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VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
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ક્રમાંકઃએકે/પરિપત્ર/૫૮૨૬/૨૦૨૦
તા.૧૬/૦૭/૨૦૨૦

પ્રતિ,
વડાશ્રી,
એકવેટીક બાયોલોજી વિભાગ,
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી,
સુરત.

વિષયઃ– M.Sc. Aquatic Biology Sem- I, II, III, IV ના અભ્યાસક્રમ અંગે.

સુજ્ઞશ્રી,

સવિનય જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૦–૨૧ થી અમલમાં આવનાર શૈક્ષણિક વર્ષ ૨૦૨૦–૨૧ અમલમાં આવનાર M.Sc. Aquatic Biology Sem- I, II, III, IV ના અભ્યાસક્રમ રીવાઈઝ કરવા બાબતે એકવેટીક બાયોલોજી વિષયની અભ્યાસસમિતિની તા.૦૧/૧૦/૨૦૧૯ ની સભાનાં ઠરાવ ક્રમાંકઃ ૩ અન્વયે નીચે મુજબ ભલામણ કરેલ છે જે ભલામણ વિજ્ઞાન વિદ્યાશાખાનાં અધ્યક્ષશ્રીએ વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ વિજ્ઞાન વિદ્યાશાખાવતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલએ તેની તા.૩૦/૬/૨૦૨૦ ની સભાના **ઠરાવ ક્રમાંકઃ૩૨** અન્વયે સ્વીકારી મંજૂર કરેલ છે. તેની જાણ સંબંધકર્તા શિક્ષકો અને વિદ્યાર્થીઓને કરવી, તદ્ઉપરાંત તેનો અમલ કરવો.

<u>એકવેટીક બાયોલોજી વિષયની અભ્યાસસમિતિ તા.૦૧/૧૦/૨૦૧૯ ની સભાનાં ભલામણ ક્રમાંકઃ ૩</u>

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૦–૨૧ થી અમલમાં આવનાર M.Sc. Aquatic Biology Sem- I, II, III, IV ના અભ્યાસક્રમને જરૂરી સુધારાવધારા સાથે રીવાઈઝકરવામાં આવ્યા અને આગળની કાર્યવાહી માટે વિજ્ઞાન વિદ્યાશાખાને ભલામણ કરવામાં આવે છે.

<u>એકેડેમિક કાઉન્સિલની તા.૩૦/૦૬/૨૦૨૦ ની સભાનાં ઠરાવ ક્રમાંકઃ ૩૨</u>

:: આથી ઠરાવવામાં આવે છે કે,એકવેટીક બાયોલોજી વિષયની અભ્યાસસમિતિએ તેની તા. ૦૧/૧૦/૨૦૯ ની સભાના ઠરાવ ક્રમાંક : ૩ અન્વયે ભલામણ કરેલ વિજ્ઞાન વિદ્યાશાખાના અધ્યક્ષશ્રીએ વિજ્ઞાન વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ મંજૂર કરેલશૈક્ષણિક વર્ષ ૨૦૨૦–૨૧ થી અમલમાં આવનાર M.Sc. Aquatic Biology Sem- I, II, III, IV ના અભ્યાસક્રમ મંજૂર કરવામાં આવે છે.

બિડાણઃ ઉપર મુજબ

ઈ.ચા. કુલસચિવ

પ્રતિ,
૧) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા.
૨) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.
૩) પી.જી. વિભાગ, વી. ન. દ. ગુ. યુનિવર્સિટી, સુરત.

...તરફ જાણ તેમજ અમલ સારૂ.

Veer Narmad South Gujarat University, Surat

Department of Aquatic Biology

M.Sc.(Aquatic Biology)

Syllabus – Semester I

Teaching and Examination scheme

Theory Paper /Practical	Teaching schedule Hrs /week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers :						
AQB:101 : Aquatic resources and their management	4	3	30	70	100	4
AQB:102 : Instrumentation	4	3	30	70	100	4
AQB:103 : Aquatic Microbiology & Fish Etiology	4	3	30	70	100	4
AQB:104 : Planktonology	4	3	30	70	100	4
Practicals :						
AQB:105: Water & sediment analysis and Instrumentation	4	5	30	70	100	4
AQB:106: Planktonology and Microbiology	4	5	30	70	100	4
		Total	180	420	600	

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Syllabus - Semester-I
AQB- 101: Aquatic Resources and their Management

Total Hrs. 45

Unit – I **Hrs 12**

Inland Ecosystem and their management:

Origin, classification and distribution of rivers, lakes and ponds, Major river system of India, management of pond, Lake, River. Thermal stratification & thermal exchange in lakes. Classification and distribution of reservoir, transitional phases of reservoir. Management of Reservoirs, Classification, morphology and distribution of estuaries, Lagoons and Coastal inlets, Management of Estuaries

Unit - II **Hrs 12**

Marine ecosystem:

Origin of ocean floor, classification of marine ecosystem, seas bottom topography: Abyssal, canyons, trenches, main physical (density, viscosity, surface tension, temperature) and chemical (major and minor constituents) properties of sea water

Tides, currents and waves, their effects in estuaries and coastal area

Unit – III **Hrs 12**

Aquatic resources:

Shell fishes: Prawn, shrimp and molluscs

Fin fishes: major carps, catfishes, hilsa, mullet, sardine, mackerel, sport fishes.

