DEPARTMENT OF MARINE LIVING RESOURCES

ANDHRA UNIVERSITY, VISAKHAPATNAM-530003

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To Dt: 02-02-2021

The Principal

College of Science and Technology

Andhra University

Visakhapatnam

Respected Sir,

Sub: DMLR - submission of 1st semester Existing syllabus- Reg.

Ref: The Principal, AUCST meeting with HOD/Chairman/Chairperson held on

 21-01-2021.

With reference to above, I am here with submitting ensuing 1st semester (2020-21 batch) existing syllabus of all the three courses of the department for your perusal and necessary action. **The twenty percent excluded syllabus is meant for assignments.**

Thanking You

 Yours faithfully

 (P. YEDUKONDALA RAO)

 M.Sc. Marine Biology & Fisheries, I Semester

 Paper 1.1: Physical & Chemical Oceanography

Dimensions of Oceans, Physical parameters of sea: Temperature, light, waves, currents, upwelling & sinking, density & pressures, tides, sound and its propagation in the sea. Constancy of composition of sea water- salinity, chlorinity, definition and significance.

Dissolved oxygen in the oceans: Distribution & factors affecting its distribution

Carbon dioxide system: Co2 equilibrium in the sea water, pH, alkalinity & buffering capacity of sea water, Calcium carbonate precipitation & dissolution phenomenon - its biological importance. Iso-cline and carbonate compensation depth.

Micro nutrient elements: N, P, Si in sea water - their forms in sea water, distribution & cycles. N:P ratios, uptake & regeneration of nutrient elements.

Chemistry of sea surface micro-layer - origin, thickness and collection of surface material, properties of the sea surface micro-layer.

National and International Institutes of marine research.

20% excluded syllabus meant for assignments:

Heat budget of ocean. The sea as a suitable physical, chemical and biological environment.

Conservative behaviour of major elements, interaction of trace elements with marine organisms, factors affecting the distribution of trace elements in the sea.

Dissolved gases in sea water- basic concepts: Solubility of gases in sea water, air-sea gas exchange, processes affecting their distribution.

**References:**

**Riley, JP and Chester R** Introduction to marine chemistry Academic Press

**Riley JP and Skirrow, G** Chemical Oceanography Academic Press

 (Vol.1,2,3 &8)

**R.A.Wiley** Sea water: Its composition, The open University

 properties & behaviour

**Broecker and Peng,** Traces in the Sea

 Lamont-Dohery

Geological Observatory, NY

**M.E.Q. Pilson** An introduction to the Cambridge Uni. Press

chemistry of the Sea

**Burton *et al.,*** Dynamic processes in

the chemistry of the upper ocean Plenum Press

**D. Satyanarayana** Introduction to marine chemistry

**Practicals:**

1. Determination of salinity by Harvey's and Kneudson's method

2. Determination of Dissolved Oxygen by titrimetric method

3. Determination of pH by pH meter method

4. Determination of alkalinity by titrimetric method

5. Calculation of tide time and tide height

6. Calculation of density of sea water using salinity and temperature data

7. Identifying the resulting phenomenon (Upwelling/sinking) by observing the vertical temperature cross-section data of a given layer of water column

8. Identification of water mass, determination of stability of water column using temperature and salinity data

9. Equipment : Nansens' water bottle, Niskin's water bottle, Secchi disc, Refractosalinometer, Reversing thermometer

Paper 1.2: Biological Oceanography

Introduction to plankton: General classification and composition of plankton. Floating mechanisms in plankton.

Collection of plankton: General account of instruments and nets employed. Methods of fixation and preservation; Analyses and enumeration of samples. Standing crop estimation methods.

Plankton in relation to fisheries: General account. Vertical distribution: Vertical migrations, Seasonal changes in plankton. Phytoplankton and Zooplankton relationships.

Primary and Secondary (zooplankton) production: General account of productivity in different oceans.

Factors affecting primary and secondary production: Nutrients, light, temperature, organic micro-nutrients, inhibitors and grazing. Particulate and dissolved organic matter in the sea.

Pelagic food chains.

Red tides.

20% excluded syllabus meant for assignments:

Distribution of plankton in space and time, Horizontal distribution: neretic and oceanic plankton; geographical distribution and indicator species.

Mass-mortality in the seas.

General survey of marine food chains: Pelagic food pyramid and factors affecting its production & stability.

