

<b>Lecture Schedule</b>		
<b>Department of Aquaculture (Code: AQC)</b>		
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<b>(1) - AQC-111, Principles of Aquaculture</b>		
<b>Theory</b>		
<b>S.No.</b>	<b>Topic</b>	<b>Class</b>
1	Basics of aquaculture, definition and scope.	1
2	History of aquaculture: Present global and national scenario.	1
3	Aquaculture vs Agriculture.	1
4	Systems of aquaculture - pond culture, pen culture, cage culture, running water culture and zero water exchange system.	1
5	Extensive, semi-intensive, intensive and super intensive aquaculture in different types of water bodies viz., freshwater, brackish water inland saline and marine water.	2
6	Principles of organic aquaculture.	1
7	Pre-stocking and post stocking pond management.	1
8	Carrying capacity of pond, factors influencing carrying capacity.	1
9	Criteria for selection of candidate species for aquaculture.	1
10	Major candidate species for aquaculture: freshwater, brackish-water and marine.	1
11	Monoculture, polyculture and integrated culture systems.	1
12	Water and soil quality in relation to fish production. Physical, chemical and biological factors affecting productivity of ponds.	2
<b>Total</b>		<b>14</b>
<b>Practical</b>		
1	Aquaculture production statistics- world and India.	1
2	Aquaculture resources of world and India.	1
3	Components of Aquaculture farms.	1
4	Estimation of carrying capacity.	1
5	Practices on pre-stocking and post stocking management.	1
6	Growth studies in aquaculture system.	1
7	Study on waste accumulation in aquaculture system (NH <sub>3</sub> , Organic matter, CO <sub>2</sub> ).	1
8	Analysis of manure.	1
<b>Total</b>		<b>8</b>

**(2) - AQC-121, Fresh Water Aquaculture**

<b>(2) - AQC-121, Fresh Water Aquaculture</b>		
<b>Theory</b>		
<b>S.No.</b>	<b>Topic</b>	<b>Class</b>
1	Major species cultured, production trends and prospect in different parts of the world.	1
2	Freshwater aquaculture resources – ponds, tanks, lakes, reservoir, etc.	1
3	Carrying capacity of pond. Nursery, rearing and grow-out ponds	1
4	Ponds preparation and management - control of aquatic weeds and algal blooms, predatory and weed fishes, liming fertilization/ manuring,	2
5	Use of biofertilizers, supplementary feeding. Water quality management.	1
6	Selection, transportation and acclimatization of seed.	1
7	Traits of important cultivable fish and their culture methods – Indian major carps, exotic carps, air breathing fishes, cold water fishes, freshwater prawns.	2
8	Wintering ponds, quarantine ponds and isolation ponds.	1
9	Sewage-fed fish culture.	1
10	Principles of organic recycling and detritus food chain.	1
11	Use of agro-industrial waste and biofertilizers in aquaculture. Composite fish culture system of Indian and exotic carps -competition and compatibility	2
12	Exotic fish species introduced to India and their impact on indigenous species.	1
13	Culture of other fresh water species: Economics of different culture practices.	1
<b>Total</b>		<b>16</b>
<b>Practical</b>		
1	Study of cultivable species of finfish.	1
2	Collection, identification and control of aquatic weeds.	2
3	Collection, identification and control of insects.	2
4	Collection, identification and control of predatory fishes, weed fishes	2
5	Collection, identification and control of eggs and larval forms of fishes.	2
6	Algal blooms and their control.	1
7	Preparation and management of nursery, rearing and grow-out ponds.	2
8	Study of effect of liming, manuring and fertilization on hydrobiology of ponds and growth of fish.	2
9	Estimation of plankton and benthic biomass.	1
10	Effect of natural and supplementary feed on growth. Visit to freshwater fish farm.	1
<b>Total</b>		<b>16</b>

