

MANONMANIAM SUNDARANAR UNIVERSITY
TIRUNELVELI
B.VOC IN VALUE ADDED AQUACULTURE (CBCS)
(With effective from the academic year 2016-17 onwards)

Sem.	Subjects	Subject Title	Hrs./Week	Credits	Marks				
					Maximum			Passing Minimum	
					Int.	Ext.	Total	Ext.	Total
I		General Component							
	GC-1	Introduction to Aquaculture	6	6	25	75	100	30	40
	GC -2	Communicative English	6	6	25	75	100	30	40
			12	12					
		Skill Component							
	SKC-1	Harvest and Post harvest Technology:Paper-1	6	6	25	75	100	30	40
	SKC-2	Practical - Harvest and Post harvest Technology:Paper-1	8	8	25	75	100	30	40
	SKC-3	Industrial Visit/record Submission	4	4	25	75	100	30	40
			18	18					
		Total	30	30					
II		General Component							
	GC-3	Biology of Fin Fishes	6	6	25	75	100	30	40
	GC-4	Life Skills	6	6	25	75	100	30	40
			12	12					
		Skill Component							
	SKC-4	Harvest and Post harvest Technology:Paper-2	6	6	25	75	100	30	40
	SKC-5	Practical - Harvest and Post harvest Technology:Paper-2	8	8	25	75	100	30	40
	SKC-6	Project work	4	4	25	75	100	30	40
			18	18					
		Total	30	30					

III		General Component							
	GC-5	Freshwater Aquaculture	6	6	25	75	100	30	40
	GC-6	Aquaculture Nutrition	6	6	25	75	100	30	40
			12	12					
		Skill Component							
	SKC-7	Aquaculture farm Design and Management	5	5	25	75	100	30	40
	SKC-8	Aquaculture Disease management	5	5	25	75	100	30	40
	SKC-9	Practical - Aquaculture farm Design and Management and Aquaculture Disease management	8	8	25	75	100	30	40
			18	18					
		Total	30	30					
IV		General Component							
	GC-7	Aquaculture Biotechnology	6	6	25	75	100	30	40
	GC-8	Ornamental Fish culture	6	6	25	75	100	30	40
			12	12					
		Skill Component							
	SKC-10	Marine hydrocolloids	4	4	25	75	100	30	40
	SKC-11	Practical - Marine hydrocolloids	8	8	25	75	100	30	40
	SKC-12	Project work	6	6	25	75	100	30	40
			18	18					
		Total	30	30					
V		General Component							
	GC-9	Fishery Resources	4	4	25	75	100	30	40
	GC-10	Environmental Studies	4	4					
	GC-11	Mariculture	4	4	25	75	100	30	40
			12	12					
		Skill Component							
	SKC-13	Hatchery technologies in aquatic organisms	6	6	25	75	100	30	40
	SKC-14	Disease Diagnosis in Aquaculture	6	6	25	75	100	30	40
	SKC-15	Practical - Hatchery technologies in aquatic organisms and Disease Diagnosis in Aquaculture	6	6	25	75	100	30	40
			18	18					

		Total	30	30					
VI		General Component							
	GC-12	Fisheries Economics and Extension	6	6	25	75	100	30	40
	GC-13	Bio-entrepreneurship	6	6	25	75	100	30	40
			12	12					
		Skill Component							
	SKC-16	Value Added Products	5	5	25	75	100	30	40
	SKC-17	Practical - Value Added Products	5	5	25	75	100	30	40
	SKC-18	Project Work	8	8	25	75	100	30	40
			18	18					
		Total	30	30					

Note: GC= General Components 72 credits; SKC-Skill Component :108 credits

SEMESTER - I

GC-1 : INTRODUCTION TO AQUACULTURE

- Unit I : Definition of Aquaculture-Introduction to Aquaculture-Types of Aquaculture (Traditional, Extensive, Semi intensive, Intensive and Super intensive).
- Unit II : Site selection for Pond Construction, Design of pond, pond construction, pond preparation.
- Unit III : Species selection for aquaculture- Types of cultivable species, present practices of fish culture in ponds.
- Unit IV : Water Quality management- Estimate DO, Salinity, pH, temperature, Ammonia, H₂S and other compounds.
- Unit V : Categories of Aquaculture-Pond culture, culture in manmade reservoirs, paddy cum aquaculture, Brackish water aquaculture, coastal aquaculture, salt pan aquaculture, cage culture and pen culture.

References:

1. Balugut, E.A.1989. Aquaculture system and practices. A selected review publishing House, New Delhi.
2. Pillai, TVR. and M. N. Kuty., 2005. Aquaculture: Principles and Practices, Wiley-Blackwell.
3. Robert R. Stickney., 2009. Aquaculture: An Introductory Text, CAB International Publishers.
4. Srivastava, Fish Biology, Narendra Publishing House
5. S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House

GC-2 : COMMUNICATIVE ENGLISH

Unit I : Learning context

Concept of learning – Learning style –Grammatical framework – sentence framing – paragraph and texts

Unit II: Reading

Basic concept – Purposes of reading-Decoding-Reading materials – Barriers of reading

Unit III: Writing

Basic concept-Writing style-Terminology-stages-English spelling and punctuation – Written texts

Unit IV: Speaking

Language functions-Conversation- Features of spoken English – Types of English course: functional English, English literature, advance English – Phonetic

Unit V: Developing Communication Skills

Meaning –Classroom presence- Features of developing learning process- Practical skills and Listening- uses of communicative English

References

1. Raman, M. & S.Sharma (2011) communication skills, OUP, New Delhi: India
2. Lata,P. & S.Kumar (2011) communication skills, OUP, New Delhi: India,
- 3.Leech,G & J.Svartvik (2002) A communicative grammar of English, Pearson, India,
4. Sethi,J. & P.V. Dharmija (2007) A course in Phonetics and spoken English.Second edition, Prentice hall: New Delhi.

