT:

- Alibaug
- Karanja
- Shriwardhan

- Uran creek
- NhavaSheva Port (JNPT) / Jawaharlal Nehru Custom House

RATNAGIRI DISTRICT:

- Ganpatipule beach
- Dapoli (Harnai / Harne Port Fish Auctioning)/ Dabhol / Burondi
- Mirkarwada Harbour (Major fish landing and assembling centre, Ratnagiri)
- Rajiwada (Satellite landing centre, Ratnagiri town)
- Guhagar beach (Use of Solunar Clock for fishing)
- Karla (Ratnagiri) – First Fisherman co-operative society of India (Estd. 1913)
- Marine Biological Research Station, Zadgaon, Ratnagiri (Aquarium Management Training Programme)
- Sangameshwar, Lanja, Rajapur

SINDHUDURG DISTRICT:

- Vengurla
- Malvan
- Deogad
- Anandwadi fish landing centre
- Sawantwadi
- Kankavali
- Sarjekot
- Tarkarli beach

Outside Maharashtra:

- Pirotan Island Marine Park (Jamnagar, Gujarat)
- Lakshwadeep Islands
- Andaman and Nicobar Islands
- The Cochin Fisheries Harbour (Cochin, Kerala)
- Veraval
- Maldives

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Annexure III

Suggested Topics for Project USACFBIO6P1 (Teachers are expected to develop additional innovative topics, varying every year, to be assigned to the students)

1) Feasibility report of the maintenance of aquarium fishes in high profile residences.
2) Feasibility report of fresh water / brackish water fish / prawn culture for extensive, semi intensive and intensive.
3) Probability report of maintenance of a culture of *Chaetopteros*and*Artemia* by the fish farmers.
4) Project report for the establishment of small / medium / large scale ice factory, freezing and canning industry.
5) Feasibility report of various packaging materials in freezing / canning industry.
6) Feasibility report for establishing an aquarium shop.
7) Feasibility report for establishing a fish feed industry.
8) Monitoring various physico-chemical parameters of an aquarium / pond / lake / river / sea.
9) Feasibility report for establishing value added products of fish / shell fish.
10) Project report for culture of commercially important nutritious algae and its products.
11) Project report on survey of fish markets for fluctuation in the availability and price of fishes.

The project may be submitted in a group not exceeding three students.

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Annexure IV
Learners' space

When education system today has identified special needs of slow learners we are still silent about needs of high IQ students. Teachers are therefore recommended to identify and encourage such students to undertake research with a view to publish paper/s in peer reviewed International Indexed Journals with high impact factor thus providing 'learners' space'.

Some of the suggestive avenues are listed below which can certainly be not exhaustive since the said students under the guidance of teachers can identify latest areas of research. Needless to say that 'learners' space" is optional additional activity which may not be undertaken by college if not befitting.

1. Developing statistical model for forecasting fish landing of prominent fishes.
2. Undertaking physicochemical oceanographic research at the established centres in the deep sea preferably in collaboration with reputed research institutes.
3. Addressing issues of marine oil pollution.

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Annexure – V
Play and Ponder

While learner's space is for high IQ Students, play and ponder could be a general activity creating interest in the subject and could also be a part of pedagogy wherein it may be considered as innovative teaching methodology.

Following are some of the suggestive activities though of course teachers can creatively develop more in the years to develop.

1. Making different fishery gears (nets).
2. Setting up an aquarium in laboratory.
3. Preparation of Prawn pickle and Fish pickle and obtaining feedback from 10 students and 5 teachers.
4. Preparation of fish poultry feed using waste from fish market (fish scales, crab shell, prawn shell, viscera, gills, operculum etc.)

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Model Question Paper USACFBIO501

Duration: 2.5 Hours **Total marks: 75**

N.B.: 1) Question No. 1 is compulsory.
2) Attempt any four questions from question No. 2 to question No. 9.
3) Draw neat and labelled diagrams wherever necessary.