Aquatic plants: freshwater higher vascular plants, sea weeds, sea grasses and mangroves

Unit – IV **Hrs 09**

Ornamental fish

Status of Ornamental fish trading in India, Design and construction of Aquaria, setting up and management of aquarium Equipment used in aquaria (Biological filters, aerators, heaters etc.), Transportation of ornamental fishes

References:

- Bames R.S.K. (1999). Introduction to Marine Ecology, Blackwell Science.
- Edmondson, W.T. (1976). Freshwater Biology 2nd Ed. John Wiley (Ed) and Sons Inc.
- Golterman, H.L., Clyno, R.S. and Ohnstad, M.A.M. (1978). Methods for physical and chemical analysis of freshwater.2nd Ed. IBP Handbook no.8 Blackwell scientific publication.
- Grasshoff, K. Enrhardt, M. and Kreenling, K.(1983). Methods of seawater analysisi.2nd Ed. Verlag Chemical
- Hutchinson, G.E. (1976). A Treatise on limnology. Vol. I & II John Wiley & sons.
- Jeffery S. Levinton (2000). Marine Ecology, Biodiversity and Function. Oxford.
- Jhingaran, V.G. (1985). Fish and Fisheries of India. Hindustan publication Corp., New Delhi.
- Lecren, E.D. and Lowe-Mac Connel, R.H. (1980). The functioning of freshwater ecosystem. Cambridge University Press.
- Nair,B. N. and Thampy D.M. (1980). A text Book of Marine Ecology.
- Nybakaken, J.W. (2001). Marine Biology an Ecological Approach 4th edition.
- Perkins, E.J. (1980). The Biology of Estuaries and coastal water. Academic Press, London.

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Syllabus – Semester I
AQB 102: Instrumentation

Total Hrs. 45

Unit - I

Hrs 10

Microscopy:

Principle and construction of Microscopes

Types of microscopes: Simple microscope, compound microscope (Student's microscope, Stereoscopic microscope, Phase contrast microscope, fluorescence microscope and interference microscope) and Electron microscope

Unit - II

Hrs 10

Photometry:

Principle and application of turbidometer

Introduction, Principle and application of Colorometer, Spectrophotometer, (Single bean & double beam), infrared spectroscope, NMR and Mass spectrometer

Unit - III

Hrs 08

Centrifugation and density gradients:

Separation method

Centrifuge: Introduction,construction components and types of centrifuge,

Introduction, principle and types of centrifugation

(Differential centrifugation and Density gradient centrifugation)

Unit - IV

Hrs 17

(A) Chromatography & Electrophoretic techniques:

Principle of chromatography

Types of chromatography

Protein electrophoresis: SDS, PAGE, Western blotting

(B) Water quality analysers:

Conductivity meter , pH meter, Salino meter, DO meter,

COD reflaxor (close and open)

BOD analyser

References:

- Brown, S.B (1980). An introduction to spectroscopy for Biochemists, Academic press, London, New York.
- E.D.P. Robertis and E.M.F. Robertis (2001). Cell and Molecular Biology, Lippincott Williams & Wilkins, London
- Hawcroft, D.M. (1996). Electrophoresis. The Basics IRL press, Oxford.
- Jenning, W.G. (1993). Analytical Gas chromatography. Academic Press. New York.
- Skoogs, H, P.and Nieman, M (2006). Principle of Instrumental analysis. Thomson Inc Ltd.