SKC-1 : HARVEST AND POST HARVEST TECHNOLOGY – PAPER I

- Unit I : Introduction to fish harvest techniques. Different types of fishing crafts and gears available for fish harvesting in inland, marine traditional and mechanised sectors.
- Unit II : Active, passive and traditional fishing gears – their principles and operations (shore seine, gill net, trawl net, hook and line fishing, fishing traps).
- Unit III : Introduction to fish preservation – concepts, importance and principles of fish preservation – History of preservation techniques by drying – Types of dryers – processing prior to drying.
- Unit IV : Concept and importance of preservation by using high temperature; methods used – canning and effect of high temperature on fish and fishery products.
- Unit V : Low temperature preservation – Concepts & history, types of preservation methods by low temperature – Equipments used – Treatment before freezing the food.

References :

1. Processing of Fish and Fish products – FAO 2011.
2. Fish Processing Technology – George M. Hall, Springer 1992.
3. Fish Processing Technology, Ananthan, 2008.
4. Post Harvest Technology & Fish and Fish Products – K. K. Balachandran, 1996.
5. A Text Book of Fish Processing – K. Gopakumar, 1995 – CIFT Publication.

SKC-2 : Practical - HARVEST AND POST HARVEST TECHNOLOGY – PAPER I

Identification of important freshwater, brackish water, marine water finfishes and shellfishes.

1. Identification of shrimp, lobster & molluscs.
2. Filleting of fish.
3. Grading, glazing and packing of prawns.
4. Observation of physical changes during freezing.
5. Observation of sensory changes during freezing, drying and smoking.
6. Preparation of dried products.
7. Preparation of cured products.
8. Examination of moisture content in dried products.
9. Examination of spoilage in dried products.

SEMESTER – II

GC-3 : BIOLOGY OF FIN FISHES

- Unit I : Introduction to Fish biology, definition and basic concept of biosystematics, Importance of fish classification and their taxonomical studies.
- Unit II : Morphological and anatomical characteristics of fin fishes (Alimentary canal, gills, swim bladder, accessory respiratory organs, lateral line system and sound and light producing organs).
- Unit III : Food values of fishes, both fresh water and marine water fishes- qualitative and quantitative analysis of stomach content-seasonal changes in food availability and food preference.
- Unit IV : Growth of fish (absolute, relative and maturity, estimation of fecundity, spawning, reproductive behaviour and parental care, social behaviour, aggregation and locality- Migrational pattern.

Reference Books:

1. Pillai, TVR. and M. N. Kutty., 2005. Aquaculture: Principles and Practices, Wiley-Blackwell.
2. Jhingran, V.C. 1991. Fish and Fisheries in India. Hindustan Publishing Company, New Delhi, India.
3. Day, F. 1981. Fishes of India Vol. I and II; William Sason and sons Ltd., London.
4. Santanam, R. 1980. Fisheries Science, Daya Publishing House, New Delhi, India.
5. Yadav, B.N. 1997. Fish and fisheries, Daya Publishing House, New Delhi, India.
6. Khanna, S.S. and Sing, H.R. 2003. Fish Biology and fisheries, Narendra Publishing House, New Delhi, India.
7. J.R. Norman, A history of Fishes, Hill and Wang Publishers
8. Bone and R Moore, Biology of Fishes, Talyor and Francis Group, CRC Press, U.K.
9. D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group, CRC Press, UK
10. Srivastava, Fish Biology, Narendra Publishing House
11. Sinha, V.R. P. and Srinivastava, H. C. (1991). Aquaculture Productivity. Oxford and IBH Publications CO., Ltd., New Delhi.
12. Yadav, B. N. (1997). Fish and fisheries. Daya Publishing house, New Delhi.
13. FAO volumes for fish identification.

GC-4 : LIFE SKILL

(Common to All Courses)

UNIT- I ATTITUDE : Positive thinking – Goal setting – Problem Solving and Decision making – Leadership and Team Work.

UNIT- II COMMUNICATION SKILLS: Oral communication: Concept of English language – Fluency – Verbal communication in official and public situations.

UNIT-III COMMUNICATION SKILLS: Written Communication: Comprehension – Writing a formal letter like application for Job, enquiry, reply, complaint and such others – preparation of Resume, Curriculum Vitae.

UNIT- IV COMPUTING SKILLS – 1: Introduction to Computers, its various components and their respective functions – Memory storage devices – Microsoft (MS) Office – MS Word.

UNIT - V COMPUTING SKILLS – 2 Internet Basics – Origin of Internet – MODEM – ISP – Upload – Download – e-mail – Origin of worldwide web (www) Browsers – Search engines.

Reference book:

1. Life skill, Manonmaniam Sundaranar University Publications Division (2011)

SKC-4 : HARVEST AND POST HARVEST TECHNOLOGY – PAPER II

- Unit I : Composition and nutritional value of fish as food – moisture, lipid, protein, carbohydrates; changes in fish after death as spoilage of fish – biochemistry of fish spoilage.
- Unit II : Handling and sanitation of fresh and harvested fish – Bacteriology of fish, water and occurrence of bacteria on fish and its load – microbial spoilage of fish and methods of preservation.
- Unit III : Handling of fish in on board & offshores – sorting – evisceration and removal of gills, ice and icing methods, fish holds, containers, cleaning and disinfection personal hygiene and HCCP.
- Unit IV : By products and value added products : Fish meal manufacturing process – fish silage, fish oil (Body oil and liver oil) production – fish maws, fins and leather production – chitin, chitosan and glucosamine production from shrimp waste – FPC, fish soup powder – fish balls – fish curry – fish pickle – fish enzyme – surumi products – fermented fishery products.
- Unit V : Transportation and packaging of fishery products : Transportation of frozen foods – concept of cold chain and quality control – Introduction of packaging – objectives and requirements – Environmental aspects of food packaging.

