

SACRED HEART COLLEGE (AUTONOMOUS)

Department of Aquaculture

Master of Aquaculture and Fish Processing

Course plan

Academic Year 2016 - 17

Semester 2

Course 1: 16P2AQCT05: ECOLOGY OF CULTURE SYSTEM AND AQUATIC BIOLOGY

COURSE PLAN

PROGRAMME	MASTER OF AQUACULTURE & FISH PROCESSING	SEMESTER	2
COURSE CODE AND TITLE	16P2AQCT05: ECOLOGY OF CULTURE SYSTEM AND AQUATIC BIOLOGY	CREDIT	4
HOURS/WEEK	4	HOURS/SEM	72
FACULTY NAME	Dr. T. V. Anna Mercy, Dr. V. C. George, Dr. S. Sanjeev		

COURSE OBJECTIVES

To understand the basic ecology and aquatic biology as applicable to aquaculture organisms in captivity and controlled conditions
To evaluate the ways and means of circumventing, ecological imbalances for production of better aquaculture yield
To understand the basic features of fisheries oceanography
To understand the physico-chemical characteristics of marine environment
To describe mud banks in capture fisheries
To evaluate the effect of trawl banning in stock enhancement
To know the different types of major groups of microbes from culture ecosystems
To understand the growth and reproduction of microbes in relation to different physico-chemical conditions in pond

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	REMARKS
MODULE I				
1	Role of physical parameters like depth, in ponds.	PPT	video	
2	Role of physical parameter like temperature.	PPT/Lecture		
3	Role of physical parameters like salinity.	PPT/Lecture		
4	Role of physical parameters like light.	PPT/Lecture		
5	Role of physical, light, turbidity, and wind in ponds.	PPT/Lecture		
6	Circulation and mixing patterns in ponds.	PPT/Lecture		
7	Open sea farming.	PPT/Lecture		
8	Physical characteristics in relation to open sea farming.	PPT/Lecture		
9	Types of open sea farming.	PPT/Lecture		
10	Effect of monsoon on pond physical conditions.	PPT/Lecture	e-resource	
11	Seasonal and diurnal variation in pond.	PPT/Lecture		
12	Chemical characteristics with reference to carbon dioxide distribution.	PPT/Lecture		
13	Chemical characteristics with reference to dissolved oxygen distribution.	Lecture		
14	Classification of Aquatic micro organisms	Lecture		
15	Identification of aquatic micro organisms	Lecture		

16	Sampling, isolation and purification of major groups of microbes from culture ecosystems.	Lecture		
17	Rivers of Kerala.	PPT/Lecture		
18	Characteristics of estuaries.	PPT/Lecture		
19	Classification, of estuaries.	PPT/Lecture		
20	Estuarine horizontal stratification, communities and adaptation.	PPT/Lecture		
21	Aerobic and anaerobic degradation of organic matter in pond bottom.	PPT/Lecture		
22	Anaerobic degradation of organic matter in pond bottom.	PPT/Lecture		
23	Sludge accumulation.	PPT/Lecture		
24	Water quality management.	PPT/Lecture		
25	Primary and secondary productivity in ponds	Lecture		
26	Benthic productivity	Lecture		
27	Macro and micro benthos including benthic algae in ponds	Lecture		
28	Benthic algae production in ponds	PPT/Lecture		
29	Growth and reproduction in bacteria	Lecture		
CIA 1				
30	Microbial population in relation to physical, chemical and biological characteristics in ponds	PPT/Lecture		
31	Major estuaries of India	PPT/Lecture		
32	Physico-chemical characteristics of marine environment.	PPT/Lecture		

