

CIRCULAR:-

A reference is invited to the scheme of papers at the B.Sc. degree course under revised pattern vide pamphlet No.141 and to this office Circular No UG/343 of 2004, dated 16th August,2004 and Principals of the affiliated colleges in the Faculty of Science are hereby informed that the recommendation made by the Board of Studies in Zoology at its meeting held on 28th February,2005 has been accepted by the Academic Council at its meeting held on 2nd April,2005 vide item No.4.16 and that in accordance therewith the Applied Components (Fishery Biology, Marine Science and Economic Entomology) in the subject of Zoology at the T.Y.B.Sc. (Theory and Practical) examination is as per Appendix and that the same has been brought into force with effect from the academic year 2005-2006.

MUMBAI-400 032

29th August, 2005

for REGISTRAR

To,

The Principals of the affiliated colleges in Sciences

AC/4.16/ 02.04.05

No.UG/ 351 -A of 2005, MUMBAI-400 032 29th August, 2005

Copy forwarded with compliments for information to :-

- 1) The Dean, Faculty of Science
- 2) The Chairman, Board of Studies in Zoology

for REGISTRAR

Copy to :-

The Director, Board of College and University Development, the Deputy Registrar (Eligibility and Migration Section), the Director of Students Welfare, the Personal Assistants to the Vice-Chancellor, the Pro-Vice-Chancellor, the Registrar and the Assistant Registrar, Administrative sub-center, Ratnagiri for information .

The Officer on Special Duty-cum-Controller of Examinations (10 copies), the Finance and Accounts Officer (2 copies), Record Section (5 copies), Publications Section (5 copies), the Deputy Registrar, Enrolment, Eligibility and Migration Section (3 copies), the Deputy Registrar, Statistical Unit (2 copies), the Deputy Registrar (Accounts Section),Vidyanagari (2 copies), the Deputy Registrar, Affiliation Section (2 copies), the Director, Institute of Distance Education,(10 copies),the Director University Computer Center (IDE Building), Vidyanagari, (2 copies) the Deputy Registrar (Special Cell), the Deputy Registrar,(PRO) . the Assistant Registrar, Academic Authorities Unit (2 copies)and the Assistant Registrar, Executive Authorities Unit (2 copies) . They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above Circular and that no separate Action Taken Report will be sent in this connection. the Assistant Registrar Constituent Colleges Unit (2 copies), BUCT(1 copy), the Deputy Account, Unit V(1 copy), the In-charge Director, Centralize Computing Facility (1 copy), the Receptionist (1 copy), the Telephone Operator (1 copy), the Secretary MUASA (1 copy), the Superintendent, Post-Graduate Section (2 copies), the Superintendent, Thesis Section (2 copies)

UNIVERSITY OF MUMBAI



Revised Syllabus

for

T.Y. B.Sc.

Applied Component Group

in the Subject of

Zoology

(Fishery Biology, Marine Science, Economic Entomology)

(with effect from the academic year 2005-2006)

T Y B Sc- FISHERY BIOLOGY

(APPLIED COMPONENT)

[EFFECTIVE FROM ACADEMIC YEAR 2005-2006]

PAPER I

LECTURES: 60/Year

(15 LECTURES/UNIT)

Unit I

- a. Zonation of the sea (Vertical and horizontal)
- b. Deep-sea adaptations of fishes.
- c. Ecological adaptations of inter tidal organisms.
- d. A brief introduction to physicochemical factors of the marine environment with reference to light, temperature, nutrients, salinity, pH, O₂ and CO₂.

Unit II

- a. Introduction to fisheries.
- b. Marine fisheries of India. General information of major commercial fisheries:
 - Elasmobranchs (Shark, Rays, Skates)
 - Polynemids.
 - Scombridae (Indian Mackerel, Seer fish)
 - Ribbonfish.
 - Sardine.
 - Bombay duck.
 - Crustaceans (Prawn, Crab, Lobster)
 - Molluscs (Mussel, Cuttle fish, Squid, Octopus)
 - Algae (Seaweeds) - Economic uses.
- c. Various institutes imparting fishery education in India (CMFRI, MPEDA, CIFA, CIBA, CIFT, CIFE, NIO and FSI)

Unit III

Fish as food commodity:

- Introduction.
- Preservation and Quality control (Post Mortem control of organoleptic and chemical changes- Rigor mortis, bacterial and chemical spoilage, rancidity, autolysis, toxicity)
- Biochemical composition of raw fish.
- Nutritional value of raw, preserved and processed fish.
- Value addition in fish.
- Fish products and by-products (Body/liver oil, Meal, Manure etc.)