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Syllabus - Semester-I
AQB- 103: Aquatic Microbiology & Fish Etiology

Total Hrs. 45

Unit – I **Hrs 13**

Microorganisms associated with aquatic ecosystem: General classification of microbes: conventional and modern methods, Microbial communities in Aquatic Environment

General structure and characteristics of microbes (bacteria, fungi, algae and virus), microbes and its role in environmental changes

Role of microbes in biogeochemical cycles: Carbon, Nitrogen, Phosphorus and Sulphur cycles and their significance, Decomposition of organic matter in aquatic ecosystem

Unit - II **Hrs 10**

Methods of studying microorganisms

Quantitative estimation of microorganisms in aquatic ecosystems

Collection, isolation, cultivation and characterization of microorganisms, Study of Biofilm, Nutrition & growth of microorganisms, Preservation of aquatic microbes, culture collection centres

Unit - III **Hrs 12**

Etiology and Therapy of fish diseases

Physical, chemical and physiological defence mechanisms in fishes, Methods of pathological examination of fish, Diagnostic tools: Histopathological methods, PCR, ELISA

Mode of action of drugs, Use of Anti parasites, Sedatives, Disinfectants, Use of Probiotics, regulation of the use of drugs in aquaculture

Unit - IV **Hrs 10**

Quality control of fish

Post mortem changes (Hypermia, Riger mortis, Autolysis, Microbial Pultrification, Auto oxidation) Fish pathogens; their prevention and control, Microbial quality control of processed fishery products, HACCP

References:

- Frazier, W.C and Westnoff, D.C. (2008). Food microbiology, Tala McGraw hill publishing company, New Delhi
- Jay, J.M. (2005). Modern food microbiology, CBS publishers, New Delhi
- Modi, H.A. (1995). Elementary microbiology, Ekta Prackashan, Nadiyad
- Mukundan, M.K. and Balasubramaniam, S. (2007). Seafood quality assurance, central Institute of Fisheries Technology, Cochin.
- Munn, C.B. (2004). Marine microbiology, Bio-Scientific publishers, London & New York.
- Patel, R.J. and Patel, K.R. (2000). Experimental microbiology, Aditya, Ahmedabad, India.
- Rheinheimer, G.C. (1974). Aquatic microbiology, John Wiley and sons, England.
- Sigee, D.C. (2005). Freshwater microbiology, John Wiley and Sons, England.
- Surendran, P.K., Thampuran, N., Nambiar, N.V. and Laliha, K.V. (2009). Microbiological examination of seafood. Central Institute of Fisheries Technology, Cochin.
- Whitman, K.A. (2004). Finfish & shellfish bacteriology, CBS publishers, New Delhi.
- Willey,M.J., Sherwood, L.M. and Woowerton, C.J. (2008). Prescott, Harley and Klein's microbiology, McGraw hill campany, New Delhi
- Schaperclaus, W. (2001) : Fish diseases Vol I & Vol II, Oxonian Press Pvt. Ltd., New Delhi
- Mitra, A. & K. Banerjee. 2004. *Marine Microbiology*. Narendra Publishing House, Delhi, 159pp.
- Pelezar, M.J., E.C.S. Cahn & H.R. Krieg 1981. Elements of Microbiology. McGraw Hill Book Co., NY, 692 pp
- Rosenberg, E.B. & I.R. Cohen 1983. Microbial Biology. CBS College Publ., NY, 433 pp.

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Syllabus – Semester I
AQB: 104 Planktonology

Total Hrs. 45

Unit - I **Hrs 13**

Introduction of plankton:

General classification, collection of plankton general account of instruments and nets employed, Methods of fixation and preservation of plankton. Regional differences in (primary and secondary) production.

Unit - II **Hrs 10**

Productivity:

Method of estimation of Primary productivity, secondary and tertiary productivity, factors affecting productivity. Estimation of standing crop-wet and dry weight estimation - plankton volume setting and displacement method. Oxidation as carbon. (as organic matter)

Unit - III **Hrs 10**

Mechanisms in plankton:

Adaptation of plankton – structural (weight, increases of surface area, floatation) and physiological (specific gravity, water content, fat content, defensive vacuoles, gas, mono and divalentions) mechanisms, Interrelation of phytoplankton and zooplankton, Harmful algal blooms - its causes and effects

Unit – IV **Hrs 12**

Ecological and Commercial Importance of primary producers:

Effects of plankton production in aquatic environment. Microalgae as a source of protein. Periphyton - Importance of Periphyton in aquatic environment, Biofuel and other commercial products from algae. Types of larvae and their distribution, chemical communication and settlement of larve of marine benthic organisms.