33	Microbial population in relation to physical, chemical and biological characteristics in ponds.	PPT/Lecture		
34	Classification thermal stratification.	PPT/Lecture		
35	Ecological energetic of ponds.	PPT/Lecture		
36	Effect of organic fertilizers on pond productivity.	Lecture	Quiz	
37	Effect of inorganic fertilizers on pond productivity.	Lecture	Q & Ans Session	
38	Carrying capacity of culture systems.	PPT/Lecture		
39	Lotic aquatic systems.	PPT/Lecture		
40	Lentic aquatic systems.	PPT/Lecture		
41	Mud banks and monsoon trawling.	PPT/Lecture		
42	Eutrophication.	PPT/Lecture		
43	Ecological energetic of ponds.	Lecture		
44	Effect of organic fertilizers on pond productivity.	PPT/Lecture		
45	Effect of inorganic fertilizers on pond productivity.	PPT/Lecture		
46	Carrying capacity of culture systems.	PPT/Lecture		
47	Lotic aquatic systems.	PPT/Lecture		
48	Lentic aquatic systems.	PPT/Lecture		
49	Mud banks and monsoon trawling.	PPT/Lecture		
50	Eutrophication.	PPT/Lecture		
51	Pathogenic bacteria in culture systems	PPT/Lecture		

52	Role of microbes in regeneration of nutrients.	PPT/Lecture		
53	Role of microbes in sulphide production in ponds.	PPT/Lecture		
54	Seminar		Group discussion	
55	Seminar		Group discussion	
56	Seminar		Group discussion	
57	Seminar		Group discussion	
58	Seminar		Group discussion	
CIA 2				
59	Special groups of bacteria relevant in culture systems.	Lecture	Demo video	
60	Objective, scope and relation to fishery science,	Lecture		
61	Relation to fishery science.	Lecture	Group discussion	
62	Major oceans.	Lecture		
63	Chemical composition of sea water	PPT/Lecture		
64	Marine communities.	PPT/Lecture		
65	Different types of stratification in ocean.	PPT/Lecture		
66	Major estuaries of India.	PPT/Lecture		

67	Special group of bacteria relevant in culture system.	PPT/Lecture		
68	Seminar		Group discussion	
69	Seminar		Group discussion	
70	Seminar		Group discussion	
71	Seminar		Group discussion	
72	Seminar		Group discussion	

GROUP ASSIGNMENTS/SEMINAR – Details & Guidelines

	Topic of Assignment & Nature of Seminar (Individual Presentation)
1	Physical characteristics of water required for fish culture in fresh water system.
2.	Open sea farming- present status and future prospects
3	Rivers of Kerala and scope of fish culture in rivers
4	Carrying capacity of a pond.
5	Factors affecting the productivity of a fresh water fish pond
6	Present status & future prospects of fresh water fish culture in Kerala
7	Role of Macro and micro benthos in culture ponds
8	Physic chemical characteristics of marine environment
9	Effect of trawl ban on the fisheries of Kerala
10	Chemical composition of sea water

References

- Verma P. S. and Agarwal, V. K. 2001, Environmental biology, S. Chand and Co. Ltd, New Delhi.
- Boyd C. E, 1982, Water quality management for pond fish culture, Elsevier Science Publication.

Web resource references:

- <http://www.fao.org/3/ad002e/AD002E01.htm>
- <http://www.fao.org/3/i3099e/i3099e02.pdf>

<http://www.fao.org/3/AC267E/AC267E00.htm>

COURSE 2: 16P2AQCT06: Biochemistry and nutrition of fin fish and shell fish

PROGRAMME	MASTER OF AQUACULTURE & FISH PROCESSING	SEMESTER	2
COURSE CODE AND TITLE	16P2AQCT06: Biochemistry and nutrition of fin fish and shell fish	CREDIT	3
HOURS/WEEK	3	HOURS/SEM	72
FACULTY NAME	Ms. Sangeetha K. R. , Dr. P. M. Sherief		

COURSE OBJECTIVES
To understand the basic principles of biochemistry as applied to aquaculture organisms in relation with environmental factors
To understand the application of different additives in aquaculture feeds
To describe the nutritional bioenergetics in fin fish and shell fish
To understand the classification of feed stuff and anti-nutritional factors present in its
To evaluate of quality of feed ingredients and finished feed
To analyse the feed formulation strategies and methods
To understand the management of feeding in aquaculture arms and hatcheries
To understand the nutritional requirements of finfishes and shell fishes under culture condition