<b>(3) - AQC-212, Ornamental Fish Production and Management</b>		
<b>Theory</b>		
<b>S.No.</b>	<b>Topic</b>	<b>Class</b>
1	World trade of ornamental fish and export potential.	1
2	Different varieties of exotic and indigenous fishes.	1
3	Principles of a balanced aquarium.	1
4	Fabrication, setting up and maintenance of freshwater and marine aquarium.	1
5	Water quality management.	1
6	Water filtration system-biological, mechanical and chemical.	1
7	Types of filters.	1
8	Aquarium plants and their propagation methods.	1
9	Lighting and aeration.	1
10	Aquarium accessories and decorative.	1
11	Aquarium fish feeds. Dry, wet and live feeds.	1
12	Breeding and rearing of ornamental fishes. Broodstock management.	1
13	Application of genetics and biotechnology for producing quality strains.	1
14	Management practices of ornamental fish farms.	1
15	Common diseases and their control.	1
16	Conditioning, packing, transport and quarantine methods.	1
17	Trade regulations and wild life act in relation to ornamental fishes.	1
<b>Total</b>		<b>17</b>
<b>Practical</b>		
1	Identification of common ornamental fishes and plants.	1
2	Fabrication of all-glass aquarium.	2
3	Setting up and maintenance of Aquarium accessories and equipment.	1
4	Conditioning and packing of ornamental fishes.	1
5	Preparation of feed.	1
6	Setting up of breeding tank for live bearers, barbs, goldfish, tetras, chiclids, gouramis, fighters and catfishes.	2
7	Identification of ornamental fish diseases and prophylactic measures.	2
<b>Total</b>		<b>10</b>

<b>(4) - AQC-221, Coastal Aquaculture and Mariculture</b>		
<b>Theory</b>		
<b>S.No.</b>	<b>Topic</b>	<b>Class</b>
1	An overview of sea farming and shore-based aquaculture in different parts of the world.	2
2	Resources for shore-based aquaculture and sea farming in India.	2
3	Traits of important cultivable fish and shellfish (seabass, mullet, milkfish, grouper, cobia, snappers, ayu, pearlspot, tiger shrimp, white shrimp, mud crab, mussel, clam, oysters (edible and pearl oyster), lobster, seaweeds, Seed resources.	10
4	Coastal aquaculture system: traditional (pokkali, bheries, gazanis, khazans),	2
5	semi- intensive, intensive aquaculture practice of commercially important species of fish and shellfish.	3
6	Methods of Shellfish Culture rafts, racks, cages, poles and ropes.	4
7	Water and soil quality management.	2
8	Estimation of growth, survival and pond productivity. Seaweed culture, Pearl culture, Sea ranching.	1
<b>Total</b>		<b>26</b>
<b>Practical</b>		
1	Identification of important cultivable species.	2
2	Collection and identification of commercially important seed of fish and shellfishes.	2
3	Types of fertilizers - Pond preparation.	1
4	Seed selection, quality and acclimatization.	1
5	Water quality parameters.	2
6	Estimation of seed survival.	1
7	Pond biomass estimation.	1
8	Material, apparatus and machinery for Coastal aquaculture and mariculture.	2
9	Estimation of feed intake. Growth and health monitoring. Fouling organisms in cages and pens.	2
<b>Total</b>		<b>14</b>

**(5) - AQC-311, Finfish Hatchery Management**

<b>Theory</b>		
<b>S.No.</b>	<b>Topic</b>	<b>Class</b>
1	Inland and marine fish seed resources.	1
2	Natural breeding of finfishes.	1
3	Selection of riverine spawn collection sites, gears used and methods of collection.	2
4	Spawn quality and quantity indices. Advantages and disadvantages of riverine seed collection.	1
5	Sexual maturity and breeding season of various cultivable species.	4
6	Development of gametes in male and female.	2
7	Fish egg and embryonic development.	2
8	Methods of breeding; bundh breeding - wet and dry bundhs, collection and hatching of eggs, factors involved in bundh breeding, advantages and disadvantages of bundh breeding.	3
9	Induced breeding of warm water finfishes,	2
10	environmental factors affecting spawning, sympatric breeding.	1
11	Hypophysation of fishes.	2
12	Fish pituitary gland – its structure, collection, preservation and preparation of extract for injection, dosages and methods of injection.	2
13	Brood-stock management and transportation of brood fish.	2
14	Synthetic hormones used for induced breeding of carps.	2
15	Different types of fish hatcheries-traditional, Chinese, glass jar and modern controlled hatcheries.	3
16	Causes of mortalities of eggs and spawn and remedies.	2
17	Spawn rearing techniques.	2
18	Use of anesthetics in fish breeding and transport.	1
19	Breeding techniques for Indian major carps, exotic carps, mahaseers, trouts, tilapias, catfishes, murrels,	2
20	Grey-mullets, milk fish, pearl spot, sea bass,	2
21	sea horse, groupers, pacu, cobia, pompanos and indigenous fishes, etc.	2
22	Off-season and multiple breeding of carps.	1
<b>Total</b>		<b>42</b>
<b>Practical</b>		
1	Study of maturity stages in fishes.	2
2	Collection and preservation of fish pituitary gland, preparation of PG extract, Hypophysation.	3
3	Calculation of fecundity.	1
4	Brood-stock maintenance and selection of breeders for injection.	2
5	Histological studies of ovary and testes.	2
6	Different fish hatchery systems,	2
7	study of fish eggs and embryonic developmental stages.	2
8	Identification of eggs, spawn, fry and fingerlings of different species.	2
9	Preparation and management of fish nursery.	2
10	Fish seed and brood-stock transportation, use of anesthetics, disinfectants and antibiotics in fish breeding.	2
11	Water quality monitoring in fish hatcheries and nurseries.	2
12	Breeding and larval rearing of common finfishes.	1
<b>Total</b>		<b>23</b>