**References:**

 **Angel MV** Biological Oceanography Methuen

 **Friedrich H** Marine ecology S & J

 **Raymont JEG** Plankton & Productivity Pergamon

 **Ekman S** Zoogeography of the sea S & J

 **Parsons et al** Biological Oceanographic Pergamon

**Practicals:**

1. Identification of Phytoplankton: Diatoms, Flagellates, Dinoflagellates, Coccolithophores and Toxic dinoflagellates

2. Identification of Zooplankton: Holoplankton, Neroplankton, Coastal and Oceanic plankton

3. Analysis and enumeration of Phytoplankton and Zooplankton: Biomass and standing crop

 estimation

4. Estimation of particulate organic matter in sea water

5. Chlorophyll estimation

6. Plankton nets

 Paper 1.3: Marine Ecology

Classification of marine environment: general characters of the populations of the primary biotic divisions (plankton, nekton, benthos- shallow and deep sea).

Shore Environment: Distribution of life on rocky shore, sandy shore and muddy shore, Zonation and adaptations of organisms.

Biological significance of tides.

Ecology of coral reefs and mangrove habitats; their special features.

Benthos: Distribution of shallow water benthic organisms; Fauna of deep sea and hadal regions – their adaptations.

Larval Ecology: Types of larvae and their distribution. Chemical communications and settlement of larvae of marine benthic organisms.

Detritus based food chains.

Ecological importance and conservation of marine algae.

Ecological modelling.

20% excluded syllabus meant for assignments:

Zoogeography of seas with special reference to Indo-west Pacific region.

Macro, micro and benthic fauna and their ecology, aerobic and anaerobic environments,

Benthic and autotrophic production, chemical composition of Sediments, animal-sedimentRelations.

**References:**

 **Svedrup *et al*** The Oceans Prentice Hall

 **Tait RV** Elements of marine ecology Butterworths

 **Riley & Skirrow** Chemical Oceanography Academic Press

 **Newell RC** Biology of intertidal animals Logos Press

 **Kinne O (Ed)** Marine ecology John Wiley & Sons

 **Marshall NB** Aspects of Deepsea Biology Hutchinson

 **Ekman S** Zoogeography of the sea. Sidgwick & Jackson

**Practicals:**

1. Representative organisms of rocky shore, sandy shore and muddy shore with special reference

 to their ecological features, adaptations, economic importance.

2. Larvae of marine benthic organisms.

3. Ecological modelling of ecosystems

4. Analysis of sediment composition analysis

5. Field visit to rocky, sandy and muddy shores.

6. Computational species diversity indices using the data collected from rocky shore/zooplankton

 sample

7. Instruments: Cores, Grab sampler, dredge.

 Paper 1.4: Biostatistics

Introduction to statistics: Sampling and sampling design Collection of primary and secondary data.

Classification and tabulation of data.

Diagrammatic (one dimensional & two dimensional) representation of data. Graphical representation (Histogram, frequency polygon, frequency curve,and ogive curve) of data Measures of central tendency (Mean, median and mode).

Measures of dispersion: standard deviation, standard error, variance, Skewness, kurtosis and moments. Correlation and regression analyses Probability and distributions.

Estimation and testing of hypotheses; Tests of significance: Z test, t test, F test, Chi-square test, ANOVA (one way and two way), ANCOVA, multi-variate analyses

20% excluded syllabus meant for assignments:

Computer applications: Analyses of data using Microsoft Excel in stock assessment, use of virtual population analysis and pedigree analysis and predictive models.

Applications of statistics in marine biology and fisheries: data collection analyses.

Types of errors, levels of significance.

**References:**

 **Arora & Malhan** Biostatistics Himalaya

 **Ramakrishnan** Biostatistics Saras

 **Gupta SC** Statistical methods Sultan chand

 **Sokal & Rohlf** Biometry Freeman

 Jorgenson SE Fundamentals of ecological modelling Elsevier

Practicals:

**Problems on**

1) Classification of data.

2) Diagrammatic representation & Graphical representation of data.

3) Measures of central tendency.

4) Measures of dispersion.

5) Correlation analysis.

6) Probability and distribution.

7) Estimation and confidence limits.

8) Parametric tests - Z, P, and F

9) Analysis of variance.

10) Chi-square test.

11) Case study on Marine Biological data

12) Analysis of secondary data- MS Excel.

**M.Sc. Coastal Aquaculture and Marine Biotechnology – I Semester**

**Paper 1.1: Oceanography and Marine Biology**

Dimensions of oceans; Physical parameters of sea: Tides, waves, light, temperature, currents, density, pressure.

