

SVU COLLEGE OF SCIENCES
CHOICE BASED CREDIT SYSTEM (CBCS)

M.Sc., AQUACULTURE

SYLLABUS AND REGULATIONS
WITH EFFECT FROM 2015-16



DEPARTMENT OF
FISHERY SCIENCE AND AQUACULTURE
SRI VENKATESWARA UNIVERSITY:: TIRUPATI
2015

SRI VENKATESWARA UNIVERSITY::TIRUPATI
S.V.U.COLLEGE OF SCIENCES
DEPARTMENT OF FISHERY SCIENCE & AQUACULTURE
(Revised syllabus for regular students those who study in S.V.U. College (Campus), Tirupati)
(with effect from the batch of students who admitted during the academic year 2015-16)

M.Sc. AQUACULTURE

(CHOICE BASED CREDIT SYSTEM)

SCHEME OF INSTRUCTION AND EXAMINATION

Sem	Course Code	Title of the course	Core/ elective	No.of Credits	Uni.Exams Duration (Hours)	IE	EE	Total Marks
I	AQC:101	CONCEPTS OF AQUATIC ECOLOGY	Core	04	3	30	70	100
	AQC:102	SYSTEMATICS AND EXTERNAL ANATOMY OF CULTIVABLE ORGANISMS	Core	04	3	30	70	100
	AQC:103	PRINCIPLES OF AQUACULTURE	Core	04	3	30	70	100
	AQC:104	FISH NUTRITION AND WATER QUALITY MANAGEMENT	Core	04	3	30	70	100
	AQC:105	IDENTIFICATION AND MORPHOLOGY OF CULTIVABLE ORGANISMS	--	04	3	--	100	100
	AQC:106	SOIL AND WATER CHARACTERISTICS	--	04	3	--	100	100
II	AQC:201	PHYSIOLOGY OF CULTIVABLE ORGANISMS	Core	04	3	30	70	100
	AQC:202	CAPTURE FISHERIES	Core	04	3	30	70	100
	AQC:203	FRESHWATER AQUACULTURE	Core	04	3	30	70	100
	AQC:204	COASTAL AQUACULTURE	Core	04	3	30	70	100
	AQC:205	PHYSIOLOGY OF FINFISH AND SHELLFISH	--	04	3	--	100	100
	AQC:206	FISH NUTRITION	--	04	3	--	100	100
	--	Human Values and Professional Ethichs – I	--	04	--	30	70	100
III	AQC:301	MICROBIOLOGY AND FISH PATHOLOGY	Core	04	3	30	70	100
	AQC:302	FISHERY ECONOMICS, EXTENSION AND ENVIRONMENTAL MANAGEMENT	Core	04	3	30	70	100
	AQC:303	CELL BIOLOGY AND GENETICS	Core	04	3	30	70	100
	AQC:304	FISH IMMUNOLOGY	Core	04	3	30	70	100
	AQC:305	MICROBIOLOGY AND FISH DISEASES	--	04	3	--	100	100
	AQC:306	CELL BIOLOGY, ENETICS AND IMMUNOLOGY	--	04	3	--	100	100
	AQC:307	ORNAMENTAL FISH CULTURE (THEORY)	Optional	--	--	--	--	--
IV	AQC:401	AQUACULTURE BIOTECHNOLOGY	Core	04	3	30	70	100
	AQC:402	PROJECT WORK / DISSERTATION	Core	04	3	30	70	100
	AQC:403	COMPUTER APPLICATIONS, INFORMATION TECHNOLOGY AND BIOSTATISTICS IN AQUACULTURE	Core	04	3	30	70	100
	AQC:404	ESSENTIALS OF BIOCHEMISTRY	Core	04	3	30	70	100
	AQC:405	BIOTECNOLOGY AND BIOSTATISTICS	--	04	3	--	100	100
	AQC:406	BIOCHEMICAL ESTIMATIONS	Core	04	3	30	70	100
	AQC:407	GENERAL PRINCIPLES AND PRACTICES OF AQUACULTURE (THEORY)	Optional	--	--	--	--	--
	AQC:408	BIOINFORMATICS IN AQUACULTURE (THEORY)	Optional	--	--	--	--	--
	--	Human Values and Professional Ethichs – II	--	04	--	30	70	100

Note: AQC: Aquaculture; EE: External Elective; IE: Internal Elective

I – Semester

AQC 101 : CONCEPTS OF AQUATIC ECOLOGY

UNIT – I

INTRODUCTION : Definition of ecology, organism and environment; features of organism - environment relations; living and non - living environments; the ecosystem or habitat.

AQUATIC ECOSYSTEMS : Freshwater ecosystems - Lotic and Lentic ecosystems; Marine ecosystems - oceans and seas, zonation of the seas - rocky, sandy and muddy shores; classification of marine habitat - pelagic, benthic, neretic, oceanic, littoral and abyssal.

UNIT – II

PHYSICAL CHARACTERISTICS OF WATER : Light - penetration of sunlight into aquatic media, effect of light on productivity, photoperiodicity in animals; Temperature - annual temperature cycles, thermal stratification of water bodies, thermal optimum, maximum and minimum, water movements, periodic and aperiodic current systems; Turbidity - causes, variations and effects.

CHEMICAL CHARACTERISTICS OF WATER : Atmosphere and atmospheric gases dissolved in water; Oxygen - oxygen and life, hypoxia, anoxia and hyperoxia, adaptations of animals to varying oxygen tensions; Carbon dioxide - sources of CO_2 , its ecological effects; pH or hydrogen ion concentration - its significance.

INORGANIC SALTS : Salts as liming factors; basic nutrient salts; ecological effects of salinity; effect of salinity on animals; total hardness and total alkalinity.

UNIT – III

BIOGEOCHEMICAL CYCLES : Nitrogen cycle; phosphorus cycle; sulfur cycle; carbon cycle; trace elements - manganese and copper.

ORGANIC MATTER : Aquatic vegetation – zones of aquatic vegetation; Plankton - classification of plankton, factors affecting plankton distribution, plankton counting and sampling; phytoplankton - zooplankton relationship, plankton productivity; Benthos - phytobenthos and zoobenthos.

UNIT – IV

PRODUCTIVITY : Concept of productivity – standing crop, rate of production and rate of removal; primary and secondary productivity; classification of water bodies on the basis of productivity.

DYNAMICS OF AQUATIC ECOSYSTEM : Principal steps and components – niches, trophic levels and relations; producers, consumers, decomposers and transformers; food chain and food web; pyramid of biomasses; pyramid of numbers; energy transfer in the ecosystem.

SUGGESTED READING :

Santhanam, R. 1993. A Manual of Fresh Water Ecology : An Aspect of Fishery Environment. Daya Publishing House, New Delhi.

Pillai, N. K. 1993. Marine Biology and Ecology. Daya Publishing House, New Delhi.

Reid, G. K. and R. D. Wood. 1976. Ecology of Inland Waters and Estuaries D. Van Nostrand Company.

Kormondy, E. J. 1996. Concepts of Ecology. Prentice Hall of India Pvt. Ltd. New Delhi.

Cole, G. L. 1954. Text Book of Limnology. The C. V. Mosloy Co.,

Odum, E. P. 1996. Fundamentals of Ecology. 3rd Edn. Natraj Publishers, Dehradun.

Santhanam, R. and A. Srinivasan. 1994. A Manual of Marine Zooplankton. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Pillai, N. K. 1986. Introduction to Planktonology. Himalaya Publishing House, Mumbai.