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	REMARKS
MODULE I				
1	Atoms.	PPT	video	
2	Bonds	PPT/Lecture		
3	concepts of PH and buffers	PPT/Lecture		
4	Classification of carbohydrates.	PPT/Lecture		
5	Monosaccharides,	PPT/Lecture		
6	Reaction of monosaccharides with acid and alkali.	PPT/Lecture		
7	Disaccharides	PPT/Lecture		
8	Oligosaccharides and Polysaccharides.	PPT/Lecture		
9	Classification of lipids.	PPT/Lecture		
10	General properties of lipids.	PPT/Lecture	e-resource	
11	Oxidation of lipids.	PPT/Lecture		
12	Iodine number.	PPT/Lecture		
13	Classification of saturated and unsaturated FA.	Lecture		
14	PUFA, MUFA.	Lecture		
15	Compound lipids.	Lecture		
16	Phospholipids, Glycolipids, Spingolipids	Lecture		
17	Simple lipids, Steroids, Cholesterol, Prostaglandins.	PPT/Lecture		
18	Metabolism of lipids: fatty acid break down,	PPT/Lecture		

19	Fatty acid synthesis	PPT/Lecture		
20	Proteins. Amino acids.	PPT/Lecture		
21	Structural organization of proteins.	PPT/Lecture		
22	Globular and fibrous proteins.	PPT/Lecture		
23	Enzyme classification.	PPT/Lecture		
24	Enzyme kinetics	PPT/Lecture		
25	Seminar		Discussion	
26	Seminar		Discussion	
27	Seminar		Discussion	
28	Seminar		Discussion	
29	Seminar		Discussion	
CIA 1				
30	Principles of nutrition.., nutritional bioenergetics in finfish and shellfish.	PPT/Lecture		
31	Mechanism of food capture.	PPT/Lecture		
32	Protein quality and sources.	PPT/Lecture		
33	Nitrogen balance.	PPT/Lecture		
34	Metabolism of proteins.	PPT/Lecture		
	Metabolism of phenyl alanine sereine and glycine.	PPT/Lecture		
35	Urea cycle.	PPT/Lecture		
36	Types of enzyme inhibition.	Lecture	Quiz	
37	Isoenzymes, co-enzymes.	Lecture	Q & Ans Session	
38	Lipids, their functions	PPT/Lecture		

39	Negative aspects of lipids,	PPT/Lecture		
40	Phospholipids and sterol requirements carbohydrates; their sources and utilization.	PPT/Lecture		
41	Classification of feed stuff.	PPT/Lecture		
42	Anti-nutritional factors in feed ingredients and their effect on finfish and shell fish.	PPT/Lecture		
43	Additives in fin fish and shell fish.	Lecture		
44	Feed formulation strategies and methods.	PPT/Lecture		
45	Chemical methods of evaluation; biological methods of evaluation.	PPT/Lecture		
46	Bases and sugars, Nucleotides.	PPT/Lecture		
47	Replication of DNA.	PPT/Lecture		
48	Transcription and translation process.	PPT/Lecture		
49	Recent advances in larval nutrition	PPT/Lecture		
50	Storage and quality control of feeds.	PPT/Lecture		
51	Feed dispensing methods.	PPT/Lecture		
52	Mass culture and cyst production;	PPT/Lecture		
53	Micro diets for larvae.	PPT/Lecture		
54	Seminar		Group discussion	
55	Seminar		Group discussion	
56	Seminar		Group discussion	

57	Seminar		Group discussion	
58	Seminar		Group discussion	
CIA 2				
59	Chemical methods of evaluation.	Lecture		
60	Biological methods of evaluation.	Lecture		
61	Recent advances in larval nutrition	Lecture	Group discussion	
62	FCR/ FCE.	Lecture		
63	PER,BV,	PPT/Lecture		
64	NPU,NPR	PPT/Lecture		
65	Seminar		Group discussion	
66	Seminar		Group discussion	
67	Seminar		Group discussion	
68	Seminar		Group discussion	
69	Seminar		Group discussion	
70	Seminar		Group discussion	
71	Seminar		Group discussion	
72	Seminar		Group discussion	