**(6) - AQC-223, Shellfish Hatchery Management**

<b>Theory</b>		
<b>S.No.</b>	<b>Topic</b>	<b>Class</b>
1	Natural seed resources, site selection and collection methods.	2
2	Life cycle of important shellfish ( <i>Penaeus monodon</i> , <i>P. indicus</i> , <i>Macrobrachium rosenbergii</i> , <i>P. Vannamei</i> , <i>Scylla serrata</i> , lobster, edible, oyster, pearl oyster, fresh water mussel, holothurians, horse-shoe carb, Sepia, Loligo, cray fish etc.).	6
3	Sexual maturity and breeding seasons of different species.	2
4	Maturation stages of <i>Macrobrachium rosenbergii</i> and <i>Penaeus monodon</i> . And <i>P. Vannamei</i> .	2
5	Induced maturation in <i>Penaeus monodon</i> and <i>P. Vannamei P. Indicus</i> by eye stalk ablation.	1
6	Reproductive physiology.	1
7	Reproductive harmones in crustaceans.	1
8	Brood stock management of <i>Penaeus monodon</i> and <i>Macrobrachium rosenbergii</i> .	2
9	Breeding and hatchery management of <i>Penaeus monodon</i> and <i>Macrobrachium rosenbergii</i>	2
10	Breeding and hatchery management of crabslobster, mussel, edible and pearl oyster.	4
11	Food and feeding of larval stages of important shellfishes.	2
12	Health management in hatcheries.	2
<b>Total</b>		<b>27</b>
<b>Practical</b>		
1	Identification of brood stock and maturity stages of important crustaceans and molluscs.	4
2	Observations on gonadal maturation of <i>Penaeus monodon</i> and <i>Macrobrachium rosenbergii</i> .	2
3	Breeding and larval rearing of <i>Macrobrachium rosenbergii</i> and <i>Penaeus monodon P. Vannamei</i> .	2
4	Identification of larval stages of important crustaceans and molluscs.	3
5	Demonstration of eyestalk ablation in <i>Penaeus monodon</i> .	2
6	Collection, packing and transportation of shrimp/prawn seed and brood stock.	2
7	Practice in the operation of shrimp and prawn hatcheries.	2
8	Water treatment and management in shrimp and prawn hatcheries.	2
9	Different chemicals and drugs used in shrimp/ prawn hatchery.	1
<b>Total</b>		<b>20</b>

**(7) - AQC-122, Aquaculture in Reservoir**

<b>(7) - AQC-122, Aquaculture in Reservoir</b>		
<b>Theory</b>		
<b>S.No.</b>	<b>Topic</b>	<b>Class</b>
1	Definition of reservoirs; nature and extent of reservoirs in india, topography and species diversity; importance of morpho-edaphic index in reservoir productivity and classification;	2
2	factors influencing fish production; trophic phases in reservoir; pre-impoundment and post- impoundment stages and their significance in establishment of reservoirs fisheries.	2
3	Salient features of reservoir limnology and their significance to fisheries development; management of small, medium and large reservoirs; present status and future prospects in reservoirs fish production.	2
4	Fisheries of some important reservoirs; recent advances in reservoirs fisheries management; conservation measures in reservoir fisheries. Fish stocking in Reservoirs	2
5	Role of cage and pen culture in enhancement of fish production from reservoirs; history of cage culture, advantages of cage culture; selection of suitable site of cage culture; cage materials, designs, shape, size and fabrication; cage frames and supporting system. Integration of cage culture with other farming systems.	4
6	History of pen culture, pen materials, fabrication; breeding of fish in pen; rearing of spawn in pen; grow-out from pens. Suitable species for culture in cages and pens; constraints in cage and pen culture; economics of cage and pen culture.	4
<b>Total</b>		<b>16</b>
<b>Practical</b>		
1	Preparation of charts on the present situation of reservoirs fisheries productivity;	2
2	detailed case studies of selected reservoirs on the changing trends in capture fisheries profile; drawing inferences from the analysis of data;	6
3	suggestions for the sustainable development of reservoirs fisheries.	2
4	Case studies on cage and pen culture;	2
5	field visit to cage and pen culture site to acquaint with construction details and operation.	2
<b>Total</b>		<b>14</b>