Balakrishnan Nair, N and D. M. Thampy. 1980. A Text Book of Marine Ecology. Mc Millan Co. of India Ltd.

AQC 102 : SYSTEMATICS AND EXTERNAL ANATOMY OF CULTIVABLE ORGANISMS

UNIT – I

SYSTEMATICS : Classification of fishes up to subclass level; major groups of fresh water fish and their salient features and distribution.

UNIT – II

SYSTEMATICS : Classification of commercially important crustaceans and molluscs upto sub class level and their salient features and distribution.

UNIT – III

GROSS EXTERNAL ANATOMY : Basic structure of the skin in fishes; epidermal derivatives – microridges and integumentary glands; dermal derivatives – cosmoid scales, ganoid scales, placoid scales, elasmoid, cycloid and ctenoid scales; fish age and scales; integumentary pigments; mouth and jaws; gill slits; fins – median fins and paired fins, origin of paired fins; coloration – morphology of chromatophores, pigments, physical and chemical colours, mixed colours, colour change, adaptive significance.

UNIT – IV

GROSS EXTERNAL ANATOMY : External morphology of shell fish : prawn, shrimp, crab and molluscs – exoskeleton and appendages; variations in exoskeleton.

SUGGESTED READING :

- Lagler, K. F., J. E. Bardach and R. R. Miller. 1977. Ichthyology. John Wiley.
- Moyl, P. B. 1995. Fishes : An Introduction to Ichthyology. 3/Ed. Narendra Publishing House, New Delhi.
- Talwar, P. K. and V. G. Jhingran. 1991. Inland Fishes of India and Adjacent Countries. Vol. I & II. Oxford and IBM Publishing Co., New Delhi.
- Kurian, C. V. and V. O. Sebastian. 1976. Prawns and Prawn Fisheries of India. Hindustan Publishing Co., 1976.
- Bond E. Carl. 1979. Biology of Fishes. Saunders.
- Datta Munshi and Srivastava. 1995. Natural History of Fishes and Systematics of Fresh Water Fishes of India. Daya Publishing House, New Delhi.
- Parihar, R. P. 1994. A Text Book of Fish Biology and Indian Fisheries. Central Publishing House, Allahabad.
- Lankaster, E. R. 1996. A classification of animals from the point of view of Economic Zoology. Daya Publishing House, New Delhi.
- Srivastava, C. B. L. 1999. Fish Biology. Narendra Publishing House, New Delhi.
- Khanna, S. S. 1997. An Introduction to Fishes. Central Book Depot, Allahabad.

AQC 103 : PRINCIPLES OF AQUACULTURE

UNIT – I

AQUACULTURE SYSTEMS AND METHODS: Scope and definition; origins and growth of aquaculture; biological and technological basis; Traditional, extensive, semi - intensive and intensive culture; monoculture, polyculture, composite culture, mixed culture, monosex culture; cage culture, pen culture, raft culture, race way culture, culture in recirculatory systems; warm water and cold water aquaculture; sewage – fed fish culture, integrated fish farming.

SELECTION OF SITES : Survey and location of suitable site – topography; soil characteristics; acid sulphate soils; water source; hydrometeorological data.

UNIT – II

AQUACULTURE ENGINEERING : Design and construction of pond, lay out and design of aquaculture farm, construction, water intake system, drainage system; aeration and aerators; recent advances in aquaculture engineering; tips for better aquaculture practices; design and construction of hatcheries.

HYDROLOGY OF PONDS : Types of ponds; sources of water – precipitation, direct run off, stream inflow, ground water inflow, regulated inflow; losses of water– evaporation, seepage, outflow, consumptive use, water budgets of embankment ponds; water budget of an excavated pond; water exchange.

UNIT – III

SELECTION OF SPECIES : Biological characteristics of aquaculture species; economic and market considerations; seed resources, collection and transportation.

PRE STOCKING MANAGEMENT : Sun drying, ploughing / tilling, desilting, liming and fertilization, eradication of weed fishes.

7. STOCKING : Acclimatization of seed and release; species combinations; stocking density; ratio.

UNIT – IV

8. POST STOCKING MANAGEMENT : Water and soil quality parameters required for optimum production, control of aquatic weeds and aquatic insects, algal blooms; specific food consumption, food conversion ratio (FCR), protein efficiency ratio, true net protein utilization, apparent net protein utilization, biological value of protein.

9. GROWTH : Measurement of growth; length - weight relationship; methods of determination of age in fishes and shellfish based on length data and growth checks; ponderal index; growth hormones.

SUGGESTED READING :

Mathew Landau. 1995. Introduction to Aquaculture. Daya Publishing House, New Delhi.

Pillay, T. V. R. 1993. Aquaculture : Principles and Practices. Fishing News Books. Black Well Scientific Publications.

MPEDA, 1991. Hand Book on Shrimp Farming, Kochi, India.

Jhingran, V. G. 1982. Fish and Fisheries of India. Hindustan Publishing Corporation, New Delhi.

Chakrabarti, N. M. 1998. Biology, Culture and Production of Indian Major Carps. Narendra Publishing House, New Delhi.

Coche, A. G. and J. F. Muir. 1996. Pond Construction and Fresh Water Fish Culture – Pond Farm Structures and Layouts – Simple Methods for Aquaculture. FAO. Daya Publishing House, New Delhi.

Upadhyay, A. S. 1995. A Hand Book on Design, Construction and Equipments in Coastal Aquaculture (Shrimp Farming). Daya Publishing House, New Delhi.

Wheaton, F. W. 1985. Aquaculture Engineering. MPEDA, Cochin.

MPEDA 1990. Aquaculture Engineering and Water Quality Management. Cochin, India.

AQC 104 : FISH NUTRITION AND WATER QUALITY MANAGEMENT

UNIT – I

NUTRITION : Importance of nutrition; nutritional requirements; nutritive needs of finfish with special reference to carps and cat fishes and shrimp and prawn; major nutrients – carbohydrates, proteins and lipids and their importance. Natural food and live feed culture : methods of collection of live feed organisms; identification, isolation and maintenance of phytoplankton and zooplankton; mass culture of spirulina and azolla, culture of rotifers (Brachionus and Moina) and artemia.

FOOD AND FEEDING HABITS : Types of food – basic food, secondary food, incidental food, obligatory food; feeding habits – detritivores, scavengers, herbivores, omnivores, carnivores, surface feeders, column feeders, bottom feeders; monophagic, stenophagic and euryphagic fishes; seasonal changes in food availability and food preferences; food and feeding in relation to age; food selectivity and feeding intensity; feeding strategies; food and feeding habits of prawns, shrimps, crabs and bivalves; morphological adaptations for feeding in fishes.

UNIT – II

SUPPLEMENTARY FEEDS : Supplementary feed and feed formulations; different types of feeds (dry feed, wet feed, floating feed, sinking feed and flakes); feed composition; nutrient source; feed ingredients (conventional and non-conventional, their nutritive value); water stability of feeds; use of attractants in feeds; binders; processing of feeds (importance of anabolic agents, antioxidants and mould inhibitors; anti nutritional factors); storage and quality control; determination of energy content in feeds.

FEEDING : Introduction; feeding and fish production; fate of nutrients in feed; water quality and feeding rates – temporal changes; relationship to maximum feeding rate; effects of weather on maximum feeding rate; effluents from fish ponds; off-flavor.