References :

1. Fundamentals of quality control of the twigg, a food industry – K. Karamer, 1970.
2. Seafood Chemistry, Processing Technology and Quality – f. Shahidi & R. J. Botta, 2008.
3. Quality control in fish processing – CIFT Manual, Cochin, 1979.
4. Fishery Science, its methods and application – George A. R., 1991.
5. Seafood Recipes – MPEDA Publication, 1993.

SKC-5 : Practical - HARVEST AND POST HARVEST TECHNOLOGY – PAPER II

1. Handling and sanitation of fresh and harvested fish.
2. Visit to landing centres and fish markets.
3. Observation of microbial spoilage in fishery products.
4. Handling of fish – sorting of shrimp in grade-wise.
5. Demonstration of evisceration and removal of gills in fish.
6. Demonstration of icing methods in fish preservation.
7. Demonstration of cleaning and disinfection of processing materials.
8. Fish meal production.
9. Chitin and chitosan production from shrimp shell waste.
10. Fish soup, fish curry and fish pickle production.

SEMESTER III

Freshwater aquaculture [GC-5]

Unit - 1 : Freshwater Fish Culture: Various freshwater organisms used for aquaculture in India. Culture of carps; Nursery rearing and stocking ponds – composite fish culture, Preparation of ponds– different methods for the eradication of weed fishes, predators, aquatic insects and aquatic weeds, stocking and post stocking management, harvesting. Culture of air breathing fishes.

Unit – 2 : Culture of Prawns, Molluscs and Frog: Cultivable species of freshwater prawns and their biology – culture of *Macrobrachium rosenbergii*. Important freshwater molluscs. Freshwater pearl culture.

Unit – 3 : Sewage fed fish culture : Sewage fed fish culture, sewage treatment,– Sewage cum fish culture in India. Fish in relation to public health – Larvivores fishes and mosquito eradication using fishes.

Unit – 4 : Integrated Farming : Recent development in integrated farming – Rice cum fish culture, Duck cum fish culture, Poultry cum fish culture and Pig cum fish culture. Organic aquafarming. Fish culture in cages and pens. Running water fish culture.

Unit – 5 : Freshwater Aquaculture Systems : Fish culture in cages and pens, race way, indoor tanks, canals, silo culture, Aquaponics. Monoculture, polyculture, composite fish culture.

Suggested Readings:

1. S.H. Singh and A.K. Ahmad, 2011. Freshwater Aquaculture, Daya Publishing House, New Delhi.
2. N. Romoanowski, 2006. Sustainable Freshwater Aquacultures: The complete guide from backyard to investor, University of New Southwales Press.
3. R.K. Rath, 2000. Freshwater Aquaculture, Laurier Books Ltd.
4. Ahilan, B. Textbook of freshwater Aquaculture, Daya Publishing House, New Delhi.
5. J.E. Bardach and J.H. Rhyther, 2013. Aquaculture: The Farming and Husbandary of Freshwater and Marine organisms, John Wiley & Sons.

Aquaculture Nutrition [GC-6]

Unit – 1 : Nutritional Requirements of Fishes : Protein and amino acid requirement, carbohydrate and lipid requirement, Essential fatty acids, Non protein nitrogen sources. Vitamin and mineral requirements, vitamin C for fish and shell fishes.

Unit – 2 : Larval nutrition: Larval stages, nutritional requirements of fish and shellfish larvae, quality requirements of larval feeds (particle size, digestibility), natural food and its importance in aquaculture, nutritional quality of commonly used fish food organisms, bioenrichment, biofilm / periphyton and its uses.

Unit – 3 : Feed ingredients and Feed additives: Different feed ingredients- animal, plant, microbial origin, SCP, silages, fermented products. Anti-nutritional factors. Storage, quality standards, proximate composition & chemical evaluation. Digestibility studies and methods. Feeds and feed additives, pigments, immunostimulants, non-nutritional feed additives - chemoattractants, feeding stimulants, growth promoters, preservatives.

Unit – 4 : Types of Feed & Feed Manufacturing : Different types of feeds : Simple feed, compound feed, crumbles, micro-encapsulated feed. Types of compound feeds : Mash / meal, wet feeds, dry feeds. Feed Formulation - Square method. Feed manufacturing processes: Different size and grades of fish / shrimp feeds - starter, grower and finisher feeds. Micro-bound feed, micro encapsulated feed. Storage and transportation of feeds. Quality problems- toxins, pests, rancidity.

Unit – 5 : Feed Management: Practical feeding in grow-outs of fishes & shrimps. Feed ration, feed quantity estimation, feeding frequency. Check trays, demand feeders, automatic feeders, feed dispensers. Farm made feeds, factory made fish & shrimp feeds in India. Record keeping.

Suggested Readings:

1. Daniel. L. Merrifield and E. Ringo, 2014, Aquaculture Nutrition, Wiley- Blackwell.
2. Torn Lovell, 1998. Nutrition and Feeding of Fish, 2nd Edition, Kluwer Academic Publishers.
3. D. Allen Davis, 2015. Feed and Feeding Practices in Aquaculture, Woodhead Publishing.
4. J. Guillaume, S. Kaushik, P. Bergot and J. Watson, 2008. Nutrition and Feeding of fish and crustaceans, Springer Parxis publications.