Chemical parameters of the sea: salinity, dissolved oxygen, carbon dioxide, pH, nutrients and trace elements.

Composition of seawater and brackishwater.

Classification of marine habitats and ecological divisions of the ocean. Plankton, nekton, benthos and their adaptations.

Ecology of coral reefs and mangrove habitats; their special features.

Law pertaining to the seas: Historical perspectives in International negotiations and settlements over open seas. Modern law of the sea.

Remote sensing applications in oceanography and marine biology.

20% excluded syllabus meant for assignments:

Heat budget of the oceans, sound and its propagation in the sea.

Sea- ranching of economically important marine organisms.

Elements of Geographic Information Systems (GIS), GPS and their role in oceanography.

National and International Institutes of marine research.

**References**

 **Svedrup et al** The Oceans Prentice Hall

 **Tait RV** Elements of marine ecology Butterworths

 **Riley & Skirrow** Chemical Oceanography Academic Press

 **Newell RC** Biology of intertidal animals Logos Press

 **Kinne O (Ed)** Marine ecology John Wiley & Sons

 **Mann KH** Ecology of coastal waters

 **King CAH** Introd. Phys. & Biol. Oceang. ELBS

**Practicals:**

1. Determination of Salinity of the sea water sample adopting Harvey's Method

2. Determination of the Dissolved Oxygen concentration in the sea water adopting

 Winkler's Method

3. Determination of Alkalinity of the sea water sample following Titrimetric Method

4. Determination of pH of sea water sample using a digital pH meter.

5.Identification of Phytoplankton Zooplanktons Nekton, Intertidal and sub-tidal

 organisms, coral reefs and mangroves.

**Paper 1.2: Finfish Culture**

Important cultivable finfish species and their biology - milkfish, mullets, seabass, yellowtail, pearl spot and tilapia.

Criteria for selection of finfish for culture.

Classification of culture systems: ponds, pens, cages, raceways

Pond preparation and fertilization, eradication of weed and predatory finfishes.

Culture practices of milkfish, mullets, seabass, cobia and yellowtail.

Monoculture and polyculture: principles and practices. Integrated farming, organic farming and their management.

20% excluded syllabus meant for assignments:

Biology of grouper, cobia, silver pompano, pacu, sea breams, salmon, rabbit fish

Harvesting and post-harvesting technology of cultured finfish.

Production, quality control, marketing and economics.

Coastal Aquaculture Authority and its role.

**References:**

 **Bardach JE et al** Aquaculture Wiley Interscience

 **Huet & Timmermans** Textbook of fish culture FNB

 **Pillay TVR** Aquaculture: principles and practices FNB

 **Santhanam R et al** Coastal aquaculture CBS

**Practicals:**

1. Fish identification based on morphometric and meristic data.
2. Dissect and display the digestive system of herbivorous and carnivorous fish and reproductive system of fish
3. Important calculations in aquaculture: FCR and FCE, Daily ration of feed, Survival rate, Specific growth rate, Quantifying the seed for transport.
4. Identification:

 A. Cultivable fishes

 B. Predatory and weed fishes

 C. Fertilizers

 D. Supplementary feeds

 **Paper 1.3: Crustacean Farming**

Status of crustacean farming in India and abroad.

Important cultivable species and their biology - *Penaeus monodon, P. indicus,*

*P. vannamei, P. semisulcatus and Macrobrachium rosenbergii; Scylla serrata* and *Panilurus homarus.*

Types of farming practices: Traditional, extensive, semi-intensive, intensive, super- intensive and ultra-intensive.

Farming of prawn, shrimp, crab, lobster. Harvesting and handling.

 Culture in: Cages, re-circulatory systems and rice fields.

20% excluded syllabus meant for assignments:

Marketing and economics.

Supplementary feeding: dry feeds, wet feeds, role of artificial feeds; feed ingredients and nutritional quality.

 **References:**

 **Shigueno K** Shrimp culture of Japan AITP, Tokyo

 **Milne PH** Fish & shellfish farming in coastal waters FNB

 **McVey JP** Crustacean aquaculture CRC handbook CRC press

 **Korringa P** Farming of marine fishes & shrimps Elseiver

 **Walne PR** Culture of bivalve mollusks PNB

**Practicals:**

1. Identification of shrimp upto species level based on morphological characters.
2. Dissect and display the appendages of shrimp and crab.
3. Dissect and display the digestive system of shrimp, crab and lobster
4. Dissect and display the reproductive system of shrimp and squilla.
5. Identification:

A. Cultivable crustaceans

B. Larval forms

C. Shrimp and crab feed.

**Paper 1.4: Aquaculture Engineering**

 Scope and importance of aquaculture engineering.