Q. 1] Write notes on <u>any 5</u> of the following (Mixed questions from all units): 15

a) Niskin water sampler
b) Dredges
c) Gill net
d) Hooks and lines
e) IMC
f) Advantages of induced breeding in carps
g) Monoculture of Giant freshwater prawn
h) GIFT
i) Physical features of *Lates calcarifer*
j) Pearl bank in India
k) Master carton
l) Polyolefin
m) Feasibility report.
n) Major export markets of sea-food
o) _____ (if case study is opted)
p) _____ (if case study is opted)

Q. 2 Question based on Unit 1

Q. 2 A] With reference to oceanography describe working of GPS. Add a note on Life Saving Devices. **15**

OR

Q. 2 B] Explain the following:

(i) Rudder **7**
(ii) Peterson's grab **8**

Q. 3 Question based on Unit 2

Q. 3 A] Give an account on Wood as a Boat-Building material. Add a note on 4-stroke engine. **15**

OR

Q. 3 B] Explain the following:

(i) Structure and operation of trawl net **7**
(ii) Non-conventional methods of fishing **8**

Q. 4 Question based on Unit 3

Q. 4 A] Write an account on Semi intensive polyculture practice in India. Add a note on extensive fish farming. **15**

OR

Q. 4 B] Explain:

(i) Nursery management of *Cirrhinus mrigala* **7**

(ii) Breeding techniques in Indian Major Carps **8**

Q. 5 Question based on Unit 4

Q. 5 A] Describe the Breeding of Neon tetra and Flower Horn. **15**

OR

Q. 5 B] Describe breeding and rearing of:

(i) Air breathing fishes **7**

(ii) *Macrobrachium rosenbergii* **8**

Q. 6 Question based on Unit 5

Q. 6 A] Discuss the following w.r.t. commercial aquaculture cultures of *Litopenaeus vannamei and Scylla serrata* **15**

OR

Q. 6 B] Discuss the following:

(i) Food and Feeding habit of *Lates calcarifer* **7**

(ii) Pearl culture **8**

Q. 7 Question based on Unit 6

Q. 7 A] Explain Organoleptic tests to detect quality of fish along with Chemical methods to detect freshness of fish **15**

OR

Q. 7 B] Explain the following:

(i) Autolysis and Hyperaemia **7**

(ii) Rigor mortis in fish **8**

Q. 8 Question based on Unit 7

Q. 8 A] With reference to marketing and finance discuss operation of fishery cooperative society in your district. Add a note on basic accounting and costing in fisheries. **15**

OR

Q. 8 B] With reference to fishery sector describe:

(i) Global fish marketing strategies **7**

(ii) Role of MPEDA **8**

Q. 9 Question based on Unit 8

Q. 9 A] Question based on case study / simulation (if opted).

15

Case Study: Cage Culture of *Tor khudree in* River Indrayani at Dehu, Pune, India.

Dehu is an ancient town located near Pune, on the banks of the Indravati River and is famous as the birth place of the poet Saint Tukaram. At Dehu just behind the Gatha

Mandir there was a *Matsya doha.* It was like a fish sanctuary where pilgrims enjoyed feeding the Mahseer.

Mahseer is a world famous, outstanding game fish found all along the Himalayan Belt inhabiting different rivers throughout the length and breadth in India, Pakistan, Bangladesh, Sri Lanka and even Thailand. Despite of their abundance at one time, the Mahseer population has been declining in number and size in natural waters and is in serious danger of extinction in India. Six valid species and three subspecies of Mahseer are found in various river systems of India. Out of these, three species are declared as endangered by IUCN. Due to water pollution and river valley projects in Maharashtra, the Deccan Mahseer (*Tor khudree and T. musselah*) have been decimated from Bhima, Krishna and Koyna river systems.