References:

- Edmondson, W.T. (1976). Freshwater Biology. 2nd Ed. John Wiley (Ed) and sons Inc.
- Hutchinsn, G.E. (1976). A treatise on limnology. Vol. I & II John Wiley & Sons.
- Jhingran, V.G. (1985). Fish and fisheries of India. Hindustan Publication Corp., New Delhi
- Nybakken, J.W.(2001). Marine Biology an Ecological Approach 4th edition. Addison Wesley Edu. Pub. Inc.
- Peter McRoy, C. and G. Helferich (1977). Sea grass Ecosystems. A scientifique perspective. Marcel Dekker Inc. New York
- Sumich, J. l. (1999). Introduction to the biology of marine life 7th Edition. The McGraw hill Companies Inc.
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Veer Narmad South Gujarat University, Surat

Department of Aquatic Biology
M.Sc. (Aquatic Biology)
Syllabus – Semester I (Practical)
AQB 105: Water & Sediment analysis and Instrumentation

Total Hrs. 30

- Titrimetric estimation of
    a) Dissolved oxygen,
    b) Alkalinity(PA & TA),
    c) Hardness (total, Ca & Mg)
    d) Chloride
- Colorimetric estimation of water and sediments
    a) Silicate,
    b) Ammonia and
    c) Ammonical nitrogen
- Light penetration, TS,TSS and TDS estimation
- Instrumentation: Standardization and measurement of water quality by following instruments
    a) Turbidometer,
    b) pH meter,
    c) Colorimeter,
    d) Conductivity meter
    e) Salinometer
- Field and Institutes visits

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Syllabus – Semester I (Practical)
AQB 106: Planktonology and Microbiology

Total Hrs. 30

- Collection, fixation and preservation of plankton (freshwater and marine water)
- Quantitative estimation of plankton (counting method)& chlorophyll estimation
- Identification of Phytoplankton(freshwater and marine water)
- Identification of Zooplankton(freshwater and marine water)
- Examination of bacteria by Gram's staining technique and hanging drop technique
- Isolation Methods for bacteria.
- Estimation of *Vibrio sp.*and *Streptococus faecalis* by membrane filter techniques
- Assessment of microbiological quality of water bodies using SPC and MPN techniques
- Quantitative assessment of microbiological quality of sediments and fish products using SPC
- Field and Institutes visits

Veer Narmad South Gujarat University

Department of Aquatic Biology

M.Sc. (Aquatic Biology) Semester – II

Teaching and Examination scheme

Theory Paper /Practical	Teaching schedule Hrs/week	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
Theory papers :						
AQB: 201 : Fish Nutrition, Biochemistry and Feed Technology	4	3	30	70	100	4
AQB: 202 : Fish Genetics and Biotechnology	4	3	30	70	100	4
AQB: 203 : Aquatic Pollution and Toxicology	4	3	30	70	100	4
AQB: 204 : Biostatistics, Extension Education and Fisheries legislation	4	3	30	70	100	4
Practicals:						
AQB: 205 : Biochemistry,Genetics and Biotechnology	4	5	30	70	100	4
AQB: 206 : Aquatic Pollution & Biostastics	4	5	30	70	100	4
		Total	180	420	600	

Veer Narmad South Gujarat University
Department of Aquatic Biology
M.Sc. (Aquatic Biology)
Syllabus – Semester II
AQB 201: Fish Nutrition, Biochemistry and Feed Technology

Total Hrs.45

Unit - I **Hrs 12**

General fish nutrition:

Principles of nutrition. Types of aqua feed. Nutritional requirements of fish and prawn at various developmental stages

Unit - II **Hrs 12**

Biochemistry:

Importance Carbohydrates, Protein , Lipid (energy food) , Minerals and Vitamins (non energy food), Proximate composition of fish and feeds

Unit - III **Hrs 06**

Chemical and Biological analysis:

Gastro-somatic Index (GaSI), Feed Conversion Ratio (FCR), Food Conversion Efficiency (FCE), Protein Efficiency Ratio (PER), Productive Protein Value (PPV), Net Protein Utilization (NPU).

Unit - IV **Hrs 15**

Feed Technology:

Feed processing and manufacture machineries, Sources of feed ingredients, eco-friendly and Economic feed formulation. Role of feed attractants, binders, growth promoters (antibiotics, probiotics), coloring and flavoring agents, Antinutritional factors, method of feed formulation (mixing, grinding, pulverizing, cooking, extruding, pelleting, drying packing).

References:

- ADCP (Aquaculture Development and Co-ordination Programme) (1980). Fish Feed Technology, ADCP/REP/80/11.FAO, Rome.
- D' Abramo, LR., Conklin, D.E and Aklyama. D.M, (1977). Crustacean Nutrition: Advances in Aquaculture Vol. 6. World Aquaculture Society, Baton Roughe, L.A.
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- Jobling, M. (1994). Fish Bioenergetics. Chapman & Hall. London.
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- Lovell, R.T. (1998). Nutrition and Feeding of Fishes, Chapman & Hall, New York.
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Veer Narmad South Gujarat University, Surat
Department of Aquatic Biology
M.Sc. (Aquatic Biology)
Syllabus – Semester II
AQB: 202 Fish Genetics and Biotechnology

