Academic Council: Date 26 / 04 / 2010, R. No.: (2)
Executive Council: Date 07 / 05 / 2010, R. No.: (3)

BHAVNAGAR UNIVERSITY

BHAVNAGAR

(NACC Accreditation Grade "B")

CREDIT AND SEMESTER SYSTEM SYLLABUS

MASTER OF SCIENCE (M.Sc.)

MARINE SCIENCE

(In Force From Academic Year: 2010-2011)

M.Sc (Marine Science)

SYLLABUS

Effective from
2010

Department of Marine Sciences
Bhavnagar University
Bhavnagar – 364 022.
Gujarat, India.

FACULTY OF SCIENCE
M.Sc. (MARINE SCIENCE)

SEMESTER SCHEME

R.M.Sc 1 Eligibility for Admission:

A candidate who has passed a graduation degree of three years duration from a recognized university or equivalent in subjects zoology / botany / microbiology / biotechnology / fisheries / forestry /environmental science / agriculture / veterinary science etc., or the candidate have passed second year B.Sc with any of the subjects (as subsidiary subjects) mentioned above may become eligible to apply for admission to a master's programme of Marine Science subject in Bhavnagar University.

The admission will be given on the basis of a common merit list prepared by the Departments and the reservation rules of Government/UGC/Bhavnagar University will be applicable on the same.

Merit list will be prepared by the Departments as per the prevailing rules applicable to them from time to time.

R.M.Sc.2 Attendance

No candidate shall be considered to have pursued a regular paper of study unless he/she is certified by the HOD/Principal to have attended the 75% of the total number of sessions conducted in each semester during his/her paper of study.

Any student not complying with this requirement will not be allowed to appear in the semester examination. However, the Department/College may condone the required percentage of attendance by not more than 10 % during a semester.

All other cases below 65% of attendance will be referred to vice Chancellor for his discretion to allow the student to appear in Examination.

If a student is going out of class to officially represent the university/ Institution with permission of HOD/ Principal/ Course Coordinator in local/ state / national/ international activities his / her attendance should be compensated. Such exemption should normally not exceed 20 days in a semester.

R.M.Sc.3 Examination Scheme

The Examination scheme is trifurcated in following

1. Scheme of Promotion to next semester
2. Scheme for assessment criteria for different type of Papers
3. Scheme of passing in examination and award of Grade in respective examination

1.Scheme of promotion:

For the programme of 4 semester (Promotion to next semester)

The minimum marks of passing the examination for each semester shall be 36% in each paper of the semester. The paper will be exempted for further examination if the candidate secures minimum 36 % marks in that paper.

Promotion to Second Semester

A candidate will be promoted to second semester irrespective of candidate's result of 1st semester provided that the candidate's term has been granted. (Attendance)

Promotion to Third Semester

To be eligible for promotion to the 3rd semester of the programme, a student must pass successfully at least 75 % of papers out of total papers offered during first & Second Semester of the programme.

Promotion to 4th Semester

A student must pass at-least 50 % papers of all 1st, 2nd & 3rd semester taken together.

To be eligible for award of degree, a candidate has to pass all the papers offered during two year programme within the span period.

The percentage fraction of a paper if comes in point fraction than the count will be taken as nearest most integer. (For example fractions 2.25/2.5/2.75 will be taken as 2 or fractions 3.25/3.5/3.75 taken as 3 and so on)

_ R.M.Sc.4 Evaluation during examination

The examination and evaluation for the term end papers of a Programme shall be conducted by the examiners appointed by the Vice Chancellor from time to time.

4.1 Evaluation Criteria:

All papers will have 30% continuous internal evaluation and 70% term end evaluation in postgraduate programme.

4.2 Paper setting criteria for theory examination:

The Structure of the papers will be decided by the respective boards.

4.3 Evaluation of project-studies / Dissertation

For the paper/practical of research based Project, the student will submit a project report. Out of this written part for the project study shall account for 70% of marks and the viva-voce/ Presentation or practical to be conducted by a panel of examiners for the remaining 30% of marks will be assessed by a panel of examiner(s). Dissertation/Project commences in III semester but evaluated and grade point are to be added in 4th semester.