 Types of soils, important soil properties; soil texture & structure, soil-water Relationships.

 Computation of area by various survey methods (chain, plane table, magnetic compass

and leveling (auto leveler), earth work estimations.

Properties of fluids, computation of time to fill/drain pond/tank.

Fundamentals of waves & tides; their effects on aquaculture installations.

Engineering properties of materials. Types of materials used in aquaculture. Technical considerations in site selection for hatchery/farm/cages

Design and construction of a hatchery (carp/shrimp), pond, cages, pens, raceways.

Different types of feeding equipment, feed control systems, dynamic feeding systems.

20% excluded syllabus meant for assignments:

Water treatment: Filtration of water for aquaculture; water re-circulatory equipments. Working principles of PH meter, salinometer, spectrophotometer, D.O. meter, Secchi disc, heaters, ozonisers, UV filtration unit, pumps and aerators (types, selection and positioning).

**References:**

 **Lawson TB** Fundm. Aquaculture engineering CBS

 **Whaton FW** Aquaculture engineering John Wiley

 **Timmon** Aquaculture engineering Blackwell

 **Bose & Mitra** Coastal aquaculture engineering Oxford & IBH

Punnima Surveying Laxmi publishers

 **AGOR** Elements of Civil Engg. Khanna

 **BC mal** Soil & Water Conservation Engg. Kalyani

 **Practicals:**

1. Determination of bulk and particulate density of soil

2. Land survey -chain, plane table, magnetic prism, autoleveler

3. Lay-out preparation of fish and shrimp hatchery

4. lay-out preparation of fish/shrimp farm

5. Designs of various monk sluices

6. Numericals on optimal height and width of dikes and earth work

**M.Sc. Marine Biotechnology – I Semester**

**Paper 1.1: Oceanography and Marine Biology**

Dimensions of oceans; Physical parameters of sea: Tides, waves, light, temperature, currents, density, pressure.

Chemical parameters of the sea: salinity, dissolved oxygen, carbon dioxide, PH, nutrients and trace elements.

Composition of seawater and brackishwater.

Classification of marine habitats and ecological divisions of the Ocean.

Plankton, nekton, benthos and their adaptations.

Ecology of coral reefs and mangrove habitats; their special features.

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**Practicals:**

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2. Determination of the Dissolved Oxygen concentration in the sea water adopting Winkler's

 Method

3. Determination of Alkalinity of the sea water sample following Titrimetric Method

4. Determination of pH of sea water sample using a digital pH meter.

5.Identification of Phytoplankton, Zooplankton, Nekton, Intertidal, sub-tidal

 organisms, corals and mangroves.

 **Paper 1.2: Biochemistry**

Basic concepts of biochemistry: An overview, types of chemical bonds.

Structure & properties of biomolecules: Carbohydrates, lipids, proteins.

Proximate composition of fish and shellfish.

Metabolism of carbohydrates - Glycolysis, Gluconeogenesis, Kreb's cycle,

Oxidative phosphorylation; protein metabolism, lipid metabolism- Beta fatty acid oxidation.

Principles of Metabolic regulation- regulatory steps, signals and second messengers.

Bioenergetics: Basic principles, Equillibria and concept of free energy; Coupled processes

Structure and properties of Vitamins and hormones; Prostaglandins, leucotrienes, thromboxanes, interferons, interleukins

20% excluded syllabus meant for assignments:

Types of antibiotics

Biological membranes: organization-sideness and function, transport of biomolecules and cytoskeletal organization.

Biochemical pathway of photosynthesis and factors affecting.

 **References:**

**Stryer H** Biochemistry Freeman

**Lehninger AL** Principles of biochemistry CBS

**Voet & Voet** Biochemistry

**Plummer** An introduction to practical biochemistry.

**Practicals:**

1. Estimation of moisture in fish/shrimp muscle

2. Estimation of protein in fish/shrimp muscle by Lowry's method

3. Estimation of carbohydrate in fish/shrimp muscle by Anthrone method

4. Estimation of lipid in fish/shrimp muscle by Sulpho- Phospho vanillin method

5. Separation of proteins by Acrylamide GEL Electrophoresis

6. Estimation of glycine by formal titration

7. Analytical method to detect carbohydrates

8. Analytical method to detect amino acids-

9. Analytical method to detect proteins

10. Analytical method to detect lipids

11. Equipments in Biochemistry

**Paper 1.3: Reproductive Physiology and Endocrinology**

Anatomy and histology of gonads in fin fish and shellfish.