GROUP ASSIGNMENTS/SEMINAR – Details & Guidelines

	Topic of Assignment & Nature of Seminar (Individual Presentation)
1	Adaptations to various types of feeding in fin fishes, crustaceans and mollusc
2.	Nutritional bioenergetics
3	Gross protein requirements and protein quality
4	Lipids – sources ,function and negative aspects
5	Protein sparing action of lipids and carbohydrates
6	Carbohydrate –sources in fish food and utilization by fishes
7	Essential and non-essential aminoacids and their quantitative requirements
8	Requirements of fattyacids ,steroids and phospholipids in fish food
9	Water and fat soluble vitamins ,their function ,deficiency and hyper dosage syndrome
10	Mineral requirements and importance in dietary level ,deficiency and hyper dosage syndrome
11	Nutritional requirements of finfish ,mollusk and crustacean larvae
12	Nutritive value of phytoplankton and their mass culture
13	Nutritive value of rotifer and their mass culture
14	Nutritive value of cladocerans and their mass culture
15	Nutritive value of artemia and their mass culture
16	Feed dispensing methods
17	Feeding strategies of fish larvae in hatcheries
18	Types of live feeds used in hatcheries
19	Types of artificial feeds used in hatcheries and farms
20	Feed manufacturing process –small scale and large scale

References

- Das D. 2000, Biochemistry, Academic publishers, Calcutta.
- Dr. Snahotra M. K. Shrimp feed formulation and feeding management, CMFRI special bulletin.
- Devadasan K. 1994, Fish nutrition and bioactive substances in aquatic organisms.

Web resource references:

- <https://thefishsite.com/articles/principles-of-fish-nutrition>
- <http://www.fao.org/in-action/globefish/fishery-information/resource-detail/en/c/338772/>
- <http://www.fao.org/3/ab470e/AB470E01.htm>

COURSE 3: 16P2AQCT07: PHYSIOLOGY AND PATHOLOGY OF FIN FISH AND SHELL FISH

PROGRAMME	MASTER OF AQUACULTURE & FISH PROCESSING	SEMESTER	2
COURSE CODE AND TITLE	16P2AQCT07: PHYSIOLOGY AND PATHOLOGY OF FIN FISH AND SHELL FISH	CREDIT	4
HOURS/WEEK	4	HOURS/SEM	72
FACULTY NAME	LITTY MARY		

COURSE OBJECTIVES
To understand the basic physiology of fin fish and shell fish and its relation to cultural conditions
To identify pathogens in aquacultural organisms
To understand the classification of disease in aquaculture systems
To describe the disease control of fin and shellfish, remedial and prophylactic measures
To study physiological characters of fin fish and shell fish
To understand the biological rhythm in aquatic organisms
To understand the ecophysiology and environmental requirements for the metabolism of aquatic organisms
To understand the principles and application of eye stalk ablation and hypophysation in fin fish and shell fish hatcheries

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	REMARKS
MODULE I- Physiology				
1	Physiology of respiratory	PPT	video	
2	Physiology circulatory system	PPT/Lecture		
3	Physiology Digestive system	PPT/Lecture		

4	Ecophysiology	PPT/Lecture	e-resource	
5	Effect of environmental factors on acid base regulation and biotic interactions	PPT/Lecture		
6	Hormonal control of osmotic regulation.	PPT/Lecture		
7	Mechanism and biology of neuron coordination.	Lecture		
8	Sense organs- Receptive mechanisms and effector systems in sense organs	Lecture		
9	Effect of biotic and abiotic factors in reproduction and metabolism.	Lecture		
10	General morphology of neurosecretory system in crustaceans	Lecture		
11	Structure of sinus gland complex . 'x' organ, 'y' organ and androgenic gland.	PPT/Lecture		
12	Seminar	PPT/Lecture	Group discussion	
13	Seminar	PPT/Lecture	Group discussion	
14	Seminar	PPT/Lecture	Group discussion	
15	Seminar	PPT/Lecture	Group discussion	
16	Seminar	PPT/Lecture	Group discussion	
MODULE II- Endocrinology				
17	Endocrine organs in fishes	PPT/Lecture		
18	Reproductive systems and secondary sexual characters	PPT/Lecture		
19	The chemical aspects of hormone action: Molting, growth and reproduction in crustaceans	Lecture		