Total Hrs. 45

Unit - I **Hrs 13**

Fundamentals of Molecular Biology

DNA as a genetic material, DNA replication and Mutations, Structure and Types of RNA, Transcription, protein synthesis

Recombinant DNA technology, DNA barcoding

Unit - II **Hrs 12**

Principle of fish genetics

Chromosome study: Fish chromosome preparation method, Banding techniques, Fish as a cytogenetic model

Genetic manipulation: Sex-reversion and sex control, Chromosomal manipulation Transgenic fish

Unit - III **Hrs 12**

Fish Biotechnology

Scope and application

PCR technique, Cryopreservation, Vaccination in fish biotechnology

Hybridization: Significance of hybridization, modification in genomic structure of hybrid offsprings, characteristics of hybrids, natural and artificial hybridization

Unit - IV **Hrs 08**

Bioinformatics: Use of computers in Bioinformatics, Search engines and Databases, Application of Bioinformatics in Aquatic Biology

Nanotechnology: Introduction, History, Applications in aquatic biology

References

- Arthur M. Lesk (2003). Introduction to Bioinformatics Oxford Uni.Press.
- Falcon, D.S. (2000). An Introduction to quantitative genetics ELBS publisher, England
- Lakra W.S. (2000). Fish Genetics and Biotechnology CIFE, Mumbai
- Lewin Benjamin (2008). GENES- IX London; Jones & Bartler Publ.
- Michel & Notre C.D. (2003). Bioinformatics, A Beginners Guide Wiley Publ.Inc.
- Murthy C.V.S. (2004). Bioinformatics Himalaya publishing House
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- Krebs & Jocelyn. 2013. *Lewin's Essential Genes*. Jones & Barlett Learning, 867pp.
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- Lewin & Benjamin. 2008. *Genes lX*. Jones & Barlett publishers, Massachusetts, 892pp.
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- Lehninger, A.L. 2004. Principles of Biochemistry, 4th edition, W.H Freeman and Company.
- Muralidharan, V.S. & A. Subramania. 2009. *Nanosciences & technology*. Ane Books Pvt. Ltd., New Delhi, 150pp.

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Department of Aquatic Biology
M.Sc. (Aquatic Biology)
Syllabus – Semestre II
AQB 203: Aquatic Pollution and Toxicology

Total Hrs. 45

Unit – I

Hrs 08

General Introduction:

Water pollution: sources, Fate of pollutants in Aquatic system, their monitoring and control in water bodies. Interaction of pollutants and factors affecting toxicity

Unit - II

Hrs 14

Effluents and their treatment:

Sewage, industrial and agricultural discharges. Characteristics of effluent, Biological concern: Eutophication, Bioaccumulation and Biomagnification, waste water treatment methods. water quality standards (Stream and effluent standards) and water quality indices.

Unit - III

Hrs 13

Pollution:

Thermal pollution, Oil pollution, Radioactive pollution, Detergent pollution- Their sources, fate, biological effects and management. Acid rain and its effects in aquatic system

Role of Central Pollution Control Board (CPCB) and Gujarat Pollution Control Board (GPCB) in management of pollution.

Unit - IV

Hrs 10

Toxicology:

Basic toxicological concepts and principles, classification of toxicants-metals, pesticides, teratogens, xenobiotics, toxin of animal and plant origin, Toxicity test procedures: Bioassay, Biostimulation and Bioinhibition, Biomarkers as water quality monitors.

References:

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- Goel, P.K. (2006). Water pollution, New age international publishers, New Delhi.
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- Prabhakar, V.K. (2001). Marine ecology & pollution, Anmol publications New Delhi.
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Veer Narmad South Gujarat University, Surat
Department of Aquatic Biology
M.Sc. (Aquatic Biology)
Syllabus – Semester III
AQB 204: Biostatistics, Extension Education and Fisheries Legislation

Total Hrs.45

Unit-I **Hrs. 12**

Fundamental of Biostatistics:

Biostatistics Introduction, Sampling techniques, Standard deviation , Standard error, co-efficient of Variation, Correlation and regression, Hypothesis testing (Student test, 't' test, X^2 test and 'f' test), Analysis of variance (ANOVA)

Unit - II **Hrs. 14**

Fisheries Extension Education:

Fisheries extension education: Introduction, principle, functionaries, Extension methods, Diffusion of innovation, communication, training strategies in transfer of technologies, role of farmers-extension and research linkages. Entrepreneurship development process. Cooperatives Principles, role, structure and organisations.

Unit - III **Hrs.12**

Inland and Marine Fisheries Regulation and Development:

Inland fisheries Act, Leasing policies for water bodies, Biodiversity Act, Aquaculture Authority Act, Maritime Zones of India Act 1981. Coastal Regulation Zone (CRZ) and Integrated Coastal Zone Management (ICZM) in the context of aquaculture sustainability.