4.4 Educational Tours/ Camp (Where Applicable)

Educational tours if they are part of assessment will be assessed for 70% of marks for a written experience submission and 30 % marks will be based on viva/practical presentation by a panel of examiner(s). Educational Tours/ Field works may be carried out in any semester or all semesters, but evaluated and Grade points are to be added in 4th Semester only.

4.5 Continuous Internal Assessment:

During programme Continuous assessment marks shall be based on methods such as:

1. Participation in seminars, case discussions and group work Activities.
2. Class tests, quizzes, individual and group oral presentations.
3. Submission of written assignments, term papers etc.
4. Classroom participation and attendance
5. Take home examination
6. Any other innovative methods as introduced by the faculty concerned with prior declaration to the students

The weightage given to each of these factors shall be decided and announced at the beginning of the semester by concerned Head of the programme.

4.6 Re-examination/ Part Examination/ATKT

A student who fails to attain minimum passing marks in a paper will be allowed to re-appear in that paper in any semester. However, the total number of attempts for a paper shall not exceed three during the span period of the programme.

R.M.Sc. 5 Scheme of passing in examination and award of Grade in respective examination

A candidate will have to secure minimum 40% marks separately in both segment of continuous assessment and term end examination. A sum of continuous assessment and term end examination will be the final award of total marks to a candidate in each paper. The degree shall be awarded to successful students on the basis of the combined results of all the semesters examinations as follows:

40%	or more but less than 45%	Pass Division.
45%	or more but less than 60%	Second Division
60%	or more but less than 75%	First Division
75%	or above	Distinction.

The Grades will be awarded to a candidate in following criteria.

Grade Point System in Bhavnagar University
Percentage Initial Grade Point Grade Class / Division

85-100	9	A++	Honours/Distinction
80-<85	8	A+	Honours/Distinction
75-<80	7	A	First Division
70-<75	6	A-	First Division
65-<70	5	B+	First Division
60-<65	4	B	First Division
55-<60	3	B-	Second Division
50-<55	2	C+	Second Division
45-<50	1	C	Third Division
40-<45	<1	C-	Third Division
36-<40	0	D	Third Division
<36	-	F	Fail

Conversion Formula :

Grade Point = (Percentage of Marks Obtained – 40) /5

e.g. 88% = (89-40)/5 = 49/5 = 9.8 Grade Point & A++ Grade
52% = (52-40)/5 = 12/5 = 2.4 Grade Point & C+ Grade
42% = (42-40)/5 = 2/5 = 0.4 Grade Point & C- Grade

Percentage Obtained = Grade Point X 5 + 40

e.g. 3.2 Grade Point = 3.2 X 5 + 40 = 16.0 + 40 = 56%
2.4 Grade Point = 2.4 X 5 + 40 = 12.0 + 40 = 52%

R.M.Sc.6 Span of Programme:

For the Marine Science master degree programme the span of the programme shall be ***eight*** semesters.

R.M.Sc.7 Improvement

A candidate who has passed in a theory paper shall be allowed to appear again for respective theory paper only once in immediate next semester examination in order to improve grade by paying the prescribed fees.

If a candidate's grade is improved it will be considered for the improvement in the class but the same will not be considered for award of any prize, medal, rank and distinction.

If the candidate does not improve marks, his/her previous marks and grade will be considered for award.

No candidate shall be allowed to improve marks in papers other than term end theory paper.

R.M.Sc.8 Inter disciplinary credit courses

The candidate must earn minimum credit as prescribed in respective programme to the respective degree awarded.

In addition to minimum credit of the respective programme the candidate shall be allowed to opt for inter disciplinary courses offered by other Departments and earn extra credit to the tune of maximum one interdisciplinary course per semester and earn extra credit.

The additional credit so earned shall be reflected in mark sheet but will not be counted for the award of class / grade of the same programme.

R.M.Sc. 9 Detailed structure of Examination

NAME OF THE SUBJECT: MARINE SCIENCE (M.Sc.)