Unit IV

Dynamics of fish population:

- Population density, Mortality, Natality.
- Population structure, year class.
- Estimate of population.
- Fluctuation in population, abundance.
- Population dynamics and Fishery catches.
- Determination of age in fish.
- Repercussion of over exploitation.

PAPER II

LECTURES: 60/Year (15 LECTURES/UNIT)

Unit I

- a. Fishing gear and Conventional fishing methods:
 - Nets (Gill and Rampani operations, Drift, Bag (Dol), Dip or Scoop, Cast, Purse seine, Hooks and line)
 - Materials used in fishing gears and properties of fibres.
 - Net making by braiding and cutting, important knots, hitches and bends.
- b. Fishing Crafts:
 - East coast crafts (Catamaran, Orissa type 5 logs, Kolamaran 7 logs, Coramandal type, Boat catamaran)
 - West coast crafts (Canoe- Dugout, Plank built, Out rigger, Built up boats, Satpati trawlers)

Unit II

- a. Unconventional fishing methods:
 - Introduction.
 - Electro fishing.
 - Light fishing.
 - Fish finding (Echo-sounder, Sonar)
- b. Trade and Marketing:
 - Traditional and modern methods.
 - International marketing (Commercial and Ornamental varieties)

Unit III

- a. Indian aquaculture:
 - Composite Prawn culture.
 - Pearl Oyster culture.
 - Oyster and Mussels- Raft culture.
- b. Ornamental Fishery:
 - Aquarium and its maintenance.
 - Varieties and their breeding.

Unit IV

- a. Fish pathology:
 - An elementary idea.
 - Parasitic: Fungal, Bacterial, Protozoan and Worm infections
 - Crustacean diseases.
 - Non-parasitic infections.
- b. Fish physiology:
 - Introduction (General overview)
 - Respiration and Osmoregulation.
 - Fecundity.
 - Breeding and Spawning.
 - Migration.

PRACTICAL I

1. Extraction and estimation of body fat content of fish.

2. Food and feeding habits of fish (Surface, Column and Detritous)

3. Fishes of commercial importance:

- Elasmobranchs: *Scoliodon*, *Sphyrna*, *Pristis*, Sting/Electric Ray.
- Clupeidae: *Sardinella longiceps*, *Clupea lile* (Lesser Sardine), *Dussumeria acuta*.
- Scombridae: *Rastrelliger kanagurta*, *Cybium guttatus*.
- Scopelidae: *Harpodon nehereus* (Bombay duck), *Saurida tumbil*.
- Stromatiodae: *Pampus argenticus*, *Pampus chinensis*.
- Apolectidae: *Formio niger*.
- Trichiuridae: *Trichiurus* sps. (Ribbonfish)
- Polynemidae: *Polynemus tetradactylus*, *Polynemus indicus*, *Polynemus heptadactylus*.
- Freshwater fishes: Rohu, Catla, Clarius, Anabas.
- Crustaceans: (Prawns, Lobsters, Crabs)
- Molluscs: Bivalves (Clam, Mussels), Gastropods (Trochus, Turbo, Natica), Cephalopods (Cuttle fish, Squid)