Unit - IV **/** **Hrs. 07**

International Law of the Sea:

Historical perspectives, Exclusive Economic Zone, Regulatory and developmental issues concerning deep sea fishing – Guidelines for operation Indian deep sea fishing vessels in Indian EEZ.

References:

- Branson, E.J. (2008). Fish welfare. Pub. Blackwell Publication, Oxford.
- Malhotra, S.P. & Sinha, V.R.P. (2007). Indian Fisheries and Aquaculture in A Globalizing Economy, 2 Vols. Narendra publishing house New Delhi.
- Coupes, A., and Edgar, H. (1987). The marine environment and sustainable development; law, policy and science law of the sea institute, Honolulu.
- G.W. (2009). Towards Sustainable Fisheries Law: A Comparative Analysis. IUCN Environmental Policy and Law Paper No. 74. IUCN publication Service, Switzerland
- Neler, A.P., Rangnar Ameson and Nina Mollett. (1997). Right Based Fishing. Klupner Academic Publisher.
- O'Connell, D.P. (1982). The international law the sea. Clarendon press.
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- Dahama, O.P. (1983): Extension and rural welfare. Ramprasad and Son's, Agra
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- Panse, V. G. and Sukhatme, P.V. (1978): Statistical methods for agricultural workers, ICAR, New Delhi.
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- Ray, G.I. (1991): Extension communication and management, Naya Prakash, Kolkatta

Veer Narmad South Gujarat University, Surat
Department of Aquatic Biology
M.Sc. (Aquatic Biology)
Syllabus – Semester II (Practical)
AQB 205: Biochemistry, Genetics and Biotechnology

Total Hrs. 30

- Biochemical quantification of (Protein, Lipid, Sugar and Ash) in fish
- Biochemical quantification of (Protein, Lipid, Sugar and Ash) in feed
- Feed formulation by pearson square formula.
- Demonstation: Isolation of DNA from aquatic organism
- DNA Staining using Schiff's reagent in aquatic plants
- RNA staining by Pyronine-Y and toludene blue in aquatic plants
- Study of banding techniques with the help of images.
- Demonstration : PCR, COMAT ASSAY, Electrophoresis
- Information retrival from sequence databases.
- Sequence alignment using BLAST.
- Field and Institutes visit

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Syllabus – Semester II (Practical)
AQB 206: Aquatic Pollution and Biostatistics

Total Hrs. 30

- Estimation of BOD and COD
- Colorimetric estimation of inorganic phosphate, nitrate, nitrite from water and sediment
- Preparations and observations of slides for micronuclei test in fish blood
- Histology : Fixation, embedding sectioning and staining of fish tissues
- Histological and histopathological observations of fish tissue
- Demonstration: Observation of behavioral changes and determination of LC_{50}
- Standard deviation, CV, SE, Independent t-test, Paired t-test, Chi square test, co-relation, regression, ANOVA.
- Field and Institutes visit

Veer Narmad South Gujarat University

M.Sc. (Aquatic Biology) Semester – III

Teaching and Examination scheme

Theory Paper /Practical	Teaching schedule Hrs./week	Exam Schedule			Total marks	Credit
		Duration (Hrs.)	Internal marks	External marks		
Theory papers :						
AQB: 301 – Fish Physiology, Endocrinology & Disease Management	4	3	30	70	100	4
AQB:302 **–** Fisheries Technology	4	3	30	70	100	4
AQB: 303 – Freshwater Aquaculture	4	3	30	70	100	4
AQB: 304 – Marine water Aquaculture	4	3	30	70	100	4
Practicals :						
AQB: 305 – Fish Physiology, Etiology and Fisheries Technology	4	5	30	70	100	4
AQB: 306 –Aquaculture management	4	5	30	70	100	4
		Total	180	420	600	

Veer Narmad South Gujarat University, Surat
Department of Aquatic Biology
M.Sc. (Aquatic Biology)
Syllabus - Semester-I
AQB- 301: Fish Physiology, Endocrinology & Disease Management

Total Hrs. 45

Unit-I: **Hrs. 12**

Digestion: Digestive system of fish and associated digestive glands (liver, pancreas and gall bladder), Mechanism of digestion

Respiration: Structure and function of gills, Mechanism of respiration, Hemoglobin – Oxygen Uptake and Dissociation, accessory respiratory organs

Unit-II: **Hrs. 08**

Circulation: Blood and its components. Structure of heart and function,

Excretion : Structure and function of kidney, nitrogenous end products and pattern of their excretion,

Osmoregulation : Introduction, Osmoregulation in fresh water, brackish water and marine water fish

Unit-III: **Hrs.08**

Reproduction & Development: Reproductive system of fish, Structure and function of gonads, Fecundity, Fertilization, Incubation, Hatching, Larvae and Metamorphosis

Endocrinology : Hormonal control of pineal, thyroid, pituitary gland in fishes, pancreatic hormone in fishes, Endocrinology of ecdysis in crustacean.