UNIT – III

FERTILIZATION : Properties of chemical fertilizers: Primary nutrients; secondary nutrients; sources of fertilizers; mixed fertilizers; solubility of fertilizers. Effects of fertilization on plants and invertebrates: Phytoplankton; zooplankton; benthos; macrophytes; water transparency as an index to fertilization; fish yield in fertilized ponds. Organic fertilizers: Sources; influence on pond ecology and fish production.

LIMING : Properties of liming materials – compounds, neutralizing value, fineness; effects of liming on pond ecosystem – chemistry, production of plankton and invertebrates; fish production; liming rates for ponds; application of liming materials for ponds – selection of liming material and time of application; methods of application; residual effects of liming.

UNIT – IV

DYNAMICS OF DISSOLVED OXYGEN : Introduction; diffusion; photosynthesis; respiration; diel changes in dissolved oxygen concentrations; predicting decline in dissolved oxygen concentrations; oxygen budgets of fish ponds; algal die-offs; overturns; identification of oxygen problems.

AERATION : Introduction; principles of aeration; emergency aeration; supplemental or continuous aeration; destratification; practical considerations.

MISCELLANEOUS TREATMENTS : Introduction; potassium permanganate; hydrogen peroxide; calcium hydroxide; reduction of pH; control of turbidity; salinity; hardness and chloride; water exchange; chlorine removal; rotenone; formalin and malachite green; methods of applying chemicals.

SUGGESTED READING :

1. Halver, J. E. 1972. Fish Nutrition. Academic Press, New York.
2. Sena, S. De Silva and Trevor A. Anderson. Fish Nutrition in Aquaculture. Chapman & Hall London. 1998, p. 319.
3. Lovell, J. 1989. Nutrition and Feeding of Fish. Von Nostrand.
4. MPEDA, 1990. Hand Book on Aquafarming – Live feed.
5. MPEDA, 1990. Hand Book on Aquafarming – Aquaculture feed.
6. MPEDA 1990. Aquaculture Engineering and Water Quality Management. Cochin, India.
7. Pillay, T. V. R. Aquaculture : Principles and Practices. Fishing News Books.
8. Jhingran, V. G. 1985. Fish and Fisheries of India. Hindustan Publishing Corporation, New Delhi.
9. Boyd, C. E. 1982. Water Quality Management for Pond Fish Culture. Elsevier Science Publishers.
10. Chakroff, M. 1993. Freshwater Fish Pond Culture and Management. Daya Publishing House, New Delhi.
11. Pillay, T. V. R. and W. A. Dill. 1979. Advances in Aquaculture. Fishing News Books Ltd.

PRACTICALS

I – Semester

AQC 105: IDENTIFICATION AND MORPHOLOGY OF CULTIVABLE ORGANISMS

Identification of commercially important finfish – marine fishes, freshwater fishes, exotic carps, ornamental fishes, predatory fishes and weed fishes.

Identification of commercially important shellfish – crabs, prawns and shrimps.

Identification of eggs and larval forms of cultivable finfish and shellfish.

Identification of fins and scales of fish; mounting of scales.

Collection and identification of fish food organisms.

Biometric analysis.

Length-weight relationship.

Dissections : (1) Digestive system (2) Reproductive system in finfish and shellfish.

Identification of different crafts and gear.

Identification of aquatic insects.

Identification of aquatic weeds.

AQC 106 : SOIL AND WATER CHARACTERISTICS

Determination of temperature, pH and transparency.

Estimation of dissolved oxygen and primary productivity.

Estimation of carbondioxide.

Estimation of total ammonia – nitrogen and nitrate – nitrogen.

Estimation of phosphates.

Estimation of iron.

Estimation of chlorine

Determination of hardness.

Estimation of organic matter and biological oxygen demand (BOD)

Determination of salinity.

Plankton analysis.

II – Semester

AQC 201 : PHYSIOLOGY OF CULTIVABLE ORGANISMS

unit – i

DIGESTION : Digestive systems, digestive enzymes, absorption and assimilation.

RESPIRATION : Respiratory organs, mechanisms of ventilation, respiratory pigments, gaseous exchange mechanism, response of the respiratory system to external changes; accessory respiratory organs.

UNIT – II

EXCRETION AND OSMOREGULATION : Mechanism of excretion – kidney structure and functions of freshwater and marine teleosts. Osmoregulation in freshwater fishes and marine fishes and salt balance.

CIRCULATORY SYSTEM : Arteries and veins; mechanical properties and regulation of cardiac activity; general properties of the cardiovascular system; effects of drugs.

UNIT– III
NEUROENDOCRINE SYSTEM : Neuroendocrine system in finfish; neuroendocrine regulation of moulting and reproduction in crustaceans.
REPRODUCTION : Reproductive cycles, sexual maturity, spawning and fecundity, gonado somatic index, fertilization, hormones and reproductive behaviour in fishes.

UNIT – IV
BIOLUMINESCENCE : Light organs – biochemistry, regulation of light emission, significance and employment of luminiscence.
MATING AND PARENTAL CARE :The abyssal and pelagic eggs; attachment devices; spawning sites; nest building and other means of parental care; ovoviviparity and viviparity; types of larvae; metamorphosis; larval life and feeding habits of larvae in finfish and shellfish.
SUGGESTED READING :
Hoar W.S. and D. J. Randal. 1976. Fish Physiology. Vol. I to IX Academic Press, New York.
Khanna, S. S. 1996. An Introduction to fishes. Central book depot, Allahabad.
Lynwood S. Smith. 1999. Introduction to Fish Physiology. Narendra Publishing House, Delhi.
Harper, A. L. 1989. Physiological Chemistry.
Lagler, K. F., J. E. Bardach and R. R. Miller.1972. Ichthyology. John Wiley.
AQC 202 : CAPTURE FISHERIES
UNIT – i
CRAFTS - Introduction to fishing crafts; types of fishing crafts : indigenous crafts – coracle, sangadam, shoe dhoni, catamaran, tuticorin boats, dugout canoe, outrigger canoes, masula boats; / built up boats – Kakinada nava, Machilipatnam nava, dinghy and nauka. Materials used for construction of fishing crafts – timber, metals for sheating, metallic fitting, protection of the boat.
GEAR – types of fishing gear – disabling type, traps and barriers, filtering type, entangling type, self fishing type, wounding gear. Nets – types of nets; common fishing gears for inland waters – traps, angling, cast net, stake net, hand seings, gill net. Gears for spawn collection – Midnapore type of net, murshidabad type of net, lalgola type, jaunpur type. Gamcha, - midnapore type, murshidabad type – materials used for fishing gear; preservation of fishing gears.
UNIT – II
RIVERINE FISHERIES OF INDIA : Ecology of riverine environment; different river systems and their fisheries; regulations of populations and exploitation; improvement of fish stocks; status of spawn prospecting; fisheries of major and minor carps and cat fishes.
LACUSTRINE FISHERIES : Lakes and reservoirs; development of reservoir fisheries; commercial exploitation of reservoirs; recent advances in reservoir management.
UNIT – III
MARINE FISHERIES : Marine fishery resources of India; historical background and recent trends; problems of inshore fisheries; fishery resources of the continental shelf; exploitation and management of under exploited and unexploited resources of EEZ.
PELAGIC FISHERIES : Pelagic fishery resources of India; fisheries of oil sardine, lesser sardines, anchovies, mackerel, ribbon fishes and cephalopods.
DEMERSAL FISHERIES : Fisheries of elasmobranchs; bombay duck, silver bellies, thredfins and other perches; flat fishes, shrimps, crabs, oysters and clams.