4. Ecological adaptations of rocky, muddy, sandy shore organisms.

5. Estimation of pH, O₂, NO₂, NO₃, SiO₃, PO₄-P .

PRACTICAL II

1. Different types of nets (Gill, Drift, Dol, Trawl, Purse seine, Drag, Rampani) and crafts (Dugout canoe, Outrigger canoe, Trawler, Satpati trawler, Catamaran, Masula, Dinghi, Tuticorin boat)
2. Knots (Overhand, Reef, Figure 8, Bowline, Fisherman's, Sheep shank), Hitches (Clove, Rolling) and Bends (Single sheet, Double sheet)
3. Fish pathology with reference to parasitic infections (Fungal- *Saprolegnia* or *Achlya*, Bacterial- Fin rot, Protozoan- White spot & Velvet, Worms- *Trematode Gyrodactylus* & *Dactylogyrus*, *Annelids*-Leeches and Crustaceans- Fish louse *Argulus*)
4. Preparation of herbaria of seaweeds and Identification (any five)
5. Setting up of an Aquarium (Project)
6. Identification of Molluscan shells:
 - *Cellana radiata*
 - *Diodora bombayana*
 - *Umbonium*
 - *Littorina* sps.
 - *Nerita* sps.
 - *Natica*
 - *Turbo*
 - *Turritella* sps.
 - *Telescopium*
 - *Lambis lambis*
 - *Tibia curta*
 - *Cypraea* sps.
 - *Murex adustus*
 - *Murex tribulus*
 - *Thais* sps.
 - *Babylonia*
 - *Xanthus pyrum*
 - *Oliya* sps.
 - *Conus* sps.
 - *Terebra* sps.
 - *Arca pristigrata*
 - *Graffium*
 - *Cardita antiquata*
 - *Meretrix*
 - *Katelsia*
 - *Paphia textile*
 - *Donax*
7. Fish fecundity,
8. Accessory respiratory organs in fish (Arborescent, Labyrinthine, Dendriform, Air bladder)

REFERENCE BOOKS SUGGESTED

- Fish and fisheries – S.S.Khanna
- Laboratory investigations – P.Michael
 - Tata McGraw Hill, New Delhi.
- Introduction to Planktology – Krishnan Pillai
 - Himalaya Publishing House.
- Wealth of India – Vol. IV
 - CSIR Publication
- Fish and fisheries – Chandy
 - National Book Trust
- Marine ecology – Nair and Thampy
 - The Macmillan Co. of India Ltd.
- Course Manual in Fishing Technology – Lata Shenoi
 - Central Institute of Fisheries Education, Mumbai.
- Marine ecology – R.V.Tait
- Oceans Their Physics Chemistry & General Biology –H.U.Svedrup, M.W.Johnson, R.H.Fleming
 - Asia Publishing House.
- Fishery science and Indian fisheries – C.B.L.Srivatsava
 - Kitab Mahal, Allahabad.
- Fish and fisheries of India – V.G.Jhingran
 - Hindustan Publishing Corporation, New Delhi.
- Marine fisheries – D.V.Bal and K.V.Rao
 - Tata McGraw Hill, New Delhi.

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T.Y.B.Sc. Marine Science

(Applied Component)

Effective from the academic year 2005 - 2006

Marine Science Paper –I (60 lectures)

Unit I.

15 Lectures

- A) History of Oceanography with emphasis on Indian ocean expedition and Antarctic expedition .
- B) Brief information about institutes CIFE, NIO, CMFRI, MPEDA, FSI

Unit II.

15 Lectures

- A) Brief idea of physical properties : Density , Illumination (colour of the sea) , Temperature , Currents (wind driven circulation and thermohaline circulation), different types of Waves including tsunami ,Tides (spring tides and neap tides)
- B) Oceanographic instruments :
Nansen's reversing bottle, Reversing thermometer, Echosounder, Current meter, Secchi disc, Typical plankton net, Trawl, Dredge, Grab (Peterson's)

Unit III.

15 Lectures

Brief idea of chemical properties : salinity , pH , dissolved gases- oxygen and carbon dioxide ,nitrates , phosphates , silicates , sulphates , Fe , Mg and dissolved organic matter .

Unit IV .

15 Lectures

- A) Zonation of the sea (Vertical and horizontal)
Exclusive Economic Zone
Osmoregulation and impact of pressure in marine organisms.

B) Marine Biodiversity :

- i) Plankton – Adaptations and general classification
- ii) Nekton - Adaptations
- iii) Benthos – Adaptations
- iv) Intertidal organisms (rocky, sandy ,muddy shores)

Marine Science Paper II (60 lectures)

Unit I.

15 Lectures

A) Organic production : (in the sea)

- i) Concept of productivity, standing crop, biomass
- ii) Brief idea of measurement of photosynthesis, standing crop and nutrient uptake
- iii) Factors regulating organic production : light, temperature , nutrients, grazing rate.

B) Specialized marine ecosystems :

- i) Mangrove
- ii) Coral reef

Unit II.

15 Lectures

A) Ocean related climatic changes :

- i) Monsoon
- ii) Cyclone
- iii) El Nino

B) Remote sensing and satellite imagery

C) Anthropogenic impact on marine environment :

- i) Reclamation
- ii) Pollution : Domestic sewage , pesticides ,oils , radioactive and thermal waste.
- iii) Mariculture : Prawn and pearl culture .