Role of hormones in sex reversal in fish.

Unit-IV: **Hrs. 17**

Fish Diseases & Health Management

Pathogenic diseases: symptoms and control - Bacterial, Fungal, Viral diseases in fin fishes & shell fishes

Parasitic diseases: symptoms and control - Protozoan, Crustacean, and Worm diseases in fin fishes & shell fishes

Non pathogenic diseases: symptoms and control- Algal, Environmental, Nutritional and Hereditary diseases

References:

- Evans, Devid H. (1998): Physiology of Fishes. R.R. Bowker Company, book trade association of Philadelphia.
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Department of Aquatic Biology
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Syllabus – Semester III
AQB: 302 Fisheries Technology

Total Hrs.45

Unit – I **Hrs. 12**

Hatcheries: Types of Traditional, Circular, Vertical hatcheries, Shrimp/Prawn hatcheries and hatchery Management (Japanese, Galveston, Indian)

Induced breeding: Selection of brooders, extraction of pituitary gland, preparation of dosage and injection, spawning and fertilization, stripping method, use of inducing agents in induced breeding, Eyestalk ablation technique in shrimp

Unit - II **Hrs. 10**

Transportation: Causes of mortality during transportation, methods for transportation of fish seeds, fingerlings, brooders and trout eggs, use of chemicals in live fish transportation

Age and growth of fishes: Utility and methods for determining age and growth, study of maturity, mortality and yield, factors affecting the age and growth

Unit - III **Hrs. 11**

Techniques for Fishing:

Introduction of fishing crafts, types of fishing crafts (mechanized and non-mechanized)

Introduction of fishing gears, types of fishing gears (Traditional, conventional, non-conventional and Active, Passive), Maintenance and preservation of fishing gears

Remote sensing: Mechanism, satellites and cameras, Importance and Application of remote sensing in Aquatic biology

Unit - IV **Hrs. 12**

Post harvest technology: Principles and techniques of processing and preservation, chilling, freezing, drying, salting, smoking, canning, pickling, pasting, preservation with chemicals, preservation by exposure of gamma rays, modern techniques of preservation, packaging of fish and fish products, Effect of processing and preservation on nutritive aspects of fish, fishery products and by-products.

References:

- Agrawal, S.C. (1994): A hand book of fish farming, Narendra publishing house, Delhi
- Balachandran, K.K. (1998): Advances and priorities in fisheries technology, Cohin
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Department of Aquatic Biology
M.Sc. (Aquatic Biology)
Syllabus-Semester III
AQB 303: Freshwater Aquaculture

Total Hrs. 45

Unit – I: **Hrs.10**

Introduction and Pond farm Preparation:

Definition, scope of aquaculture, Recent Advances in aquaculture, Criteria for species selection for aquaculture

Selection of site for fish farm, component pond for fish farm, designing of farm: design , size, shape and layout of farm, construction of farms: method of construction, construction material, dike design and construction, water supply and drainage systems, aerator, feeders and other equipment used in farm

Unit – II: **Hrs. 20**

Culture Techniques:

Carp culture (IMC) with reference to Composite fish culture, Integrated fish farming and Sewage fed fisheries

Culture of catfishes: Rearing of grow outs, harvesting

Culture of freshwater prawns: culture systems, rearing of grow outs and harvesting

Fresh water pearl culture: Biomineralization, Implantation Methods, Collection of mussels, Pre-operative conditioning, Mussel surgery, Post-operative care, Pond culture, Food and Feeding, Pearl harvest

Unit-III: **Hrs. 7.5**

Microalgae:

Taxonomy of economically important micro algae. Distribution, morphology, reproduction, life cycle, growth physiology and Culture techniques and Importance of *Spirulina & chlorella.* Application of microalgae in waste water treatment as bioremediation

Unit-IV: **Hrs.7.5**

Freshwater Vascular plants:

Taxonomy of economically important freshwater higher vascular plants. Distribution, morphology, reproduction, life cycle, growth physiology and Culture techniques of freshwater higher vascular plants (*Trapa, Typha*), Products of higher vascular plants, Reed bed technology in waste water treatment

References:

- Bardach, E.J. Rhyther, J.H. & W.O. Mc. Larney. (1972): Aquaculture. The Farming and Husbandry of freshwater and Marine Organisms. John Wiley and Sons. New York
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- James, P McVey, (1983): Handbook of Mariculture, CRC press, Florida
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Veer Narmad South Gujarat University, Surat
Department of Aquatic Biology
M.Sc. (Aquatic Biology)
Syllabus – Semester III
AQB 304 : Marine water Aquaculture