Mahseer fish has religious touch. The villagers of Dehu call Mahseer as ~~a~~ God-fish. In 1982, because of decreased water levels due to indiscriminate pumping and illegal release of obnoxious industrial effluents into the river, the entire population of fish in the river got wiped out. According to villagers in one week 17 truckloads (Approx. 25.5 tonnes) of dead Mahseer were taken in procession and their last rites were performed according to Hindu tradition. According to the local fishermen at Dehu, the dead Mahseer fish were about the size of a buffalo. It was one of the fish species which supported the livelihood of tribals in that area. Therefore, there was an urgent need of restoration and conservation of Mahseer in this stretch of Indrayani River.

Friends of Nature Association (FoNA), an NGO made efforts and ultimately succeeded in bringing the fish back from the brink of extinction. Shashank Ogale, a senior fisheries scientist and head of corporate social responsibility and environment at Tata Power gave expert advice on the project. It was funded by the Central Institute of Fisheries Education and sanctioned by the National Fisheries Development Board. The fish were bred in artificial tanks, till they were two-three inches long. They were then put in cages and immersed in the river. When they were acquainted with the pressure and temperature of the polluted waters, they were released. The process ~~is~~ was repeated periodically.

Culture of *Tor khudree* in cages was carried out in the Indrayani River. Initially, a survey of the water quality parameters and flow of the river from Dehu to downtown to ascertain its suitability was conducted. Based on the survey and availability of water level, the site was finalized behind the Gatha Mandir at Dehu (18.72°N 73.77°E), where the cages could be installed. This experiment was conducted in floating net cages made up of HDPE with 3m X 3m X 3m dimensions having mesh size of 15 mm. In the beginning two cages were installed. The number of cages was raised to 10 in a span of six months in the year 2011 where in all 34508 *Tor khudree* were raised in 24 batches. The cages were suspended in river by air tight floating plastic barrels and frames were supported with angles of iron and wooden blocks. Cages were stocked with the fingerlings ranging from 3 cm to 5 cm in length; & weighing 20 g to 70 g of *Tor khudree* at a stocking density of 50 nos/m^2 of surface. The fish were supplemented twice a day at 2-5% body weight, with a formulated diet containing 34% protein. The experiment lasted for 3 years and periodic samples were taken every month for fish growth.

The fish generally does not breed naturally in captivity and requires to be stripped. Being an endangered species the risk of releasing the spawn enhances mortality and

hence even as an attempt of conservation, rearing in cages for six months for acclimatizing and training for survival in the natural habitat became essential allowing them to be a sizable fish sustaining the challenges of the natural habitat. Mr. Rohit Nagalgaon has continued the work with more scientific approach under the guidance of Vinayak Dalvie, Academic Coordinator of Sindhu Swaddhyay Sanstha where Mr. Ogale is the Co-guide. Rohit under the guidance of Vinayak Dalvie recently got second prize in poster presentation at the National Youth Science Congress organised by the University of Mumbai in collaboration with Swaminarayan Foundation. Today about 35,000 fully grown Mahseer are seen in the River Indrayani near Gatha Mandir and are breeding naturally.

1) What research aspects Rohit can consider in this work?
2) Can this attempt of ex-situ conservation be commercially explored in future?
3) If so how?

OR

Q. 9 B] Questions based on case study / simulation.

Simulation: Development of Integrated Fish Farm

Village Juchandra is located in between Naigaon station on Western Railway and Western Express Highway each at a distance of 2.5 km. Juchandra has Bhayander Creek in the south with the backwaters flowing in the fields at high tides. Bhayander Creek is one of the last creeks in the vicinity of Mumbai which has fairly good water quality supporting brackish water ecosystem. Evident from the salt pans which exists on its northern side though domestic pollution of Mira-Bhayander townships is imposing increasing load from the south. The Creek is divided into two by some islands one having inhabited called 'Panju bet' a village having no road access. By virtue of this breadth and depth water quality is sustained to some extent though with the rapid urbanization it is being challenged.