Semester-1

Paper No.	Title of the Paper	Maximum Marks		Minimum Marks required to Pass		Teaching hrs per week	Exam Hours	Credits	Interdisciplinary
		Internal	External	Internal	External				
Paper-1	Ecology	30	70	12	28	15 Weeks x 05 Hours = 75	3	5	Y
Paper-2	Oceanography	30	70	12	28	15 Weeks x 05 Hours = 75	3	5	Y
Paper-3	Marine living resources and Biodiversity	30	70	12	28	15 Weeks x 05 Hours = 75	3	5	N
Paper-4	Practical	100		40		15 Weeks x 18 Hours = 270	24	18	N

Semester-2

Paper No.	Title of the Paper	Maximum Marks		Minimum Marks required to Pass		Teaching hrs per week	Exam Hours	Credits	Interdisciplinary
		Internal	External	Internal	External				
Paper-5	Biochemistry, Genetics, Molecular biology and Biotechnology	30	70	12	28	15 Weeks x 05 Hours = 75	3	5	Y
Paper-6	Tools & Techniques and Biostatistics	30	70	12	28	15 Weeks x 05 Hours = 75	3	5	Y
Paper-7	Marine Biodiversity, Conservation and Tourism.	30	70	12	28	15 Weeks x 05 Hours = 75	3	5	N
Paper-8	Practical	100		40		15 Weeks x 18 Hours = 270	24	18	N

Semester-3

Paper No.	Title of the Paper	Maximum Marks		Minimum Marks required to Pass		Teaching hrs per week	Exam Hours	Credits	Interdisciplinary
		Internal	External	Internal	External				
Paper-9	Costal Regulation Zone, various Costal resources and use of Remote Sensing.	30	70	12	28	15 Weeks x 05 Hours = 75	3	5	N
Paper-10	Fisheries	30	70	12	28	15 Weeks x 05 Hours = 75	3	5	N
Paper-11	Processing & preservation technology of fish and its products.	30	70	12	28	15 Weeks x 05 Hours = 75	3	5	N
Paper-12	Practical	100		40		15 Weeks x 18 Hours = 270	24	18	N

Semester-4

Paper No.	Title of the Paper	Maximum Marks		Minimum Marks required to Pass		Teaching hrs per week	Exam Hours	Credits	Interdisciplinary
		Internal	External	Internal	External				
Paper-13	Marine pollution, ocean management, effect of climate change on sea level.	30	70	12	28	15 Weeks x 05 Hours = 75	3	5	N
Paper-14	Culture and Cultivation of Marine Biota.	30	70	12	28	15 Weeks x 05 Hours = 75	3	5	N
Paper-15	Conservation and Management of Marine Biota.	30	70	12	28	15 Weeks x 05 Hours = 75	3	5	N
Paper-16	Practical 50 Marks Dissertation 50 Marks	100		40		15 Weeks x 18 Hours = 270	24	18	N

12 Papers of Theory, each of 100 marks 12 x 100 = 1200 Marks
4 Paper of Practical, each of 100 marks 04 x 100 = 400 Marks

Total = 1600 Marks

Detailed Syllabus
(With effect from Academic Year 2010-2011)
M.Sc. Marine Sciences
Semester: I
Paper No: 1

Title of the Paper: Ecology
Credits: 5 Marks: 100 Marks
Marks: Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching hrs.	Marks/ Weight
Unit 1	Concept of ecology: The community and its development the ecosystems, Homeostasis and stability, Energy cycles.	15	14
Unit 2	Marine ecosystems: Sea as a biological environment, Oceans of the world. Oceanography and its opportunities, main divisions and zones.	15	14
Unit 3	Animal, microbial and plant communities; their relationships. The concept of food web and organic productions.	15	14
Unit 4	Ecology of Coral and Coral reef.	15	14
Unit 5	A Detailed study of Marine Habitat, with special emphasis to coastal wetlands.	15	14

Break up of Continuous Internal Evaluation:
1. Marks.
2. Marks.
3. Marks.

Total Marks: 30 Marks.