Total Hrs.45

Unit I: **Hrs. 10**

Brackish water finfish culture:

Introduction, culture methods, harvesting and marketing of important

Brackish water fin fish (Mullet, Milk fish, Sea bass and peal spot)

Unit – II: **Hrs. 15**

Shrimp culture:

types of shrimps, Preparation and management of shrimp farm (pond preparation, seed selection and stocking ,water quality, feeding, diseases, bio-security, harvesting and marketing). Effluent treatment plant in shrimp farming, Recent advances in shrimp farming (Two phase, Three phase, Race way culture ,biofloc and RAS).

Unit – III **Hrs. 12**

Mari culture:

Introductions, types and advances in Mari culture.

Edible oyster culture, Pearl oyster culture, techniques of pearl production

Lobster and Clam culture

Unit-IV **Hrs. 08**

Marine water plants –Seaweeds:

Biodiversity of Seaweeds along the coast of India and Gujarat,

Taxonomy of economically important seaweeds.

Distribution, morphology, reproduction, life cycle, growth physiology and

Culture techniques of sea weeds (*Gracilaria, Caulerpa*), Products from seaweeds,

References

- Bardach, E.J. Rhyther, J.H. and W.O. McLarney (1972): Aquaculture. The Farming and Husbandry of freshwater and Marine Organisms. John Wiley and Sons. New York
- Brown, E.E., Gratzek, J.B. (1980): Fish Farming Hand Book. AVI Publishing Company, West port USA
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Veer Narmad South Gujarat University, Surat

Department of Aquatic Biology
M.Sc. (Aquatic Biology)
Syllabus – Semester III (Practical)

AQB 305: Fish physiology, Etiology and Fisheries technology

Total Hrs. 30

- Study of buccal cavity and associate structures (Gill rackers, Buccopharynx)
- Gut content analysis and GaSI
- Measurement of fecundity, egg diameter and gonadosomatic index
- Preparation of media
- Quantitative estimation of bacterial load in fish
- Isolation and identification of pathogenic bacteria from fish
- Study of diseased specimens
- Determination of Age and Growth of fin fishes and shell fishes by means of scales and shells.
- Biometry of fish
- Study of Remote sensing techniques with the help of images.
- Study of different gears and crafts(models/ drawing)
- Study of hematological parameters (RBC, WBC, Hemoglobin content, Hematocrit value)
- Study of fishery products and byproducts
- Visit to fisheries Organizations / fish markets

Veer Narmad South Gujarat University, Surat
Department of Aquatic Biology
M.Sc. (Aquatic Biology)
Syllabus – Semester III (Practical)

AQB 306: Fisheries Technology and Aquaculture Management

Total Hrs.30

- Identification fresh water higher vascular plants.
- Identification of sea weeds
- Identification of aquatic insects and prawn larvae.
- Identification of seed stages (eggs, spawns, fry and fingerlings)
- Identification of cultivable fin fishes, shell fishes, predatory and weed fishes.
- Hatching and culturing of Artemia /Rotifier/cladocerans.
- Induced Breeding and seed production of Ornamental fish/ Catfishes
- Culture of Microalgae
- Visit to processing plant/ hatcheries

Veer Narmad South Gujarat University, Surat

Department of Aquatic Biology

M.Sc.(Aquatic Biology)

Syllabus – Semester IV

Teaching and Examination scheme

Theory Paper /Practical	Research schedule (hrs)	Exam Schedule			Total marks	Credit
		Duration (hrs)	Internal marks	External marks		
AQB: 401- Dissertation (Research Work)	18		75	200	275	18
Seminar	02		25	75	100	02
Project formulation for aquaculture	02		40	75	115	02
Certification and licensing for aquaculture	02		35	75	110	02
Total	24		175	425	600	24

Veer Narmad South Gujarat University, Surat

Department of Aquatic Biology

M.Sc.(Aquatic Biology)

Syllabus – Semester IV

AQB 401: Dissertation (Research Work)

Instruction for Dissertation

- Dissertation / Research Work should be in the field of Aquatic Biology.
- Dissertation / Research Work should be original and application oriented which demonstrates the students ability
- The proposal of Dissertation should be approved by the Head of the department.
- Project formulation for aquaculture. (Lay out, SOP, CAPEX, OPEX, Economics)
- Certification and Licesnsing for aquaculture. (MPEDA Registration, Coastal aquaculture authority, EIL- Export Import License, SIP- Sanitary Import Permit, EU, BAP, ASC).