**(8) - AQC-222, Fish Nutrition and Feed Technology**

<b>(8) - AQC-222, Fish Nutrition and Feed Technology</b>		
<b>Theory</b>		
<b>S.No.</b>	<b>Topic</b>	<b>Class</b>
1	Fundamentals of fish nutrition and growth in fish.	2
2	Principal nutrients and nutritional requirements of cultivable fish and shellfish.	4
3	Nutritional energetics: definition and forms of energy partitioning.	2
4	Methods of feed formulation and manufacturing.	4
5	Forms of feeds: wet feeds, moist feeds, dry feeds, mashes, pelleted feeds, floating and sinking pellets.	3
6	Feed additives: binders, antioxidants, enzymes, pigments, growth promoters, feed stimulants.	3
7	Feed storage: use of preservatives and antioxidants.	2
8	Feed evaluation: feed conversion ratio, feed efficiency ratio, protein efficiency ratio, net protein utilization and biological value.	4
9	Feeding devices and methods.	2
10	Non- conventional feed ingredients and anti-nutritional factors.	2
11	Digestive enzymes, feed digestibility.	2
12	Factors affecting digestibility.	2
13	Nutritional deficiency diseases.	3
<b>Total</b>		<b>35</b>
<b>Practical</b>		
1	Proximate composition analysis of feed ingredients and feeds.	4
2	Preparation of artificial feeds using locally available feed ingredients.	2
3	Determination of sinking rate and stability of feeds.	2
4	Effect of storage on feed quality.	2
<b>Total</b>		<b>10</b>

**(9) - AQC-211, Fish Food Organisms**

<b>(9) - AQC-211, Fish Food Organisms</b>		
<b>Theory</b>		
<b>S.No.</b>	<b>Topic</b>	<b>Class</b>
1	Candidate species of phytoplankton and zoo-plankton as live food organisms of freshwater and marine species.	2
2	Tropic potentials - proximate composition of live feed.	2
3	Biology, culture requirements and methodology of important live food organisms;	2
4	Green algae, blue-green algae, spirulina, diatoms,	4
5	infusoria, rotifers, cladocerans, tubifex, brine shrimp, chironomids. Culture of earthworms, bait fish and forage fish.	10
<b>Total</b>		<b>20</b>
<b>Practical</b>		
1	Methods of collection and identification of different live food organisms.	5
2	Laboratory scale culture of selected live food organisms (green algae, spirulina, infusoria, chetoceros, rotifer, cladocerans, copepod, earthworm).	4
3	Evaluation of live food organisms.	2
4	Decapsulation and hatching method of brine shrimp cyst.	3
<b>Total</b>		<b>14</b>

<b>(10) - AQC-321, Introduction to Biotechnology and Bioinformatics</b>		
<b>Theory</b>		
<b>S.No.</b>	<b>Topic</b>	<b>Class</b>
1	Biotechnology: Introduction to Biotechnology –scope and importance in fisheries/ aquaculture;	2
2	Structural organization of prokaryotic and eukaryotic cell.	1
3	Nucleic acids -structure, function and types,	1
4	Concepts of gene and genetic code,	1
5	transcription and translation, mutations and their implications.	2
6	Post transcriptional modification and RNA processing.	1
7	Gene regulation and expression in prokaryotes and eukaryotes;	2
8	DNA sequencing, Operons.	2
9	Genetic engineering- Restriction enzymes;	1
10	Gene isolation; Cloning vectors; Probes; Recombinant DNA technology - Vaccines.	3
11	Transgenic fish and Gene transfer technology,	2
12	Animal Cell Culture, Hybridoma technology.	2
13	Molecular and immunological techniques –PCR;	1
14	immuno blotting; ELISA;	2
15	Principle of hybridization; Northern blotting; Western blotting; Southern blotting;	2
16	DNA fingerprinting; Restriction fragment length polymorphism.,	1
17	Biosensors. Concept of bioremediation of water, bioprocess engineering and bio-prospecting.	1
18	Bioinformatics: Introduction to Bioinformatics; Biological Databases and tools :	1
19	Introduction; Types of biological databases; Primary and secondary databases;	1
20	PDB, NCBI, formats and contents;	1
21	Sequence retrieval, manipulation; Primer design; Restriction mapping;	1
22	ORF finding; EMBOSS, Molecular visualization Sequence analysis.	2
<b>Total</b>		<b>33</b>
<b>Practical</b>		
1	Study of structure of prokaryote and Eukaryote Cells.	4
2	Techniques of sampling process for DNA	2
3	(Blood, muscle, fins), isolation, purification and quantification of DNA,	3
4	microsatellite and RAPD,	2
5	Restriction enzymes,	1
6	Gel Electrophorus,	2
7	ELISA,	2
8	DNA sequence analysis and comparison.	3
<b>Total</b>		<b>19</b>