Reference/Text-Books/Additional Reading:

1. Odum, EP, *Fundamentals of Ecology* (3rd ed.) Saunders, (1968).
2. Kormondy, EJ, *Concepts of Ecology* (4th ed.) Prentice Hall, (1986)
3. Kumar, HD, *Modern Concepts of Ecology*, Vikas Publ. House, New Delhi(1986)
4. Bames, RSK & Hughes, RN, *An Introduction to marine Ecology,* Blackwel(1982)
5. Levingston, JS, *Marine Ecology,* Prentice Hall, (1982)
6. Longhurst, AR & Pauly, D, *Ecology of Tropical Ocean,* Academic Press,(1987)

M.Sc. Marine Sciences
Semester: I
Paper No: 2

Title of the Paper: Oceanography

Credits: 5 Marks: 100 Marks

Marks: Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching hrs.	Marks/ Weight
Unit 1	Temperature and density, light in the oceans, heat budget, water masses. Sound velocity, conduction, ice formation.	15	14
Unit 2	Ocean circulation – general surface circulation, boundary currents, Langmuir circulation, forces causing currents: Coastal Currents – storm, surges, and oceanic effects on land.	15	14
Unit 3	Properties of sea water – salinity, chlorinity. Dissolved gases, CO_2 and others. Dissolved and particulate organic compounds in the sea	15	14
Unit 4	The elements and geochemical cycles of oceans. S.P.N. and C cycles; Geology of Ocean: Plate Tectonics.	15	14
Unit 5	Estuarine chemistry.-Salinity, turbidity, pH, Ec	15	14

Break up of Continuous Internal Evaluation:

1. Marks.
2. Marks.
3. Marks.

Total Marks: 30 Marks.

Reference/Text-Books/Additional Reading:

1. Dietrich, G, *General Oceanography, an Introduction*, (1963)
2. Hill, MN, (ed.) *The Sea Vol.II*, Interscience publishers, (1963)
3. Weyl, RR,*Oceanography, an Introduction to Marine Environment* John Wiley,(1974)
4. Vetter, RC*, Oceanography, the Last Frontier, Voice of America*
5. Forum Press, (1974)
6. Weisberg, J, & Parish, P, *Introductory Oceanography*, Mc Graw Hill, (1974)
7. Ferguson wood, EJ, *The Living Ocean,* St. Martin's Press, N.Y. (1975)
8. Gordon Pierie, R, *Oceanography,* Oxford Univ. Press, (1977)
9. Ross, DA, *Introduction to Oceanography* (4th ed.) Prentice Hall, (1977)
10. Roos, DA, Introduction to Oceanography, Prentice Hall, (1982)
11. Thurman, HV, *Introduction to physical Oceanography*, Merril Publ. Co. (1988)
12. Von arx, WS, *An Introduction to Physical Oceanography*, Addison – Wesley, (1964)
13. Newman, GS, & Pierson, WJ, *Principles of Physical Oceanography,* Prentice Hall, (1965).
14. Riley, JP, & Shirrow, G, (eds.) *Chemical Oceanography*, (Vol 1-8, Academic Press.
15. Riley, JP & Chester, R, *Introduction to Marine Chemistry,* Academic Press, (1981).
16. Millero, FJ, & Sohn, ML, *Chemical Oceanography*, CRC Press, (1992).
17. Angel, MV, *Biological Oceanography*, Methuen, (1975).

M.Sc. Marine Sciences
Semester: I
Paper No: 3

Title of the Paper: Marine living resources and Biodiversity

Credits: 5 Marks: 100 Marks

Marks: Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching hrs.	Marks/ Weight
Unit 1	Biodiversity of the marine habitat. Definition and concepts of species diversity, ecosystem diversity, genetic diversity, Importance and conservation of biodiversity.	15	14
Unit 2	Marine fauna: Their classification, distribution, importance and utilization. Intertidal habitat of flora and fauna and their diversity.	15	14
Unit 3	Marine Microbiology: The bacteria, fungi and viruses of marine habitats – their classification and biology. Symbiotic and pathological associations with animals and plants.	15	14
Unit 4	Marine algae and angiosperms: Classification, morphology and biology of marine algae with special emphasis on their utilization, grasses. Mangroves and other halophytes (distribution, classification, morphology and biology).	15	14
Unit 5	Development of larvae of all marine invertebrates phyla and protochordata; speciation and evolution of marine organisms and living resources of the Indian seas. Ichttyogeography, Migration of fishes, population identification and population studies in fishes, population dynamics in fishes.	15	14