UNIT – IV
8. ESTUARINE FISHERIES: Definition; origin and classification; types of estuaries in India and their fishery resources fisheries o brackish water lakes and backwaters; problems confronting brackish water capture fishers.
9. NATURAL POPULATIONS: Natality, Mortality, Recruitment to population and Recruitment to fishery; Fishery regulations – closed seasons, mesh regulations, marketable sizes, protection of breeding grounds, stocking of natural water bodies etc.
SUGGESTED READING :
Jhingran, V. G. 1985. Fish and Fisheries of India. Hindustan Publishing Corporation, New Delhi.
Kurian, C. V. and O. V. Sebastian, 1982. Prawns and Prawn Fisheries of India. Hindustan Publishing Corporation, New Delhi.
Srivastava, U. K. and Dharma Reddy. 1983. Cold Water Fisheries of India. Concept Publishing Co., New Delhi.
Bal, D. V. and K. V. Rao. 1990. Marine Fisheries. Narendra Publishing House, New Delhi.
Proceedings of the Symposium of Living Resources of the Seas around India. CMFRI. 1973. Spl. Publ. CMFRI. Cochin.
FAO, Year Book of Fishery Statistics (Yearly).
Talwar, P. K. and R. K. Kacker. 1984. Commercial Sea Fishes of India. ZSI, Kolkata.
Khanna, S. S. 1997. An Introduction to Fishes. Central Book Depot, Allahabad.
Sinha, V. R. P. 1993. A Compendium of Aquaculture Technologies. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
Piska, R. S. 1999. Fisheries and Aquaculture. Lahari Publications, Hyderabad.
Pandian, T. J. 2001. Sustainable Indian Fisheries. National Academy of Agricultural Sciences.
AQC 203 : FRESHWATER Aquaculture
UNIT – i
CULTURE OF INDIAN MAJOR CARPS – Catla, Rohu, Mrigal
CULTURE OF EXOTIC CARPS – Grass carp, common carp, silver carp, tilapia
CULTURE OF AIR BREATHING FISHES – Murrels and cat fishes
UNIT – II
HATCHERY MANAGEMENT :
FISH: Induced breeding; hypophysation of Indian Major carps; types of hatcheries - Hapa, Jar hatchery, circular hatchery (Chinese hatchery), Modern Indian hatchery system.
FRESHWATER PRAWN : Identification of post larval stages; brood stock management, breeding and Hatchery management, larval rearing.
UNIT – III
6. FRESHWATER PRAWN CULTURE : Seed collection from natural sources; culture of <i>M.rosenbergii</i> / <i>M.malcolmsonii</i>
7. FRESHWATER PEARL CULTURE: Definition and scope, origin of pearls, pearl producing molluscs; freshwater pearl culture in the World and in India; types of pearls; mantle cavity insertion, mantle tissue insertion, gonadal insertion; water quality management.

UNIT – IV
8. AQUARIUM FISHES AND MANAGEMENT : Identification of commercially important ornamental fishes, setting and design of freshwater aquarium; taxonomy of species; live bearing fishes; egg laying fishes; biology of ornamental fishes; physiochemical properties of water used in aquaria; aquatic plants and other structures for beauty and utility; common aquarium fish diseases and their control; preparation of supplementary feeds and mass production of ornamental fishes.

SUGGESTED READING :

Pillay, T. V. R. 1998. Aquaculture Principles and Practices. The Fishing News Books.
Rath, R. K. 2000. Freshwater Aquaculture. Scientific Publishers (India) Jodhpur.
Piska, R. S. 1999. Fisheries and Aquaculture. Lahari Publications. Hyderabad.
Pandian, T. J. 2001. Sustainable Indian Fisheries. National Academy of Agricultural Sciences.

AQC 204 : COASTAL AQUACULTURE

UNIT – I
SHRIMP HATCHERY MANAGEMENT : Seed collection from natural resources, identification of post larval stages, brood stock management, breeding by eyestalk ablation, hatchery management, larval rearing of <i>Penaeus monodon</i> .; Culture of <i>P.monodon</i> and <i>P.indicus</i> . CRAB CULTURE : Culture of <i>Scylla serrata</i> , <i>Scylla oceanica</i> , <i>Scylla tranquibarica</i> . LOBSTER FISHERY : Distribution – biology of spiny lobster – abundance of spiny lobster - culture of spiny lobster – processing and preservation of lobsters.
UNIT – II
CRAY FISH CULTURE : Culture of <i>Procambarus clarkii</i> – pond culture methods – double cropping. MOLLUSCAN CULTURE : Oysters, pearl oysters and mussels.
UNIT – III
SEAWEED CULTURE : Seaweed morphology, biology, reproduction, importance of seaweeds; culture of seaweeds. MARINE AND BRACKISHWATER FISH CULTURE: Culture of <i>Lates calcarifer</i> , <i>Eetroplus suratensis</i> and <i>Mugil cephalus</i> .
UNIT – IV
POST HARVEST TECHNOLOGY : Harvesting methods - drainable ponds, undrainable ponds, cage and raceway farms, handling and transport; principles and importance of fish preservation; preservation methods - traditional and advanced methods of fish preservation – sun drying, salt curing, pickling, smoking, chilling, freezing and canning. PRESERVATION AND PROCESSING : Processing and preservation of fish products and byproducts – minced meat, FPC, fish meal, fish oils, fish hydrosate, fish sauce, fish glue; sanitation in processing plants and quality control of fresh and processed fish and fishery products.
SUGGESTED READING :
1. MPEDA, Hand Book on Aquafarming , Shrimps, lobsters, mudcrabs (1996).
2. Nandi, N. C. and S. K. Pramanik. 1994. Crabs and crab Fisheries of Sundarban . Hindustan Publishing Corporation.
3. Pillay, T. V. R. 1988. Aquaculture, Principles and Practices . Fishing News Books.
4. Piska, R. S. 1999. Fisheries and Aquaculture . Lahari Publications, Hyderabad.

207 : Human Values and Professional Ethics – I

Definition and Nature of Ethics- Its relation to Religion, Politics, Business, Legal, Medical and Environment. Need and Importance of Professional Ethics - Goals - Ethical Values in various Professions.

Nature of Values- Good and Bad, Ends and Means, Actual and potential Values, Objective and Subjective Values, Analysis of basic moral concepts- right, ought, duty, obligation, justice, responsibility and freedom, Good behavior and respect for elders.

Ahimsa (Non-Violence), Satya (Truth), Brahmacharya (Celibacy), Asteya(Non possession) and Aparigraha(Non- stealing). Purusharthas(Cardinal virtues)-Dharma (Righteousness), Artha(Wealth), Kama(Fulfillment Bodily Desires), Moksha(Liberation).

Bhagavad Gita- (a) Niskama karma. (b) Buddhism- The Four Noble Truths - Arya astanga marga, (c) Jainism- mahavratas and anuvratas. Values Embedded in Various Religions, Religious Tolerance, Gandhian Ethics.

Crime and Theories of punishment- (a) Reformative, Retributive and Deterrent. (b) Views on manu and Yajnavalkya.

Books for study:

John S Mackenzie: A manual of ethics.

“The Ethics of Management” by Larue Tone Hosmer, Richard D. Irwin Inc.

“Management Ethics - integrity at work’ by Joseph A. Petrick and John F. Quinn, Response Books:New Delhi.

“Ethics in Management” by S.A. Sherlekar, Himalaya Publishing House.