Aquaculture Farm Design and Management [SKC-7]

- Unit - 1:** Soil and water resources of fish farm, component of fish farm – Design and construction – Water regulating devices – Fertilisation of Pond – Improvement of pond bottom – Control of aquatic weeds.
- Unit – 2:** Water quality Management : Important water quality parameters – Maintenance of water quality – Types of Aerators and Aeration system.
- Unit – 3 :** Natural seed resource – Seed production and seed grounds – Methods of collection of seed for culture practices – Quantifying and acclimatization of seeds – Hatchery production of seed – Components of hatchery – Nursery management.
- Unit – 4 :** Traditional, extensive, semi-intensive and intensive culture practices in India and other countries – Advantages and disadvantages of extensive, intensive and semi-intensive culture system – Culture of shrimps, carp, milk fish and sea bass.
- Unit – 5 :** Design of freshwater and brackish water farms – Project formulation and layout – Different components of aqua farm peripheral dikes, secondary dikes, feeder canals, shine gate and monks – Design of shrimp hatcheries – Means of increasing production from aquaculture ponds.

Suggested Readings:

1. Pillay, T.V.R. 1993. Aquaculture: Principles and Practices, Fishing News Books, Blackwell Scientific Publications.
2. Upadhyay, A. S. 1995. A Hand Book on Design, Construction and Equipments in Coastal Aquaculture (Shrimp Farming). Daya Publishing House, New Delhi.
3. Lucas, J.S. 2012. Aquaculture: Farming Aquatic animals and plants, Wiley – Blackwell.
4. Christenson, K. 2015, Aquaponics: Aquaculture – An introduction to aquaculture for small farmers, 3rd Edition (Aquaponics, hydroponics, permaculture, fish farming, aquaponics system, ecosystem,
5. Huguenin, J.E. and J. Colt, 2014, Design and Operating guide for aquaculture seawater system, Elsevier.

Aquaculture Disease Management [SKC-8]

Unit – 1 : Significance and Development process of disease: Disease development process in fish and shell fish – Defense mechanism in finfish and shellfish – Specific and non-specific immune system – Role of stress and host defense mechanism in disease development.

Unit – 2 : Host pathogen and environment interaction: Viral, bacterial and fungal fish pathogens – their general biology and taxonomy – Detection and isolation techniques, symptoms, pathology – Diagnosis of known bacterial, viral and fungal diseases.

Unit – 3 : Infectious diseases: Morphology, biology and life cycle of parasites – Infectious diseases of cultured finfish and shellfish – Important disease epizootics of wild fish population – Zoonotic diseases – OIE listed and notifiable diseases – Diagnosis of parasitic diseases.

Unit – 4 : Non-infectious diseases: Nutritional deficiency diseases due to Environmental parameters and their effects of fish health – Diseases due to algal toxins – Disease of hatcheries and growout systems.

Unit – 5 : Disease management: Environment management – Chemotherapeutic agents, host management, prophylaxis –vaccines, adjuvants, immunostimulants and probiotics – Use and abuse of antibiotics and chemicals in health management – Fish health and quarantine systems – Seed certification, SPF and SPR stocks – Development and applications.

Suggested Readings:

1. Patrick, T.K. Woo, 2006. Fish Diseases and Disorders,
2. J.S.Lipton, 2009. Shrimp Disease Management, ANE Books.
3. Galina, J. 2011, Fish Diseases: Prevention and Control Strategies, Academic press.
4. Austin, B. And Austin, D.A. 2016, Bacterial fish pathogens: Disease of farmed and wild fish, Springer publications.
5. Martimore, S. And Motarjemi, Y, 2010. Food safety Management: A practical guide for Food industry, Academic press.

**PRACTICAL - AQUACULTURE FARM DESIGN AND MANAGEMENT AND
AQUACULTURE DISEASE MANAGEMENT [SKC 7 & 8]**

1. Equipment used in soil and water analysis [pH Meter, Thermometer, Salinity refractometer, Secchi disc, Nansen water sampler, Plankton net, Petersen Grab]
2. Soil analysis: Determination of soil texture, temperature, pH, conductivity, salinity.
3. Water analysis: Determination of dissolved oxygen, turbidity, pH, total alkalinity and hardness, transparency and turbidity.
4. Estimation of primary productivity and chlorophyll.
5. Application of fertilizers and pond liming.
6. Design and operation of biological filters and aerators.
7. Identification and working of various equipments in farm and hatchery.
8. Design of farm structure: ponds and dykes, earthwork calculation.
9. Methods of fish sampling for disease diagnosis. Live and post mortem examination of diseased fish.
10. Collection and identification of fish parasites.
11. Morphological, biochemical and biological tests of bacteria and virus.
12. Sampling, preparation of media and culture of pathogenic bacteria.
13. Antibiotic sensitivity assay.
14. Histological techniques for disease diagnosis.
15. Agglutination test and Challenge tests.
16. PCR and ELISA (Demonstration)

SEMESTER IV

Aquaculture Biotechnology [GC-7]

Unit – 1 : Feed Technology : Micro encapsulated feeds, micro coated feeds, micro-particulate feeds and bio-encapsulated feeds, mycotoxins and their effects on feeds.

Unit – 2 : Health Management: DNA and RNA vaccines, molecular diagnosis of viral diseases, PCR, Dot-blot, ribotyping of pathogenic microbes, RNAi, Biofilms and its impact on health management - Probiotics and prebiotics – Immunostimulants - Bioremediation of soil and water.

Unit – 3 : Algal Biotechnology: Microalgae - indoor and mass culture methods, biotechnological approaches for production of important microalgae, single cell protein from Spirulina, raceway system of micro algae culture, vitamins, minerals and omega3 fatty acids from micro algae, enrichment of micro algae with micronutrients.

Unit – 4 : Breeding and cryopreservation : Synthetic hormones for induced breeding- GnRH analogue structure and function. Definition and significance, cryopreservation of gametes and embryo, advantage and disadvantage of cryopreservation.

Unit – 5 : Transgenesis : Transgenic fishes, Methods of gene transfer in fishes, single gene traits, screening for transgenics, site of integration, applications, regulation of GMOs, IPR, Evaluation of GFP transgenics.