Development of gonad: oogenesis; spermatogenesis, metabolic changes during oogenesis and spermatogenesis and gonadal steroidogenesis.

Sex determination and differentiation, factors affecting sex differentiation.

Sexual dimorphism, primary and secondary sex characters, bisexual reproduction, inter-sexes, hermaphroditism

Regulation of seasonal reproduction: Role of environment - photoperiod, temperature, rainfall

Breeding technology: Hypophysation and Induced breeding, cryopreservation of gametes and artificial fertilization.

Neuro-endocrine systems in fish and shrimp and its role in the regulation of reproduction.

20% excluded syllabus meant for assignments:

Sex reversal in fish and shellfish, factors affecting sex reversal.

Breeding biology and endocrine control of reproductio in finfish and shellfish.

Annual reproductive cycles and breeding patterns in fin fish and shell fish. Pheromones and reproductive behaviour.

Role of hypothalamo-hypophyseal system and pineal gland, role of peripheral endocrine system, role of nutrition.

Application of biotechnology for accelerating gonadal growth and manipulation of duration of spawning. In vitro maturation of oocyte.

**References:**

**Adiyodi KG & Adiyodi RG. 1971.** Endocrine Control of Reproduction in Decapod Crustacea. Biology Reviews.

**Agarwal NK. 2008.** Fish Reproduction. APH Publ.

 **Bell TA & Lightner TA. 1988.** A Handbook of Normal Penaeid Shrimp Histology. World Aquaculture Society.

**Ghosh R. 2007.** Fish Genetics and Endocrinology. Swastik Publ. & Distr.

**Hoar WS, Randall DJ & Donaldson EM. 1983.** Fish Physiology. Vol. IX. Academic Press.

**Maria RJ, Augustine A & Kapoor BG. 2008.** Fish Reproduction. Science Publ.

**Matty AJ. 1985.** Fish Endocrinology. Croom Helm.

**Mente E. 2003.** Nutrition, Physiology and Metabolism in Crustaceans. Science Publ.

**Nikolsky GV. 2008.** The Ecology of Fishes. Academic Press.

**Thomas PC, Rath SC & Mohapatra KD. 2003.** Breeding and Seed Production of Finfish and Shellfish. Daya Publ. House.

**Practicals:**

1. Dissection of reproductive system - fish, shrimp, Celina

2. Estimation of spawning season

3. Estimation of fecundity

4. Gonadal maturity stages in fish, shrimp, mollusca

5. Dissection and display of pituitary gland from fish

6. Preparation of pituitary gland extract

7. Estimation of GSI

8. Dissection and display of various endocrine organs of fish/shrimp

**Paper 1.4: Molecular Biology**

Cell structure.

Nucleic Acids: Structures and properties of DNA and RNA

DNA replication, damage and repair in prokaryotes and eukaryotes

DNA recombination: Homologous and non-homologous, site specific recombination.

Transcription in Prokaryotes and Eukaryotes; Regulatory elements, processing of t-RNA and r- RNA; Genetic code, Translation and Translational machinery: Ribosomes, composition and assembly.

Regulation of gene expression in prokaryotes and eukaryotes.

Operon concept- Lac, Tryp, Ara, Gal and His.

DNA regulatory sequences and transacting factors, Environmental regulation of gene expression.

Mutations: Types, Physical, chemical and biological mutagens, Role of transposons in mutations.

Oncogenes and tumor suppressor genes.

20% excluded syllabus meant for assignments:

Cell function in prokaryotes and eukaroytes with reference to nucleus, mitochondria, chromosomes and ribosomes.

Cell cycle and its regulation.

Transport of proteins and molecular chaperones, Protein stability, Protein turn over

and degradation. Post- translational modifications.

DNA methylation.

 **References:**

 **Lewin B** Genes IX John Wiley

 **Watson et al** Molecular biology of gene Benj. Cumm.

 **Frifielder D** Microbial genetics

 **Lodish et al** Molecular cell biology Freeman

 **Practicals:**

1. Qualitative analysis of Nucleic acids.

2. Quantitative analysis of nucleic acids.

3. Plasmid DNA and Genomic DNA isolation & quantitation: Plasmid mini preparations

4. Isolation of RNA from yeast cells/ fish

5. Purification of DNA from an agarose gel

6. Restriction digestion of DNA

 7. Bacterial transformation