Harold H. Titus: Ethics for Today

Maitra, S.K: Hindu Ethics

William Lilly : Introduction to Ethics

Sinha: A Manual of Ethics

Manu: Manu Dharma Sastra or the Institute of Manu: Comprising the Indian System of Duties: Religious and Civil(ed.) G.C.Haughton.

Susruta Samhita: Tr.Kaviraj Kunjanlal, Kunjalal Brishagratha, Chowkamba Sanskrit series, Vol I,II and III, Varnasi, Vol I OO, 16-20, 21-32 and 74-77 only.

Caraka Samhita :Tr. Dr.Ram Karan Sarma and Vaidya Bhagavan Dash, Chowkambha Sanskrit Series office, Varanasi I, II, III Vol I PP 183-191.

Ethics, Theory and Contemporary Issues., Barbara Mackinnon, Wadsworth/Thomson Learning, 2001.

Analyzing Moral Issues, Judith A. Boss, Mayfield Publishing Company, 1999.

An Introduction to Applied Ethics (Ed.) John H.Piet and Ayodhya Prasad, Cosmo Publications.

15. Text book for Intermediate logic, Ethics and Human Values , board of Intermediate Education& Telugu Academic Hyderabad .

16. I.C Sharma Ethical Philosophy of India. Nagin&co Julundhar

III – Semester

AQC 301 : MICROBIOLOGY AND FISH PATHOLOGY

UNIT – I

INTRODUCTION TO MICROBIOLOGY: Scope and definition; major groups of microorganisms and their characteristics; classification and identification of microorganisms; fine structure, morphology and culture characteristics of bacteria and viruses.

UNIT – II

2. SOIL AND AQUATIC MICROBIOLOGY: Study of role of microorganisms in soil and water; soil and water probiotics and their importance.

3. FOOD MICROBIOLOGY : Role of microorganisms in preservation and spoilage of fishery products and food stuffs.

UNIT – III

4. VIRAL AND BACTERIAL DISEASES IN FINFISH AND SHELLFISH : Causes, symptoms, diagnosis, prophylactic and therapeutic measures.

5. PROTOZOAN AND FUNGAL DISEASES : Causes, symptoms, diagnosis and preventive measures.

UNIT – IV

6. CRUSTACEAN AND HELMINTH PARASITES IN FISH : Diseases caused by isopods and leeches; diseases caused by dactylogyrus and monocoelium; trematode larvae, nematodes and fish leeches - clinical picture, symptoms and prophylaxis. Tumours in fish - Epitheliomas and fibroepitheliomas, epithelioma papulosum; papillomas; adenomas; carcinomas; hepatoma and melanomas.

7. NUTRITIONAL DEFICIENCY DISEASES : Metabolic disturbances; vitamin deficiency ; gastritis and enteritis; aflatoxins in feed.

8. ENVIRONMENTAL STRESS DISEASES : Lack of oxygen; gas bubble disease; pH; acidosis and alkalosis; intoxications; hydrocyanic acid, free chlorine, metals, phenol, and temperature disturbances.

9. Fish farming and public health; techniques of curative baths and mass injections.

SUGGESTED READING :

David Freifelder. 1987. Microbial Genetics, Narosa Publishing House.

Michael J. Pelczar, JR. E C. S. Chan & Noel R. Krieg : Microbiology, Tata McGraw Hill Edition. 5th Edition.

Dubey, R. C. & D. K. Maheswari (2000). Text Book of Microbiology, S. Chand & Company Ltd. New Delhi.

Sharma, P. D. (1988). Microbiology, Rastogi Publications, Meerut, India.

Biswas, K. P. 1995. Prevention and Control of Fish and Prawn Diseases. Daya Publishing House, New Delhi.

Luky. 1994. Methods for the Diagnosis of Fish Disease. Daya Publishing House, New Delhi.

Kabatza, Z. 1985. Parasites and Diseases of Fish Cultured in the Tropics. Taylor and Frances, London.

Van Duijn, C. 1973. Diseases of Fishes. London Life Books Ltd.

Conroy, D. A. and Herman, R. L. 1968. Text Book of Fish Diseases. T.F.H. (Gt. Britain) Ltd.

Das, M. K. and R. K. Das. 1997. Fish and Prawn Diseases, Inland Fisheries Society of India, Barrackpore.
Chakrabarthy, N. M. 1995. Diseases of Cultivable Fresh Water Fishes and Their Control. Daya Publishing House, New Delhi.
Ellis, Anthony E. (Edr.) 1995. Fish and Shell Fish Pathology. Daya Publishing House, New Delhi.
AQC 302: FISHERY ECONOMICS, EXTENSION AND ENVIRONMENTAL MANAGEMENT
UNIT – I
AQUACULTURE ECONOMICS : Production economics – definition of economics and application of economic principles to aquaculture; the input-output relationship; maximum level of input; least-cost combination of inputs; maximum level of output; combination of products; economics of size; partial budget analysis.
MARKET ECONOMICS : Basic concepts in demand and price analysis; supply and demand for fish; elasticity of demand (price elasticity of demand, income elasticity of demand, cross elasticity of demand).
UNIT – II
ECONOMICS AND FINANCING OF AQUACULTURE : Economic viability; assets and liabilities; cost-return analysis; production costs-variable and fixed costs; operating income; evaluation of farm performance; sensitivity analysis; minimum farm size; gross revenue.
Economic feasibility of investment analysis; methods of feasibility analysis – the payback method, net present value method, average rate of return, discounting method; benefit – cost ratio; internal rate of return; cash flow analysis; socio-economic analysis; risk and insurance.
Economics of carp, prawn and shrimp breeding farms and production farms.
Role of banks, central organizations and other funding agencies in the growth and development of aquaculture.
UNIT – III
FARM MANAGEMENT : Concepts of economic principles of farm management; application of farm management principles in aquaculture.
MARKETING : Economics of fish markets; marketing and resource management; co-operatives and their importance in fish production and marketing; export oriented growth policies; fisheries projects and fish resources; institutional and management issues; planning and financing schemes for fisheries; legal and environmental issues.
FISHERIES EXTENSION : Extension education-objectives and principles; role of extension in community development; rural development strategies – programmes for weaker sections of the community; fisheries as a tool in rural development; extension strategies and methodologies; employment generation.

UNIT – IV
REMOTE SENSING : Utility of remote sensing techniques for the identification of suitable grounds for aquaculture and for obtaining data on geographical information system (GIS); role of remote sensing in the assessment of aquatic pollution.
ASSESSMENT OF ENVIRONMENTAL HAZARDS AND IMPACTS OF AQUACULTURE : Concept of clean environment; impact of fish farming on the aquatic ecosystem; impact of fish farming on socio-economic and socio cultural environment; effects of aquatic pollution on fish farming; environmental impact assessment studies (EIA); ecofriendly technologies in aquaculture.

SUGGESTED READING :
Korakandy, R., 1996. Economics of Fisheries Management – A Critique in the Third World Perspective. Daya Publishing House, New Delhi.
Allen et. al (Eds). 1984. Bio-Economics of Aquaculture. Elsevier.
Hepher, B. and Pruginin, Y. 1981. Commercial Fish Farming.
Pillay, T. V. R., 1993. Aquaculture : Principles and Practices. Fishing News Books.
Kothar, P., 1988. Marketing Management. Prentice Hall, Inc.
Adivi Reddy, A. 1976. Extension Education. Sree Lakshmi Press, Bapatla, India.
Joshi, M. V., 1996. Economics of Fisheries. Daya Publishing House, New Delhi.
Girirappa, S., 1995. The Role of Fisheries in Rural Development. Daya Publishing House, New Delhi.
Guidelines for the Promotion of Environmental Management of Coastal Aquaculture Development, FAO Fisheries Technical Paper 328. 1992. Rome.
Pillay, T. V. R. 1996. Aquaculture and the Environment. Daya Publishing House, New Delhi.
FAO, 1995. Geographical Information Systems and Remote Sensing in Inland Fisheries and Aquaculture. Daya Publishing House, New Delhi.