**(11) - AQC-213, Genetics and Breeding**

<b>(11) - AQC-213, Genetics and Breeding</b>		
	<b>Theory</b>	
<b>S.No.</b>	<b>Topic</b>	<b>Class</b>
1	Principles of genetics and breeding, Gene and chromosome as basis of inheritance, Mendel's law of inheritance – complete and incomplete dominance, monohybrid and dihybrid ratios.	5
2	Gene interactions – dominant and recessive epistasis. Pleiotropism. Lethal genes. Mutation.	3
3	Sex - linked genes, sex influenced and sex limited traits. Linkage and crossing over. Introduction to population genetics.	3
4	Hardy- Weinberg law and its significance. Chromosomal structure and aberrations.	2
5	Chromosome manipulation techniques - androgenesis, gynogenesis and polyploidy and identification of ploidy.	4
6	Sex determination. Cross breeding (hybridization) – types of cross breeding, heterosis and design of cross breeding programmes, hybridization in different fishes.	3
7	Quantitative genetics – quantitative traits, polygenic traits, heritability.	3
8	History and present status of selective breeding programs in aquaculture. Selection methods and mating designs. Design for selective breeding.	3
9	Inbreeding and its consequences. Domestication methods. Seed certification and quarantine procedures. Cryopreservation of gametes.	4
<b>Total</b>		<b>30</b>
	<b>Practical</b>	
1	Problems on Mendelian inheritance (qualitative genetics) - monohybrid and dihybrid ratios and epistasis.	2
2	Problems on quantitative traits, response to selection and heritability. Estimation of rate of inbreeding and heterosis.	2
3	Mitotic and meiotic chromosome preparation.	2
4	Demonstration of protocol of androgenesis, gynogenesis and polyploidy. Problems on gene and genotypic frequency.	2
5	Gamete cryopreservation protocols and quality evaluation of fish milt.	2
<b>Total</b>		<b>10</b>

**(12) - AQC-112, Fundamentals of Biochemistry**

<b>Theory</b>		
<b>S.No.</b>	<b>Topic</b>	<b>Class</b>
1	A brief introduction to developments in biochemistry and its transformation to molecular biology. Cell structure, water and major molecules of life.	2
2	Carbohydrate chemistry: Structure, classification, functions (mono, di and polysaccharides) isomerism and mutarotation. Metabolism of carbohydrates: glycolysis, gluconeogenesis, glycogenolysis, glycogenesis, TCA cycle, central role of TCA cycle in metabolism.	3
3	Protein chemistry: classifications and functions. Classification, structure, function and properties of amino acids. Essential and non essential amino acids. Primary, secondary, tertiary and quaternary structure of proteins. Amphoteric property. Biuret reaction and xanthoproteic reaction. Digestion and absorption of proteins.	4
4	Classification, structure, functions and properties of lipids. Essential fatty acids and phospholipids. Digestion and absorption of lipids. Lipid autooxidation. Significance of Omega-3 and Omega-6 fatty acids.	4
5	Enzymes: nomenclature; classification; specificity; mechanism of enzyme action; kinetics and regulation of enzyme activity. Steroid and peptide hormones- chemistry and function.	2
6	Structure and functions of fat and water soluble vitamins. Vitamins – classification- functions.	2
7	Minerals - classification – functions. Nucleic acids: Structure function and importance genetic code.	2
8	Transcription and translation. Protein synthesis.	2
9	Energy changes in chemical reactions, reversible and irreversible reactions in metabolism.	1
<b>Total</b>		<b>22</b>