Suggested Readings:

1. Lakra WS, Abidi SAH, Mukherjee SC & Ayyappan S. 2004. Fisheries Biotechnology. Narendra Publ. House.
2. Nagabhushanam R, Diwan AD, Zahurnec BJ & Sarojini R. 2004. Biotechnology of Aquatic Animals. Science Publ.
3. Nair PR. 2008. Biotechnology and Genetics in Fisheries and Aquaculture. Dominant Publ. 106
4. Pandian TJ, Strüssmann CA & Marian MP. 2005. Fish Genetics and Aquaculture Biotechnology. Science Publ.
5. Reddy PVGK, Ayyappan S, Thampy DM & Gopalakrishna. 2005. Text Book of Fish Genetics and Biotechnology. ICAR.

Ornamental fish culture [GC-8]

- Unit – 1 :** Introduction to Aquarium and ornamental fishes: World aquarium trade and present status. Accessories- Aerators, filters, lights, heaters. Water quality requirements. Different kinds of feeds. Culture of fish food organisms; preparation of dry feeds; feeding methods.
- Unit – 2:** Freshwater Ornamental Fishes: Different varieties of Ornamental fishes- Live bearers, Gold fish and koi, Gourami, Barbs and Tetras, angel fish and cichlids. Broodstock development, breeding, larval rearing and grow out. Larval feeds and feeding. Induced breeding.
- Unit – 3 :** Production of Ornamental Fishes: Requirements and design for the commercial production units of ornamental fishes. Commercial production of goldfish, live bearers, gouramies, barbs and tetras, angel fish. Mass production of aquarium plants. Natural ponds for the mass production of ornamental fishes. Marketing of aquarium fishes, retail outlets, export of ornamental fishes.
- Unit – 4 :** Marine Ornamental Fishes: Marine ornamental fishes – varieties and their habitat. Major marine ornamental fish resources of India. Method of collection and transportation of live fish. Use of anesthetics. Quarantine measures. Breeding of marine ornamental fishes.
- Unit – 5 :** Aquarium Management: Setting up of Fresh water, Marine and reef aquariums. Maintenance of water quality. Common diseases of aquarium fishes, their diagnosis and treatment. Handling, care & transportation of fish. Temperature acclimatisation, oxygen packing.

Suggested Readings:

1. R. Santhanam, 1987, A manual of freshwater aquaculture, Oxford, IBH
2. V.K.Dey, 1997, Hand book on aquafarming, ornamental fishes, MPEDA
3. Dholakia, A.D. 2009. Ornamental fish culture and Aquarium Management, Daya Publishing House,
4. Brain Andrews, 2011. Ornamental fish farming. The small, medium and large scale breeding and marketing of freshwater tropical fish and gold fish,
5. Ravi, K. And B.F. Phillips, 2011, Recent Advances and New species in Aquaculture, Wiley Interscience.

Marine Hydrocolloids – [SKC – 10]

Unit – I: Introduction to Hydrocolloids: Sources of hydrocolloids: Seaweeds – Methods of seaweed cultivation. Properties of hydrocolloids: viscosity, gelling properties, surface activity and emulsifying property - Enzymatic hydrolysis of hydrocolloids.

Unit – 2: Alginates: Sources of alginate from seaweeds – Methods of extraction and yield – Chemical characterization - Structure – Molecular weight determination - Physico-Chemical properties.

Unit – 3: Carrageenan - Sources of carrageenan from seaweeds – Methods of extraction and yield – Chemical characterization - Structure – Molecular weight determination - Physico-Chemical properties.

Unit – 4: Agar - Sources of agar from seaweeds – Methods of extraction and yield – Chemical characterization - Structure – Molecular weight determination - Physico-Chemical properties.

Unit – 5: Applications of hydrocolloids: Food industry – Textile industry - Pharmaceutical industry –Drug delivery system – Aquaculture industry.

References:

1. Scheupr, P.J. 1984. Chemistry of Marine Natural Products, Chemical and Biological perspectives, Academic Press, New York.
2. Williams, P.A. and Phillips, G.O. 2000. Gums and Stabilizers for the Food Industry. Royal Society of Chemistry.
3. G.O. Phillips and P.A. Williams, 2009. Handbook of hydrocolloids, 2nd Edition, Woodhead Publishing, UK.
4. C.S. Hollingworth, 2010. Hydrocolloids: Characteristics, properties and structures, Food Science and Technology,
5. Dennis. J. McHugh, 2003. A guide to the seaweed industry, Food and Agriculture Organization of the United Nations, Rome.

PRACTICAL - MARINE HYDROCOLLOIDS [SKC-11]

1. Methods of seaweed cultivation and harvesting technology.
2. Extraction of agar agar from seaweeds.
2. Extraction and quantification of carageenan from seaweeds.
3. Extraction and quantification of sodium alginate from seaweeds.
4. Immobilization of bacterial cells using sodium alginate.
5. Immobilization of bacterial cells using agar agar.
6. Analysis of gelling property of agar agar.
7. Analysis of gelling property of carageenan.
8. Analysis of gelling property of sodium alginate.

PROJECT WORK [SKC 7, 8 & 9]

A mini project work related to skill component 7, 8 & 9 has to be undertaken by the students.