AQC 303: CELL BIOLOGY AND GENETICS
UNIT – I
1. STRUCTURE OF PROKARYOTIC AND EUKARYOTIC CELLS: ultrastructure of animal cell; cell differentiation in animal cells. Structural organization of plasma membrane; membrane protein, cytoskeletal proteins; types of cell functions – transport of nutrients, osmosis and active transport.
2. CELL ORGANELLES : Organization and functions of endoplasmic reticulum, golgi complex, lysosomes, mitochondria, ribosomes, nucleus, and vacuoles.
UNIT – II
3. CHROMOSOMES : Structural organization, nucleosomes, chromonema, euchromatin, heterochromatin, centromere, kinetochore, telomeric organization.
4. Cell cycle, mitosis and meiosis; cell senescence and death.

UNIT – III
PRINCIPLES AND PHYSICO CHEMICAL BASIS OF HEREDITY : Phenotype and genotype, chromosomal basis of heredity; Mendel's laws of inheritance, mutations – types of mutations, molecular basis of mutation and its importance, chemical and physical mutagens, site directed mutagenesis.
6. GENETIC RATIONALE IN FISH BREEDING : Random genetic drift, inbreeding, measures to prevent random genetic drift and inbreeding; selective breeding programmes - selection of species and traits, choice of breeding strategy, methods of selection and evaluation of selection response, impacts of selective breeding programmes on aquaculture productivity.
UNIT – IV
7. Natural hybridization in fishes, consequences and evolutionary impacts of hybridization; artificial hybridization – hybridization in Indian carps and Chinese carps. Genetic diversity in fishes – natural genetic variation in fishes, stock concept, measuring genetic variation, importance of genetic diversity; threats to fish genetic diversity – fishing pressure, physical modification of habitat and pollution load, introduction of exotic fishes; genetic management of natural fish populations – goals and tasks and conservation approaches.
8. CYTOGENETICS OF FISHES : Chromosome preparation, staining of chromosomes, chromosome banding techniques (NOR banding, C - banding, G and R banding, Fluorescence <i>in situ</i> hybridization), trends in karyotype evolution, sex chromosomes in fishes.
SUGGESTED READING :
B. K. Padhi & R. K. Mandal, Applied Fish Genetics. Fishing Chimes, Vishakapatnam.
Chourrout, D. 1987. Genetic manipulations in fish : reviews of methods. In : Selection, hybridization and genetic engineering in aquaculture (Ed. Tiews, K.) Vol. 2, Heenemann GmbH gesellschaft, Berlin. Pages 111 – 126.
Carvalho G. R. and L. Hauser (1995). Molecular Genetics in Fisheries. Chapman and Hall, London.

D. Frifielder : Microbial genetics.

Alberts et al: Molecular Biology of cells.
H. Lodish, A. Berk, S. L. Zipursky, P. Matsudaria, D. Baltimore and J. Damell. Molecular Cell Biology. W. H. Freeman & company, New York

AQC 304 : FISH IMMUNOLOGY
UNIT – I
Historical Review; terminology; innate & acquired immunity
IMMUNE SYSTEM IN FISH : Advanced, primitive and unique features; specific and non-specific defence mechanisms.
LYMPHOID SYSTEM IN FISH : Stem cells, thymus, spleen, head, kidney and other lymph glands; lymphocyte subpopulation in fish

UNIT – II
Antigen - Types - Heptanes, Ag - Ab interactions
IMMUNOGLOBULIN : IgM structure and functional aspects; other Igs; Ig mediated immunity; antibody diversity.
COMPLEMENT SYSTEM : Classical & alternative
UNIT – III
NON IG MEDIATED HUMORAL IMMUNITY : Antigrowth factors, antienzymes, lysins, complement (properdin path way); agglutinins and opsonins.
CRUSTACEAN IMMUNE SYSTEM
CELL MEDIATED IMMUNITY : MHS class I & II, allograft rejection; anaphylactic hypersensitivity; delayed type hypersensitivity, lymphokines. Antibody probes in diagnosis of fish diseases & immunodiagnostic kits.
UNIT – IV
IMMUNOTECHNOLOGY : Immuno diffusions, immuno electrophoresis, radio immunoassay, ELISA, MLR, Hybridoma technique, immunoblotting.
CONCEPT OF IMMUNISING FISH : Vaccines and immunostimulants in fish adjuvants; features of vaccine development; vaccine delivery systems; identification of disease problems and potential vaccines; case study describing vaccination for furunculosis; commercial considerations. Management of aquacultural practices through immunological approach.
SUGGESTED READINGS :
Nandini Shetty. 2000. Immunology : Introductory Text Book - New Age International (p) Ltd., Chennai.
Karunasagar, I. 1999. Aquaculture and Biotechnology. Oxford IBH Publishers
Goldsby. R.A., J. K. Thomas and B. A. Barbara, 2000. Kuby Immunology, IVth Edn., W. H. Freeman and Co., New York.
Fish & Shell Fish Immunology. 1992. Vol. 2, No.1, Academic press.
Kimbell, E. 1988. Fundamentals of Immunology.
PRACTICALS
III – Semester
AQC 305 : MICROBIOLOGY AND FISH DISEASES
Preparation and sterilization of microbial media.
Quantitative determination of microorganisms by dilution plate technique.
Staining methods of microorganisms.
Antibiotic sensitivity.
Isolation and characterization of intestinal pathogens.
Measurement of the size of the cell.
Collection and Preservation of Diseased Fish.

External & Internal examination of diseased finfish and shellfish.
Rapid Killing of Fish.
Inspection of internal organs through autopsy.
Maceration and squash preparation of organs and microscopic observation.
Identification of disease causing microbes.
Identification of various diseases in finfish and shellfish.
AQC 306 : CELL BIOLOGY, GENETICS AND IMMUNOLOGY
Preparation of chromosomes from gill epithelium
Observation of chromosomes from fish tissues.
Preparation of chromosomes from scale and fin epithelium.
Induction of ploidy variations in different tissues of fish.
Chromosomal banding techniques.
Observation of meiotic chromosomes from testis.
Isolation of DNA from yeast.
Isolation of RNA from yeast.
Raising antibodies to fish antigen.
Immuno-electrophoresis.
Double immunodiffusion.
AQC 307 : ORNAMENTAL FISH CULTURE (THEORY)
UNIT – I
1. Classification and characteristic features of common species of freshwater ornamental fishes.
2. Classification and characteristic features of common species of brackishwater and marine ornamental fishes.
UNIT – II
3. Construction and setting up freshwater aquarium and its maintenance; aquarium plants.
4. Mass production of ornamental fishes – food and feeding habits, water quality maintenance, breeding and rearing.
UNIT – III
5. Bacterial and viral diseases of aquarium fishes – causes, symptoms and control.
6. Fungal, parasitic and nutritional deficiency diseases – causes, symptoms and control.
UNIT – IV
7. Setting up of an export oriented ornamental fish unit.
8. Economics of ornamental fish culture.
SUGGESTED READINGS :
1. V. K. Dey, 1986. Ornamental Fishes. MPEDA.
2. R. Santhanam. 1987. A Manual of Freshwater Aquaculture, Oxford X IBH.
3. V. Satyanarayana. 1996. Fish culture, Narendra Publishing House.
4. P. K. Talwar and A. G. Jhingran 1991. Indian Fishes, Oxford & IBH
5. Q. J. Shammi and S. Bhatnagar. 2002. Applied Fisheries, Agrobios (India)

IV – Semester

AQC 401 : AQUACULTURE BIOTECHNOLOGY

UNIT – I

1. DNA : Structure and replication; Principles of DNA isolation; DNA blotting
2. DNA : Transcription and translation

UNIT – II

3. Chromosomal Engineering : Genome manipulation, polyploidy, gynogenesis, androgenesis, method of chromosomal manipulation, Induction of ploidy and evaluation.
4. Hormonal manipulation of genetic sex, strategy of sex reversal, management of hormone treatment, biological effects of sex reversal, integrated approach.