Unit III.

15 Lectures

Marine resources :

- i) Algal resources
- ii) Animal resources
- iii) Mineral resources
- iv) Exclusive Economic Zone (EEZ)

Unit IV.

15 Lectures

Marine fisheries:

Brief outline of fishing methods :

- a) Demersal fishing
- b) Pelagic fishing
- c) Recent developments in fishing
- d) Experimental fishing methods

Overfishing problems .

Idea of regulation of fisheries

Marine science: Practical I

- I) Chemical analysis of sea water : Sulphates, silicates, phosphates, nitrates, carbon dioxide ,salinity
- II) Study of oceanographic instruments : Nansen's reversing bottle , reversing thermometer, Secchi's Disc, Current Meter, Echosounder, Trawls, Dredges, Grabs, Standard Plankton Net.
- III) Ecological Adaptations
- a) Zooplankton : Medusa(Coelenterate) , Nauplius, Zoea, Megalopa, Alima, Copepod, Mysis, Pleuro branchia, Sagitta, Salpa, Doliolum.
 - b) Intertidal Animals :
 - Porifera : Sponge (Sycon)
 - Coelenterata : Obelia / Sertularia, Alcyonium, Sea anemone, Coral.
 - Annelida : Nereis, Arenicola, Chaetopterus, Sabella
 - Arthropoda : Balanus, Lepas, Hermit Crab
 - Mollusca : Patella, Chiton, Trochus, Oyster, Mytilus, Sepia, Octopus, Loligo, Teredo
 - Echinodermata : Brittle Star, Star Fish, Sea urchin, Holothurian, Sea lily
 - Deep Sea Animals : Sole Fish (Psettodes, Cynoglossus) Angler Fish.
- IV) Study of Zooplankton :
- a) Sorting
 - b) Mounting
 - c) Identification
- V) Estimation of plankton biomass : Displacement method / Settlement method
- VI) Visit to any of the Research Institutes and submission of report.

Marine Science: Practical II

- I Organic Production : Estimation of primary production using dark and light bottle.
- II Estimation of Biological Oxygen Demand and Chemical Oxygen Demand
- III. Identification of common fishery specimens :
Carcharias sps. Polynemus sps. , Clupea toli , Sciaena sps , Pampus chinensis and Pampus argentieus , Formio niger, Rastrelliger kanagurta ,Cyblum guttatum , Harpodon nehereus , Chirocentrus dorab ,Muraenesox sps Coilea dussumeri , Upenoides sps .Katelaysia sps , oyster, Sepia, Penaeus , lobster , crab (Scylla serrata)
- IV Identification of marine algae (any five)
- V. Identification of shells:
Littorina, Turitella, Haliotes, Trochus, Umbonium, Nerita, Babylonia, Murex, Oliva, Natica, Conus, Conch Shell, Telescopium, Arca, Mytilus, Ostrea, Donax, Katelaysia.
- VI. Biometry : Length –weight relationship
Measurement of ova diameter—Ocular method
- VII. Isolation of pituitary from suitable fish.
- VIII. Mounting of fish scales and otoliths
- IX. Visit to Fish Landing Center / Local Fish Market / Sea Shore, submission of report

List of Reference Book: (Marine Science)

- 1) Fisheries Biology, Assessment and Management by Michael King –Fishing News Publishers, 1995
- 2) Glimpses of the Indian Ocean—S.Z.Qasim, University Press (India) Ltd. 1998
- 3) Handbook of Fish Biology and Fisheries , Edited by J.B.Hart and John Reynold
- 4) Modern Fishing Gear Technology-M.Shahul Hameed, Boopendranath-Daya Publishing House, 2000.
- 5) Fisheries Bioeconomics-Theory, Modelling and Management—FAO Fisheries Technical Paper368, FAO, 2001
- 6) Introductory Oceanography-(8th Edition) Harold Thurman, Prntice Hall
- 7) A text Book of Marine Ecology-Nair, N.B. and Thumphy, D.H. The Macmillan Company of India Ltd
- 8) The Oceans-Svedrup, H.V.et al. Asia Publishing House

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T.Y.B .Sc. Economic Entomology
(Applied Component)
Effective from the academic year 2005-2006

Economic Entomology Paper – I (60 Lectures)