L	P	T	C
6	0	0	6

SEMESTER : V

GC-9 : FISHERY RESOURCES

- Unit I : **Fisheries resources in general** : Major fisheries resources of the world, global trends in production, targeted and non-targeted fisheries resources of Indian continent. Distribution, composition, trends and dynamics of major fishery resources in freshwater and marine systems in India. – **10 h**
- Unit II : **Inland fishery resources** : Problems in inland fisheries, inland fishery resources includes riverine system and their fisheries in India. Eg. Of rivering fisheries – Ganga, Brahmaputra riverine system. East and west coast riverine system. Fisheries in major lakes of India, their origin and distribution, Bheel fisheries of India. – **12 h**
- Unit III : **Cold water and riverine fisheries resources** : Important cold water fisheries of India, sport fisheries and their significance (Eg. Mahseer and Trout Fisheries). Invasive of fish species and their importance – Important Indian reservoirs, their origin, distribution and their fishery potentials. Ecology and management of major reservoirs in India. – **14 h**
- Unit IV : **Inshore, offshore and deep sea fisheries of Indian sea, capture fisheries of India** : Important finfish, shellfish resources of India. Economics, management and development of marine fishes in India. Commercially important fishes of India (Oil sardine, mackerel, Bombay duck, Pomfret, Sole fishery etc.). – **12 h**
- Unit V : **Brackish water fishery resources** : Principle fisheries of brackish water (Eg. In Chilka, Pulicat and Kolleru lakes). Fishery resources in the brackish water environment in India. Major estuaries in India and their fishery resources. Backwater regions in India and their fishery resources. Problems and prospects of brackishwater fisheries in India, management of estuaries in India. – **12 h**

References

1. Jhingran, V. G., 1991. Fish and Fisheries of India, 3rd Edn., Hindustan Publication.
2. Sugumaran, V. V., 1997. Reservoir fisheries of India. Daya Publishers, New Delhi.
3. Jhingran, V. G. and K. L. Sehgal, 1978. Cold water fisheries of India, S. P. Publication.
4. Blaker, J. M., 1997. Fish and fisheries in Traditional estuaries. Chapman and Hall, London.
5. FAO Technical Paper on Freshwater Fisheries.

L	P	T	C
6	0	0	6

GC-10 : ENVIRONMENTAL STUDIES

- Unit I : **Ecosystem** : Concept of an ecosystem, production, consumers and decomposers. Energy flow in the ecosystem. Ecological succession, food chains, food webs and ecological pyramid. Habitat ecology, freshwater habitat – Marine habitat and Estuarine habitat. – **12 h**
- Unit II : **Marine Biodiversity** : Introduction, definition, genetic, species and ecosystem diversity. Value of Biodiversity, threats to marine biodiversity – Habitat. Selection, prey predator relationship structure and function of ecosystem.- **14h**
- Unit III : **Environmental pollution** : Definition, cause effects and control measures – Air, water, soil, marine, Thermal and nuclear power plants – Effluents treatments – Industrial & Mariculture. Oil pollution – source, cleaning, biosurfactants, marine bioremediation. – **14 h**
- Unit IV : **Biogeochemical cycles** : Carbon, nitrogen and phosphorus and hydrological cycle. Basic green house gases – climate change and its significance and causes. Impact of global warming on ecosystem. – **10 h**
- Unit V : **Aquaculture pollution** : Aquaculture water pollutants – Biofilters, parts and function – Aquaculture effluent, treatment measures. Aquaponics and Bio-floc techniques. – **10 h**

Public awareness and fieldwork – visit to a shrimp / fish hatchery / farm.

References

1. Odum, E. P., 1972. Fundamentals of Ecology by Eugene, W. B. Saunders Company, London.
2. Smith, R.L., 1986. Elements of Ecology. Harpet and Row Publishers, New York.
3. Trivedi, P.R. and K. Gurdeepraj, 1992. Environmental Biology, Akashdeep Publishing House, New Delhi.
4. Dash, M. C., 1993. Fundamentals of Ecology. Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
5. Pillay, T.V.R. and M. N. Kutty, 2005. Aquaculture Principles and Practices, Blackwaell Scientific Publishers, UK.

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GC-11 : MARICULTURE

- Unit I : **Mariculture in India** : Types of Mariculture – Extensive, Semi intensive, Intensive farming. Types of culture – Monospecies / Monosex culture, Polyculture, Integrated fish culture. Marine Species cultured in India – Cage culture, Pen culture, Raft culture – RAS. Parameters for assessing water quality in ponds – Temperature, salinity, pH, dissolved oxygen, ammonia, nitrite, nitrate, turbidity. – **14 h**
- Unit II : **Design and construction of ponds** : Criteria in selection of species for mariculture – site selection, topography accessibility to roads for transportation. Supply - power designing, construction and preparation of ponds and pond management. – **12 h**
- Unit III : **Finfish and shellfish culture** : Culture of finfish – milk fish, mullets, sea bass, cobeia. Culture of shell fish – shrimps, lobsters. Culture of Molluscs – oysters, mussels. – **10 h**
- Unit IV : **Live feed culture** : Culture of microalgae, culture of *Artemia*, culture of rotifers, culture of chironomids and culture of Tubifex. – **12 h**
- Unit V : **Seaweed culture** : Methods of seaweed culture – water quality – harvesting and processing methods – seaweed products. – **12 h**

References

1. Pillay, T.V.R. and M. N. Kutty, 2005. Aquaculture Principles and Practices, Blackwaell Scientific Publishers, UK.
2. Jingran, V. G. and Pullin, R. S.V., 1985. Hatchery Manual for the common, Chinese and Indian Major Carps, ICLARM.
3. Rath, P. K., 2000. Freshwater Aquaculture, Scientific Publishers, Jodhpur.
4. Jingran, V. G., 1991. Fish and fisheries of India, 3rd Edn., Hindustan Publication.