UNIT – III

5. Recombinant DNA and gene cloning – cloning vectors for recombinant DNA, restriction enzymes for cloning, cloning in bacteria and eukaryotes, construction and screening of genomic and cDNA libraries.
6. Polymerase chain reaction and gene amplification - basic PCR and its modifications; applications of PCR in biotechnology and genetic engineering – DNA polymorphism, DNA fingerprinting.

UNIT – IV

7. Transgenic fish, candidate genes for transfer, making gene constructs, mechanism of gene transfer, characterization of transgenic fish, potential hazards and benefits.
8. Cryopreservation of gametes, implications of cryopreservation in Aquaculture. Bioremediation :Types of bioremediation and their importance; Role of Probiotics in Aquaculture.

SUGGESTED READINGS :

1. K. Padhi & R. K. Mandal, Applied Fish Genetics. Fishing Chimes, Vishakapatnam.
2. P. S. Verma & V. K. Agarwal, 1999. Concepts of Molecular Biology,, S. Chand Company Ltd, NewDelhi.
3. Cherfas, N. B. 1981. Gynogenesis in fishes. In : Genetic bases of fish selection. (Ed. Kirpichnikov, V. S.), Springer-Verlag, Berlin, pp. 255 – 273.
4. Hackett, P. B. 1993. The molecular biology of transgenic fish. In : Biochemistry and Molecular Biology of Fish, (Eds. Hochachka, P., Mommsen, T.) Vol. 2, Elsevier Science Publishers, Amsterdam, pp. 207 – 240.
5. Leung, L. K. P. and Jamieson, B. G. M. 1991. Live preservation of fish gametes. In : Fish Evolution and Systematics : Evidence from spermatozoa (Ed. Jamieson, B. G. M.) pp. 245 –295, Cambridge University Press.
6. Old, R. W. and Primrose, S. B. 1994. Principles of gene manipulation : An introduction to genetic engineering, Blackwell Scientific Publications, Oxford.
7. Balasubramanyam, D. et al. 1998. Concepts in Biotechnology, University Press.
8. Gupta, P. K. 1999. Elements of Biotechnology, Rastogi Publications, Meerut.
9. Ranga, M. M. 1999. Animal Biotechnology, Agrobios, Jodhpur, New Delhi.
10. Karunasagar, Aquaculture and Biotechnology (for chapters 11 & 14).
11. Ranga and Shammi . 1999. Fish Biotechnology

AQC 402 : PROJECT WORK / DISSERTATION	
AQC 403 : COMPUTER APPLICATIONS, INFORMATION TECHNOLOGY AND BIOSTATISTICS IN AQUACULTURE	
UNIT- I INTRODUCTION TO COMPUTER History of computers, classification of computers, computer generations; Input, output processing and storage devices – Floppy disk, hard disk, CD-ROM,DVD.Operating system – types of operating systems – MS DOS, WINDOWS; MS – ACCESS, FOXPRO. UNIT- II COMPUTER APPLICATIONS	
Computer Graphics – graphic generation methods, uses of computer graphics, graphic forms; Internet access tools, Web searching, e-mail, File Transfer Protocol 9 FTP); Word processing and presentation softwars MS- WORD and MS- POWERPOINT, MS – EXCEL; Use of commonly available statistical packages, such as SPSS ANOVA etc.	
UNIT – III	
6. INTRODUCTION AND SCOPE OF BIOSTATISTICS Definition and scope, collection, tabulation and presentation of data; measures of central tendency – mean, median and mode; measures of dispersion, mean deviation, standard deviation, co-efficient of variation; curve fitting; correlation and regression.	
UNIT – IV	
7. STATISTICAL ANALYSIS Normal probability distribution and its applications; students t- test; correlation coefficient; regression co-efficient; F-distribution; X^2 distribution; analysis of variance (ANOVA);Probit analysis.	
SUGGESTED READINGS :	
1. Computers Today by Suresh K. Basandra 1999. Published by Galagotia Publications, Pvt. Ltd., New Delhi.	
2. Microsoft Office, by Setultz, 1997.	
3. Database Processing by D. M. Kroenke, Galgotia Publications, 1990.	
4. Introduction to Biostatistics – By Sokal-Rohlf (2 nd Edn) Freeman International Editor 1973.	
5. Bio-Statistics – An introductory Text-Goldstein, A The Macmillan Co., New York, 1971.	
6. Statistical Analysis in Biology by Mather, K Chapman and Hall, London, 1972.	
7. Probit Analysis by Finney, D. J. S. Chand & Co., Ltd., New Delhi.	
8. Biostatistics by Lewis Alvin 1971. Affiliated East West Press Pvt., Ltd., New Delhi.	
9. Statistical methods in Biology by Bailey Norman T. J. 1965. The English Language Book Society & The English University Press Ltd.	
AQC 404 : ESSENTIALS OF BIOCHEMISTRY	
UNIT – I	
1. BIOMOLECULES A brief account of structure and function of protein, lipid and carbohydrate.	
UNIT – II	
2. ENZYMES Nomenclature and classification; chemical nature of enzymes; coenzymes, properties of enzymes, factors affecting enzyme activity.	
UNIT – III	
3. METABOLISM Interconversions of protein, lipid and carbohydrates; A general account of vitamins and minerals and their importance.	

UNIT – IV
4. BIOENERGETICS
Definition and scope; bioenergetics model; structure of an energy budget; components of the energy budget – measurement of components; faecal losses – the absorption efficiency; excretory losses – the assimilation efficiency; metabolic losses; effects of environmental factors on metabolism – temperature, salinity, oxygen and other abiotic factors; examples of energy budgets.
SUGGESTED READINGS :
1. Furton, H. S. and S. Simonds. 1958. General Biochemistry. John Wiley and Sons, New York.
2. Murray et. al. 2002. Harper's Biochemistry 25 th Edn, Mc Graw Hill.
3. Nelson, D. L. and Cox, M. M. 2000. Lehninger Principles of Biochemistry. MacMillan Worth Publishers.
4. Robert J. Wootton. 1991. Ecology of Teleostean Fishes. Chapman & Hall.
5. Sibly, R.M. and Calow, P.1986. Physiological Ecology of Animals. Blackwell, Oxford.
PRACTICALS
IV SEMESTER
AQC 405 : BIOTECHNOLOGY AND BIOSTATISTICS
DNA Electrophoresis.
Estimation of DNA by Diphenylamine reaction.
Determination RNA by orcinol method.
Separation of protein through Electrophoresis (PAGE).
Separation of eyestalk peptides through HPLC.
Absorption spectrum of DNA.
Calculation of mean, median mode.
Calculation of standard deviation and coefficient of variation.
Calculation of Correlation co-efficient.
Fitting of regression lines.
Application of F-test.
Diagrammatic representation of statistical data.
AQC 406 : BIOCHEMICAL ESTIMATIONS
1. Estimation of protein, lipid and total carbohydrates in fish tissues.
2. Estimation of amino acids and free fatty acids in fish tissues.
3. Estimation of oxidative enzymes in fish tissues.
4. Estimation of digestive enzymes in fish.
5. Estimation of RNA and DNA in fish tissues.