Unit 1: General Morphology of Insects **15 Lectures**

- 1.1. External morphology of head, thorax and abdomen
- 1.2. Appendages of head, thorax and abdomen, including the mouthparts and wings
- 1.3. Exoskeleton: structure, ecdysis

Unit 2: General Anatomy of insects **15 Lectures**

- 2.1. Digestive system
- 2.2. Respiratory system
- 2.3. Circulatory system
- 2.4. Nervous system
- 2.5. Endocrine organs
- 2.6. Reproductive system
 - 2.6.1. General organization of male and female reproductive system
 - 2.6.2. Special modes of reproduction.
- 2.7. Development
 - 2.7.1. Types of metamorphosis
 - 2.7.2. Types of larvae and pupae

Unit 3: Insect Classification **15 Lectures**

- 3.1. Key to taxonomy
- 3.2. Study of the following orders with special reference to insects of economic importance
 - i) Thysanura
 - ii) Orthoptera
 - iii) Isoptera
 - iv) Hemiptera
 - v) Lepidoptera
 - vi) Diptera
 - viii) Hymenoptera
 - viii) Coleoptera

Unit 4: Insects in relation to their environment

15 Lectures

- 4.1. Abiotic factors
 - 4.1.1. Temperature
 - 4.1.2. Light
 - 4.1.3. Humidity
- 4.2. Mimicry in insects
- 4.3 Sound production and sound perception
- 4.4 Pheromones
- 4.5 Diapause

PRACTICAL I

1. Mountings:
 - a. Head sclerites of cockroach and housefly
 - b. Types of antennae (any four)
 - c. Halteres
 - d. Cornea
 - e. Mouthparts of butterfly and bedbug
2. Dissections of Housefly
 - a. Digestive system
 - b. Reproductive system
 - c. Nervous system
3. Identification of insects as per orders mentioned in theory (any 20 specimens, not more than three from each order)

Economic Entomology Paper –II (60 Lectures)

Unit 1: Economic importance of insects

15 Lectures

- 1.1. Useful insects: Insects as pollinators, silkworm moth, honey bee, lac insect
- 1.2. Harmful Insects: *Batocera*, *Dysdercus*, *Papillio*, *Heiroglyphus*, *Tribolium*, *Sarcophaga*, Bedbug, Head louse

Unit 2: Social Insects

15 Lectures

- 2.1. Social organization in insects
- 2.2. Caste system in honeybees and termites
- 2.3. Communication in honeybee
- 2.4. Bioluminescence as a mode of communication in insects

Unit 3: Control of insect pests

15 Lectures

- 3.1. Natural control: environment as a limiting factor
- 3.2. Applied control
 - 3.2.1. Chemical control
 - 3.2.1.1. Inorganic pesticides
 - 3.2.1.2. Organic insecticides (synthetic and botanical)
 - 3.2.2. Biological control
 - a) Parasitism
 - b) Predators
 - c) Pathogens
 - d) Genetic methods
 - e) Use of pheromones and hormones
 - 3.2.3. Action of insecticides
 - 3.2.4. Resistance to insecticides
 - 3.2.5. Integrated pest control

Unit 4: Medical Entomology

15 Lectures

Insects as vectors of diseases (transmission, epidemiology and control measures): *Culex*, *Anopheles*, *Aedes*, *Musca*, *Glossina*, *Phlebotomus* and *Xenopsylla*

PRACTICAL II

1. Study of the life histories of the following insects:
Silkworm, honeybee, Culex, Anopheles, Xenopsylla, Musca
2. Study of LC_{50} using a suitable insecticide
3. Effect of the following insecticides on suitable insects:
 - a. Contact poison
 - b. Fumigant
 - c. Stomach poison
4. Identification of economically important insects as per unit 1 and 4 of theory
5. Visit to apiculture center, veterinary colleges, agricultural colleges, sericulture centers etc.
6. Submission of at least 5 species of insect pests

REFERENCES

1. A Textbook of insect morphology, physiology and endocrinology – Tembhare D.B. – S. Chand
2. Principles of Insect Morphology – Snodgrass R.E. – TMH
3. Textbook of Entomology – Ross – John Wiley
4. General and Applied Entomology – David and Ananthakrishnan – TMH
5. Principles of Insect Physiology – Wigglesworth – ELBS
6. A General Textbook of Entomology – A.D. Imms – Asia Publications
7. Insect Endocrinology and Physiology – Tembhare D.B. – S Chand
8. Applied Entomology – Awasthi