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SKC-13 : HATCHERY TECHNOLOGIES IN AQUATIC ORGANISMS

- Unit I : **Seed resources and collection** : Freshwater and marine finfish and shell fish seed resources; collection methods, collection of finfish and shellfish spawners, temporary storage of spawners; spawn and quality and quantity indices. – **12 h**
- Unit II : **Sexual maturity and breeding** : Development of gametes in male and females of fin and shell fish species; types of fish eggs and embryonic development. Sexual maturity and maturation stages of Macrobrachium and penaeid species. – **12 h**
- Unit III : **Induced breeding techniques**: Hypophysation of fishes – pituitary gland and its injection; broodstock management and transportation of brood fish; synthetic hormones used for induced breeding. Induced maturation in penaeid species by eyestalk ablation. – **12 h**
- Unit IV : **Hatchery techniques** : Different types of fish hatcheries, traditional, Chinese, glass jar and modern controlled hatcheries, eggs and spawning, larval rearing in finfish. Breeding and hatchery management of penaeid species, crabs and bivalves. – **12 h**
- Unit V : **Larval production and management** : Larval rearing of common fishes, different stages of fish larvae; water quality maintenance in fish hatcheries and nurseries. Cryopreservation of gametes. Food and feeding of larval stages of important finfish and shellfish. – **12 h**

References

1. Thomas P. C. *et al.*, 2003. Breeding and seed production of finfish and shellfish, Daya Publishing House, New Delhi.
2. Rath, P. K., 2000. Freshwater Aquaculture, Scientific Publishers, Jodhpur.
3. FAO, 1992. Manual of seed production of carps.
4. Pillay, T.V.R. and M. N. Kutty, 2005. Aquaculture Principles and Practices, Blackwaell Scientific Publishers, UK.
5. Jingran, V. G. and Pullin, R. S.V., 1985. Hatchery Manual for the common, Chinese and Indian Major Carps, ICLARM.
6. James, P. M., 1983. Handbook of Mariculture, CRC Press, Florida.

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SKC-14 : DISEASE DIAGNOSIS IN AQUACULTURE

- Unit I : **Disease causing agents** : Types of diseases causing agents – Bacterial, Viral, Fungal, Protozoan and Parasitic diseases in finfishes and shellfishes. – **12 h**
- Unit II : **Disease diagnosis** : Epidemiological, laboratory, microbiological & histopathological study – Quorum sensing. Probiotic measures, Diseases and health management in hatcheries. – **12 h**
- Unit III : **Bacterial and viral disease** : Diagnosis of bacterial disease. Identification & characterization of pathogenic bacteria of finfish, shell fish. Diagnosis of viral diseases – Identification and characterization of pathogenic virus of finfish, shellfish, molluscs. – **12 h**
- Unit IV : **Molecular diagnosis** : Molecular methods of disease diagnosis. PCR, ELISA and western blot. – **12 h**
- Unit V : **Disease control** : Immunostimulants, Probiotics, vaccines. Regulation of antibiotics – usage in aquaculture. Chemotherapeutic agents, types and mode of action. – **12 h**

References

1. Pillay, T.V.R. and M. N. Kutty, 2005. Aquaculture Principles and Practices, Blackwaell Scientific Publishers, UK.
2. Jingran, V. G. and Pullin, R. S.V., 1985. Hatchery Manual for the common, Chinese and Indian Major Carps, ICLARM.
3. Rath, P. K., 2000. Freshwater Aquaculture, Scientific Publishers, Jodhpur.
4. Jingran, V. G., 1991. Fish and fisheries of India, 3rd Edn., Hindustan Publication.

SKC-15 : PRACTICAL - HATCHERY TECHNOLOGIES IN AQUATIC ORGANISMS AND DISEASE DIAGNOSIS IN AQUACULTURE

Hatchery technologies in aquatic organisms (SKC-13)

1. Collection and preservation of pituitary gland.
2. Preparation of pituitary extract.
3. Study of fish eggs and embryonic developmental stages.
4. Identification of eggs, spawns, fry and fingerlings of cultivable finfish.
5. Identification of broodstock and maturity stages of shrimp.
6. Identification of larval stages of penaeid shrimp.
7. Eyestalk ablation technique (Demonstration).
8. Identification of gonadal maturity of shrimp.

Disease Diagnosis in Aquaculture (SKC-14)

9. Sampling and labeling of infected fishes.
10. Physical examination of infected fishes.
11. Identification of protozoans infecting fishes.
12. Identification of parasites infecting fishes.
13. Identification of fungus infecting fishes.
14. Identification of bacterial pathogens in finfish and shellfish through physiological and biochemical tests.
15. Identification of viral pathogens in finfish and shellfish through PCR (Demo).
16. Histopathology analysis of gill and liver tissues of infected fishes (Demo).

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SEMESTER - VI

GC-12 : FISHERIES ECONOMICS AND EXTENSION

- Unit I : **Introduction** : Fisheries economics, basic economic terminologies – micro and macroeconomics, positive and normative economics, environmental economics, resource, scarcity, farm-firm relationships, production Contribution of fisheries sector to the economic development of the country.-**12 h**
- Unit II : **Micro and Macro-economics**: Theories of demand, supply; market – equilibrium price, consumption, utility, Consumer surplus. Farm production economics. **Macro-economics** : Introduction to national income, accounting, measurement and determinants of national income, contribution of fisheries to GNP and employment. – **14 h**
- Unit III : **Planning** : Development of Aquaculture and Fisheries Extension and Co-Operatives: Principles and planning for aquaculture development. Types of planning, planning strategies of various levels. Plan allocation and performance of FFDA, BFDA and other aquaculture related program over the different plan period of India. Formation, Monitoring, Evaluation and Profitability of aquaculture project. Entrepreneurship development. Principles and steps of fisheries Extension. Role of NGO's in fisheries extension and development. – **12 h**
- Unit IV : **Financial Assistance** : Financial Assistance available to fishery sector from Government, Commercial Banks, NABARD and other NGO's. Socio-Economic analysis, socio demographic profiles, socio-economic condition of fishermen. Fishermen folk and role of women in fisheries development. – **12 h**
- Unit V : **Marketing and Economy of Fishermen**: Market structure and price determination. Types of Market in India and Abroad, Law of Demand and Supply. Price determination and problems of fish marketing in India. Exports and Imports of fish and fishery products. Problems and Prospects of Export and Import. – **12 h**

References :