AQC 407 : GENERAL PRINCIPLES AND PRACTICES OF AQUACULTURE (THEORY)
UNIT – I
1. Definition of Aquaculture : Types of culture, pond preparation and selection of species for culture. 2. Control of aquatic weeds and predators; management of fish ponds.
UNIT – II
3. Induced breeding and seed fish production in carps; transport of seed fish and breeders. 4. Food and feeding in fish - live feed and artificial feeds. 5. Measurement of growth : Length - weight relationship; determination of age in fishes; growth hormones
UNIT – III
6. Culture of Indian major carps and air breathing fishes. 7. Culture of shrimp and prawn. 8. Integrated fish farming; aquarium fish and their maintenance.
UNIT – IV
9. Bacterial and viral diseases of fish - causes, symptoms diagnosis and control measures. 10. Protozoan and fungal diseases and their control.
SUGGESTED READINGS :
1. Santhanam, R. et.al. 1990. A Manual of Fresh Water Aquaculture Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Khanna, S. S. 1997. An Introduction to Fishes. Central Book Depot, Allahabad.
3. Pillay, T. V. R. 1993. Aquaculture : Principles and Practices. Fishing News Books
4. Jhingran, V. G. 1982. Fish and Fisheries of India. Hindustan Publishing Corporation, New Delhi
5. MPEDA 1990. Aquaculture Engineering and Water Quality Management. Cochin, India.
6. Piska, R. S. 1999. Fisheries and Aquaculture. Lahari Publications. Hyderabad.
7. Conroy, D. A. and Herman, R. L. 1968. Text Book of Fish Diseases. T.F.H. (Gt. Britain) Ltd.
8. Biswas, K. P. 1995. Prevention and Control of Fish and Prawn Diseases. Daya Publishing House, New Delhi.
AQC 408 : BIOINFORMATICS IN AQUACULTURE (THEORY)
UNIT – I
1. BIOINFORMATICS AN OVERVIEW : Definition and objectives of bioinformatics, major bioinformatics databases, data integration and data analysis, molecular biology and bioinformatics, central dogma of molecular biology , important definitions related to central dogma and overview of bioinformatics applications. 2. INFORMATION SEARCH AND DATA RETRIEVAL : Introduction, tools for web search, data retrieval tools, data mining of biological data bases.
UNIT – II
3. GENOME ANALYSIS AND GENE MAPPING : Genome analysis, gene mapping, sequence assembly problem, genetic mapping and linkage analysis, physical maps, cloning the entire genome, genome sequencing, applications of genetic maps. 4. TOOLS FOR SIMILARITY SEARCH AND SEQUENCE ALIGNMENT : Fasta, Blast, Filtering and gapped BLAST, PSI – BLAST, Comparison of running time for various programmes.
UNIT – III
5. ALIGNMENT OF PAIRS OF SEQUENCES : Introduction, biological motivation of alignment problems, methods of sequence alignments, using scoring matrices, measuring sequence detection efficiency. 6. ALIGNMENT OF MULTIPLE SEQUENCES : Introduction, methods of multiple sequence alignment, evaluating multiple alignments; phylogenetic analysis – methods of phylogenetic analysis, tree evaluation, problems in phylogenetic analysis, automated tools for phylogenetic analysis.

UNIT – IV

7. GENE IDENTIFICATION AND PREDICTION : Introduction, basis of gene prediction, pattern recognition, gene prediction methods, other gene prediction tools.

8. GENE EXPRESSION AND MICROARRAYS : Introduction, working with DNA microarrays, clustering gene expression profiles, data sources and tools for microarray analysis, applications of microarray technology.

9. GENERAL APPLICATIONS OF BIOINFORMATICS IN AQUACULTURE.

SUGGESTED READINGS :

1. S. C. Rastogi, N. Mendiratta and P. Rastogi. 2004. Bioinformatics – Concepts, Skills and Applications. CBS Publishers and Distributors, New Delhi.

2. S. C. Rastogi, N. Mendiratta and P. Rastogi. 2004. Bioinformatics – Methods and Application. Prentice Hall of India Pvt. Ltd. New Delhi.

3. D. W. Mount. 2004 Bioinformatics – Sequence and Genome Analysis. IInd. Ed. Cold Spring Harbar Laboratory Press, New York.

MODEL QUESTION PAPER
M.Sc. DEGREE EXAMINATION
Branch XV – Aquaculture
Paper – I – CONCEPTS OF AQUATIC ECOLOGY
(CBCS with effect from 2015-2016)

Time : 3 hours

Maximum : 70 Marks

PART – A

Answer any **FOUR** questions. Each question carries 5 marks.

(Marks : 4x5=20)

1. Pelagic Habitat
2. Ecosystem
3. Thermal Stratification
4. PH
5. Sulphur Cycle
6. Phytobenthos
7. Water Bodies Classification
8. Decomposers

PART – B

(4X12.5=50)

Answer **ALL** questions. Each question carries 12.5 marks

9. Write an Essay on classification of Marine Habitat.
10. Compare the lotic and lentic ecosystems with Reference to Living Components.
11. Write an Essay on the Role of Temperature in Aquatic Ecosystems.
12. What is Salinity? Discuss the Ecological Effects of Salinity.
13. Discuss The Carbon Cycle in Aquatic Ecosystems.
14. What are Plankton? Give an Account on the Classification of Plankton.
15. Discuss the Different Trophic levels in the Aquatic Ecosystem.
16. What is Productivity? Discuss the Basic Concepts of Productivity.

P G Second Semester
207 - Human Values and Professional Ethics - I
(With effect from 2014 – 2015 batch)
Model Paper

Time: 3hours

Maximum Marks: 70

I Write any five of the following short notes

5x4=20

1. Define value
2. Reformative theory of punishment
3. Retributive theory of punishment
4. Deterrent theory of punishment
5. Justice,
6. Responsibility
7. Freedom,
8. Mahavratas
9. Anuvratas
10. Ethics of Islam

II. Write any of five of the following essay questions

5x10=50

1. Define ethics; bring out its nature and its relation to Religion, Politics, Law, and Medicine.
2. Give an account of the need and importance of Ethics
3. What is meant by Value? Bring out in brief the values of Good and Bad, , Actual and potential Values, Objective and Subjective Values,
4. Analyse the basic moral concepts of right, ought, duty and, obligation,
5. Ahimsa (Non-Violence), Satya (Truth), Brahmacharya (Celibacy), Asteya(Non possession) and Aparigraha(Non- stealing).
6. Analyse the importance of Purusharthas(Dharma, Artha, Kama, Moksha.)
7. Discuss the Bhagavad Gita ethics with special emphasis on Nishkama karma.
8. Explain the ethical theory of Buddhism with reference to The Four Noble Truths (Arya astanga marga,)
9. Examine the place of Religious Tolerance in Gandhian Ethics.
10. Explain the ethical Views of Manu and Yajnavalkya and their importance to the present society.