20	Neuroendocrine control of reproduction	Lecture		
21	parasitic castration	Lecture		
22	Neurosecretory cells in molluscs	PPT/Lecture		
23	Induced maturation and spawning in molluscs	PPT/Lecture		
24	Hypophysation in fishes	PPT/Lecture		
25	Induced maturation and spawning in finfish	PPT/Lecture		
26	Induced ovarian maturation and spawning through physical, chemical methods.	Lecture		
27	Induced ovarian maturation and spawning through biological method	Lecture		
28	Use of hormonal analogues in Hypophysation of finfish.	Lecture		
29	Eyestalk ablation techniques-its principles, application of eyestalk ablation techniques in crustacean hatcheries.	Lecture		
CIA 1				
MODULE 1- Pathology				
30	Introduction. Definition of terms, classification of disease	PPT/Lecture		
31	Causes of diseases, aetiology.	PPT/Lecture		
32	Role of abiotic and biotic factors, generic, species and strain; environment,	PPT/Lecture		
33	Role of nutritional status for healthy growth	PPT/Lecture		
34	Role of Intrinsic factors and extrinsic factors in disease process.	PPT/Lecture		
35	Role of stress in disease process	PPT/Lecture		
36	Nonspecific immunity: agglutinin and precipitins	Lecture	Quiz	

37	C-reactive protein, complement in fish, phagocytosis	Lecture	Q & Ans Session	
38	Acquired immunity; -Role of thymus, T-cell; receptors	PPT/Lecture		
39	cell mediated immunity	PPT/Lecture		
40	Mechanism of cell mediated immunity, cytokines, T-helper function.	PPT/Lecture		
41	Role of macrophages, recirculation and ecotaxis of T-cell; T-cell markers.	PPT/Lecture		
42	Antigenic stimulation; memory cells.	PPT/Lecture		
43	Structure of antibody; types of antibody; types of antibodies produced in fish.	Lecture	video	
44	Humoral immunity-origin of B-cell, differentiation of B-cells into plasma cells, T and B-cell interaction	PPT/Lecture		
45	Immunization in fish and vaccination.	PPT/Lecture		
46	Basic vascular and cellular alterations	PPT/Lecture		
47	Cell metabolism and cell growth,	PPT/Lecture		
48	Necrosis, inflammation.	PPT/Lecture		
49	Defenses of the body against injury,	PPT/Lecture		
50	healing and neoplasms	PPT/Lecture		
51	Microbial disease in fishes	PPT/Lecture		
52	Microbial disease and their control	PPT/Lecture		
53	Viral Diseases in fishes	PPT/Lecture		
54	Viral Diseases and their control	PPT/Lecture	Video	
55	Bacterial Diseases in fishes	PPT/Lecture		
56	Bacterial Diseases and their control	PPT/Lecture		

57	Seminar	PPT/Lecture	Group discussion	
58	Seminar	PPT/Lecture	Group discussion	
CIA 2				
59	Bacterial Diseases and their control	Lecture	Demo video	
60	Fungal Diseases in fishes	Lecture		
61	Fungal Diseases and their control	Lecture	Group discussion	
62	Parasites and Parasitic diseases	Lecture		
63	Parasitic diseases and their control	PPT/Lecture		
64	Nutritional disease, toxic diseases in fishes	PPT/Lecture		
65	Nutritional disease, toxic diseases their control	PPT/Lecture		
66	Prophylactic and control measures, biological and chemical treatment of disease.	PPT/Lecture		
67	Integrated disease management.	PPT/Lecture		
68	Seminar	PPT/Lecture	Group discussion	
69	Seminar	PPT/Lecture	Group discussion	
70	Seminar	PPT/Lecture	Group discussion	
71	Seminar	PPT/Lecture	Group discussion	
72	Seminar	PPT/Lecture	Group discussion	