Government of Maharashtra State Department of Fisheries has a scheme to lend a land on lease for promoting prawn culture. Accordingly five hectares land can be allotted to an individual while up to 50 hectares to Private Limited Company for 30 years at a lease rent of Rs. 1000/- per hectare per year (with an increase in Rs. 1000/- every five years per hectare) and Rs. 2000/- per hectare (with an increase in Rs. 2000/- every five years per hectare) respectively.

1) As budding entrepreneur how do you assess this opportunity? **7**
2) Provide your plans for developing integrated aquafarm. **8**

Note: Questions of the model question paper are not exhaustive, but suggestive, and teachers have liberty to reframe, modify and add other questions as deemed fit.

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Model Question Paper USACFBIO601

Duration: 2.5 Hours **Total marks: 75**

N.B.: 1) Question No. 1 is compulsory.
2) Attempt any four questions from question No. 2 to question No. 9.
3) Draw neat and labelled diagrams wherever necessary.

Q. 1] Write notes on <u>any 5</u> of the following (Mixed questions from all units): 15

a) Commercial importance of ribbon fish
b) Major fish landing centers of oil sardine
c) Economic importance of *Crassostrea spp*.
d) Economic importance of lobsters
e) Preservatives used in feed.
f) Nutritional requirement at larval stage of crustaceans
g) Costiasis
h) White spots.
i) Packaging of fishes
j) Fish dressing
k) Prawn chutney
l) Chitin
m) Paddle wheels
n) Feeding cups
o) _____ (if open unit is opted)
p) _____ (if open unit is opted)

Q. 2 Question based on Unit 1

Q. 2 A] Discuss the fisheries of *Stromateus cinereus* and *Cybium guttatum* **15**

OR

Q. 2 B] Give an account of the following:

(i) Major fish landing centers of deep sea fishes **7**
(ii) *Polynemus tetradactylus* fishery **8**

Q. 3 Question based on Unit 2

Q. 3 A] Discuss the fisheries of *Sepia* and *Penaeus monodon*. **15**

OR

Q. 3 B] Explain the following:

(i) Major landing centers for shell fishes. **7**
(ii) *Scylla serrata* fishery **8**

Q. 4 Question based on Unit 3

Q. 4 A] Write an account on Nutritional requirements at various stages of development of fish and add a note on formulated feeds. **15**

OR

Q. 4 B] Describe the following:

(i) Culture of natural feed: *Artemia* **7**
(ii) Major constituents of pelleted feed **8**

Q. 5 Question based on Unit 4
Q. 5 A] Discuss diseases caused by bacteria and crustacean. Add a note on their treatment. **15**

OR

Q. 5 B] Give an account of the following w.r.t. fish pathology:
(i) Physiological disorders and diseases in fishes **7**
(ii) Fungal diseases and their treatment **8**

Q. 6 Question based on Unit 5
Q. 6 A] Describe the following w.r.t. preservation and processing –Salting method and Freezing method**.** **15**

OR

Q. 6 B] Explain the following w.r.t. preservation and processing:
(i) Types of freezers **7**
(ii) Icing method **8**

Q. 7 Question based on Unit 6
Q. 7 A] Describe the following fishery by-products **–**Fish Protein Concentrate, Pearl Essence and Gelatin **15**

OR

Q. 7 B] Write elaborate notes on the following:
(i) Proximate composition of fish meat **7**
(ii) Prawn pickle and fish wafers **8**

Q. 8 Question based on Unit 7
Q. 8 A] Write an account on pen culture and rope culture. **15**

OR

Q. 8 B] Describe the following fishes w.r.t. farm engineering:
(i) Site selection criterion for semi-intensive freshwater **7**
(ii) Construction of hatchery for semi-intensive freshwater fishes **8**

Q. 9 Question based on Unit 8
Q. 9 A] Question based on open unit.(if opted)
15

OR

Q. 9 B] Questions based on open unit.
(b) _____ **7**
(b) _____ **8**

Note: Questions of the model question paper are not exhaustive, but suggestive, and teachers have liberty to reframe, modify and add other questions as deemed fit.