1. Shyam, S Salim and Biradar, R S and Pandey, S K (2005) *Fisheries Economics and Marketing- An introduction*. Central Institute of Fisheries Education, Mumbai.
1. Thomas, C. R. and Charles Maurice, S. Managerial Economics, Tata Mcgraw – Hill Publishing Co. Ltd., New Delhi.
2. Dwivedi, D. N., Managerial Economics, Vikash Publishing House, New Delhi.
3. Dewett, K. K., Modern Economic Theory, S. Chands Co. Ltd., New Delhi.
4. Samuelson and Nordhaus, Economics, Tata Mcgraw, Hill Publishing Co. Ltd., New Delhi.
5. Mankar, V.G., Business Economics – Micro Analysis, Himalaya Publishing House, Mumbai.
6. A.Koutsoyiannis , Modern Micro economics The Mc Millan Press limited,UK
7. Ahuja.A.L., Microeconomics- Theory and Practice S Chand and Company, New Delhi
8. Mankiw Gregory Micro and Macro economics
9. Henderson JM & Quandt RE. 2000. Microeconomic Theory: A Mathematical Approach. McGraw-Hill.
10. Varian Hal R. 1999. Intermediate Microeconomics. Affiliated East-West Press.
11. David M Kreps 1990. A Course in Microeconomic Theory. Princeton University Press.
12. Silberberg E & Suen W. 2001. The Structure of Economics – A Mathematical Analysis. McGraw-Hill

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GC-13 : BIOENTREPRENEURSHIP

- Unit I : **Fisheries Extension & Employment:** Fisheries extension and education in India. Fishery as a tool for rural development and employment potentiality. Fisheries Development Activities: Different fisheries development plant in India. Role of Government, NGOs and other agencies in fisheries sector. Different fishery related laws in India. – **12 h**
- Unit II : **Concept of entrepreneurship :** Entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition. – **12 h**
- Unit III : **Government schemes and incentives for promotion of entrepreneurship :** Preparation of enterprise budget for integrated fish farming. Fiscal and monetary policies and its impact on entrepreneurship. Infrastructural and other financial requirement for fishery entrepreneurship Government policy on Small and Medium Enterprises (SMEs) / SSIs. – **14 h**
- Unit IV : Accounting procedures of fish business entity. Emerging trends in fish production, processing, marketing and exports. Assessing overall business environment in the Indian economy. – **12 h**
- Unit V : Overview of Indian social, political and economic systems and their decision making by individual entrepreneurs. Globalisation and the emerging business /entrepreneurial environment. Social Responsibility of Business. – **10 h**

References :

1. Shyam S Salim, Biradar, R.S. and Pandey, S.K., Economic Analysis of Fisheries Projects, CIFE, Mumbai.
2. Ojha, S.N. and Shyam S Salim, Entrepreneurship Development and Project Formulation, CIFE, Mumbai
3. FAO Technical Paper No.334, Fisheries Project Formulation, FAO, Roam.
4. Shang, Y.C., Aquaculture Economic Analysis – An Introduction, The World of Aquaculture Society Ltd.
5. Twiner and Simister (ed.), Project Management, Infinity Books, New Delhi
6. Chodhury, Project Management Tata McGraw Hill Publishing Company Ltd., New Delhi
7. Gittinger, J. Price, Economic analysis of Agricultural projects, EDI Series in Economic Development, John Hopkins University Press, Baltimore and London

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SKC-16 : VALUE ADDED PRODUCTS

- Unit I : **Principles of fish processing** : Processing by traditional methods – salting, sun drying, smoking, marinating and fermentation and their methods. Package and storage of processed products, quality and standard's of processed products. **-10 h**
- Unit II : **Traditional fishing products** : Marinated, dried and fermented fish products, fish and prawn pickles, fish sauce, fish paste, traditional Indian and south east Asian fermented products, Principles and methods of preparation of various fish paste products. Eg. Fish sausage, fish ham, surimi, fish cake, kmabako etc. – **12 h**
- Unit III : **Extruded and diversified products** : Theory of extrusion equipments used for extrusion, advantages and disadvantages of extruded products, method of preparation of extruded products. Value addition : Diversified fish products, battered and braided products, fish fingers, fish cutlet, fish wafers, fish soup powder etc. and imitation product. – **12 h**
- Unit IV : **Fish by-products and fish waste utilization** : Preparation and product of fish meal, fish oil (body & liver oils) shrimps waste products like chitin and chitosan, FPC, fish hydrolysae, hydrolysed and deodorized fish meat, fish silage (acid and fermented silage), fish maws, shark leather, fish glue, fish gelatin, isinglass, pearl essence, shark fin rays and Beach-de-mer. – **14 h**
- Unit V : **Quality assurance of fishery products** : Quality dimension of seafood products, sensory quality, intrinsic, extrinsic, quantitative parameters. Assessment of quality changes in processed products. Application of HACCP concept in quality of the product. Principles of hygienic and sanitation, food laws and standards. Role of Export Inspection Council, MPEDA in fishery products, Certification System of Fishery Products in India. – **12 h**

References

1. Gopakumar, K., 2002. Post harvest technology of fish and fish products, Daya Publication.
2. Hall, G. M., 1992. Text book of Fish Processing Technology, ICAR Publication.
3. Fish Processing Technology, Blackie, Hui, Y. M., Marle, D. P. and Richard, J. G., 2001.
4. Sen, D. P., 2005. Technology of Fishery Products, Fishing Chimes.
5. Wheaton, F. W. and Lawson, T. B., 1985. Processing Aquatic Products.

SKC-17 : PRACTICALS - VALUE ADDED PRODUCTS

- 1.Preparation of fish oil (body & liver oils).
- 2.Preparation of fish meal.
- 3.Preparation of insinglass
4. Preparation of silage (Acid)
- 5.Preparation of silage (Alkali)
- 6.Preparation of chitin and chitosan
- 7.Preparation of FPC
- 8.Assessment of quality of products by sensory evaluation method.

SKC-18 : Project work