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

	Topic of Assignment & Nature of Seminar (Individual Presentation)
1	Neuro secretory system in crustacean.
2.	Neuroendocrine organs in fishes
3	Osmoregulation and excretion in fishes
4	Defense mechanism in fishes
5	Viral diseases in shrimp and their control measures
6	Eyestalk ablation in crustacean
7	Induced breeding in molluscs
8	Gametogenesis in fishes
9	Vaccines- their production, types and administration
10	Extrinsic factors affecting fish growth
11	Defense mechanism and healing in fishes
12	Inflammation, Necrosis and basic vascular alterations
13	Biological rhythm
14	Lateral line system
15	Hermaphroditism.
16	Molting and its growth
17	Fungal diseases and their control
18	New generation drugs in induced breeding
19	Biological and chemical treatment of diseases
20	Pituitary hormones- storage, release and control of reproduction

References

- **Biiwas K. P. (1992), Prevention and control of fish and prawn diseases. Narendhran publishing House, Delhi**
- **Snthosh Kumar and Manju (1996), Anatomy and physiology of fishes, Vikas Publishing House, Pvt. Ltd.**

Web resource references:

- <http://www.fao.org/tempref/FI/CDrom/aquaculture/a0845t/volume2/docrep/field/003/ac160e/AC160E04.htm>
- <http://www.fao.org/3/ca4730en/ca4730en.pdf>
- <http://www.fao.org/3/x5738e02.htm>
- <https://www.sciencedirect.com/bookseries/fish-physiology/vol/4/suppl/C>

COURSE 4: 16P2AQCT08: GENETICS AND BIOTECHNOLOGY OF FIN FISHES AND SHELL FISHES.

PROGRAMME	MASTER OF AQUACULTURE & FISH PROCESSING	SEMESTER	2
COURSE CODE AND TITLE	16P2AQCT08: GENETICS AND BIOTECHNOLOGY OF FIN FISHES AND SHELL FISHES.	CREDIT	4
HOURS/WEEK	4	HOURS/SEM	72
FACULTY NAME	LITTY MARY, LEENA RAPHAEL		

COURSE OBJECTIVES
To understand Induced breeding ,genetic improvement of the stock for better strains of cultural organisms
To know the genetic engineering and biotechnological principles for crop improvement
To understand the principles of genetic technique in cytogenetics
To describe different hybridization techniques
To describe different types of probiotics and its application in aquaculture
To know the tools and techniques in modern biotechnology
To analyze the developments of fish cell lines and their application in aquaculture
To understand the different types of vaccination in fish genetics

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	REMARKS
MODULE I				
1	Introduction to genetics.	PPT	video	
2	Practical application of Mendalian Genetics.	PPT/Lecture		
3	Principles of genetics techniques in cyto genetics.	PPT/Lecture		

4	Sex linked genes and sex.	PPT/Lecture	e-resource	
5	Quantitative phenotypes.	PPT/Lecture		
6	Limited phenotypes.	PPT/Lecture		
7	Pleiotropy,	Lecture		
8	Recent trends in genetic mutations.	Lecture		
9	Genetic improvement	Lecture		
10	Need for genetic improvement inheritance.	Lecture		
11	Inbreeding.	PPT/Lecture		
12	Selection methods.	PPT/Lecture		
13	Basis of selection and its effects.	PPT/Lecture		
14	Types of hybridization- biotechnological aspects.	PPT/Lecture		
15	Types of hybridization- biological aspects.	PPT/Lecture		
16	Chromosomal manipulation- biotechnological aspects.	PPT/Lecture		
17	Chromosomal manipulation- biological aspects.	PPT/Lecture		
18	Sex-reversal and sex control.	Lecture		
19	Naturally and artificially produced Hybrids.	Lecture		
20	Common hybrids.	Lecture		
21	Types of selection.	Lecture		
22	Gamatic manipulation.	PPT/Lecture		
23	General principles of genetic engineering.	PPT/Lecture		
24	Enzymes involved in genetic engineering.	PPT/Lecture		

25	Steps in genetic engineering.	PPT/Lecture		
26	Seminar.	Lecture	Group discussion	
27	Seminar.	Lecture	Group discussion	
28	Seminar.	Lecture	Group discussion	
29	Seminar.	Lecture	Group discussion	
CIA 1				
30	Gene cloning methods.	PPT/Lecture		
31	Recombinant DNA technology.	PPT/Lecture		
32	Enzymes involved in Recombinant DNA technology.	PPT/Lecture		
33	Restriction nucleases.	PPT/Lecture		
34	Steps in recombinant technology.	PPT/Lecture		
35	Sequencing.	PPT/Lecture		
36	DNA structure.	Lecture	Quiz	
37	DNA and RNA.	Lecture	Q & Ans Session	
38	DNA fingerprinting.	PPT/Lecture		
39	Transgenic fish.	PPT/Lecture		
40	Gene transfer.	PPT/Lecture		
41	Transgenic organisms.	PPT/Lecture		
MODULE 2				
42	Introduction to Biotechnology.	PPT/Lecture		
43	Biotechnology in aquaculture.	Lecture		

44	Tools and techniques in modern biotechnology.	PPT/Lecture		
45	Different types of probiotics.	PPT/Lecture		
46	Use of probiotics in aquaculture	PPT/Lecture		
47	Bio fertilization in aquaculture	PPT/Lecture		
48	Immuno stimulants.	PPT/Lecture		
49	Immunostimulants used in aquaculture.	PPT/Lecture		
50	Bioremediation.	PPT/Lecture		
51	Bioremediation in aquaculture systems.	PPT/Lecture		
52	Bioremediation and bio fertilization in aquaculture.	PPT/Lecture		
53	Seminar.	PPT/Lecture	Group discussion	
54	Seminar.	PPT/Lecture	Group discussion	
55	Seminar.	PPT/Lecture	Group discussion	
56	Seminar.	PPT/Lecture	Group discussion	
57	Seminar.	PPT/Lecture	Group discussion	
58	Seminar.	PPT/Lecture	Group discussion	
CIA 2				
59	General principles of cell and tissue culture.	Lecture	Demo video	
60	Culture of primary cells secondary culture (subcultures).	Lecture		

61	Culture of cell lines.	Lecture	Group discussion	
62	Fish cell culture.	Lecture		
63	Development of cell lines and their applications.	PPT/Lecture		
64	PCR.	PPT/Lecture		
65	Steps in PCR.	PPT/Lecture		
66	Disease diagnosis using PCR.	PPT/Lecture		
67	Seminar.	PPT/Lecture	Group discussion	
68	Seminar.	PPT/Lecture	Group discussion	
69	Seminar.	PPT/Lecture	Group discussion	
70	Seminar.	PPT/Lecture	Group discussion	
71	Seminar.	PPT/Lecture	Group discussion	
72	Seminar.	PPT/Lecture	Group discussion	

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

	Topic of Assignment & Nature of Seminar (Individual Presentation)
1	Bioremediation in aquaculture farms
2.	Use of probiotics in aquaculture
3	Androgenesis and gynogenesis
4	Modification enzymes
5	Genetic manipulation

6	Solid state fermentation
7	Genetic engineering
8	Recombinant DNA
9	Hybridization
10	Fish cytogenetics
11	Cryopreservation
12	Polyploidy
13	Gene expression and regulation
14	Recombinant vaccines
15	Cross breeding
16	Cultural traits in hybrids
17	Mutation and mutagens
18	Evolution of fish karyotypes
19	Role of steroids in sex reversal
20	PCR

References

- Collin E. Purdom 1993, Genetics and fish breeding, Chapman and Hall.
- Jhingran A. G. (Eds.) Fish genetics in India, 1989, Today and tomorrow printers and publishers, New Dehli.

Web resource references:

- <http://www.fao.org/3/P5943E/P5943E00.htm>
- <http://www.fao.org/3/mc856e/mc856e.pdf>
- <http://www.fao.org/tempref/docrep/fao/010/a1337e/a1337e04e.pdf>
- <http://www.fao.org/3/ab412e/ab412e03.htm>
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