Break up of Continuous Internal Evaluation:

1. Marks.
2. Marks.
3. Marks.

Total Marks: 30 Marks.

Reference/Text-Books/Additional Reading:

1. Austin, B, *Marine Microbiology,* Cambridge Univ. Press, (1988).
2. Fredrich, H, *Marine Biology* of Sidgwick & Jackson, (1969).
3. Lobban, CS, & Wynne, MJ, *The Biological of Seaweeds*, Blackwell, (1981)
4. Nair, MB, & Thamphy, DM, *A Text Book of Marine Biology*, Mac millan, (1980).
5. Nicol, JAC, *The Biology of Marine Animals*, Pitman, (1960).
6. Parsons, TR, Takhasi, M, & Hargrave, B, *Biological Oceanographic Processes,*Perqmon, (1977).
7. Sieburth, J. MC N., *Sea Microbas*, Oxford Univ. Press, (1979).
8. Southward, AJ, *Life on the Seashore*, Heinemann, (1965).

M.Sc. Marine Sciences
Semester : I
Paper No : 4

Title of the Paper: **Practical**

Credits: 18 Marks: 100 Marks

Sr. No	Practical	No. of Practical	Hrs. required
01	Ecological estimation: Acidity and Alkalinity (pH), Chloride, Atmospheric temperature by use of various thermometer, BOD, COD, DO, Ec, Turbidity, TDS. Study of Productivity.	10	30
02	Analysis of various marine pollutants (like Sulfate, Aluminum Phosphorus, Oil , Grease and Organic Metter etc.)	04	12
03	Identification and study of Larvae of Marine Invertebrates and Vertebrates.	06	18
04	Beach profile survey and sediment sample collection.	03	09
05	Field observation on marine fauna and flora regarding the effect of pollution.(Hydro biological analysis)	02	06
06	Identification and classification of marine fauna from protozoa to mammals.	10	30
07	Isolation of Bacteria from marine sediments and water sample	02	06
08	Identification and classification of Marine Algae.	03	09
09	Qualitative study of marine habitat. And grain size analysis	06	18
10	Identification & Classification of corals and coral reef by preserved specimen and charts.	03	09
11	Identification of Mangrove	01	03
12	Preparation of agar gel from seaweed	03	09
13	Preparation of alginate from seaweed	03	09
14	Preparation of Carrageenan from seaweed.	03	09
15	Identification of Sediment samples with special reference to texture and composition under microscope.	01	03
16	Study of Bathymetry map.	01	03
17	Recognition of contour maps, dome, basis, ridge.	01	03
18	Analysis of size, roundness and spherically by visual comparison charts and Identification of Minerals.	01	03
19	Operation of Current meter	01	03
20	Measurements of evaporation, transpiration and relative humidity.	01	03

Break up of Continuous Internal Evaluation:

1. Marks.
2. Marks.
3. Marks.

Total Marks: 30 Marks.

M.Sc. Marine Sciences
Semester: II
Paper No: 5

Title of the Paper: Biochemistry, Genetics, Molecular biology and Biotechnology.

Credits: 5 Marks: 100 Marks

Marks: Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching hrs.	Marks/ Weight
Unit 1	Structure, classification and function of proteins, carbohydrates, fats and vitamins. Metabolism: Energy yielding processes. Photosynthesis, respiration and mineral metabolism.	15	14
Unit 2	Mendelian inheritance, modification of Mendelian inheritence (neo-mendelism), gene concept and interaction of genes (complementary), epistasis, inhibitory etc.Linkage, sex-linked genes and lethal genes. Extra-chromosomal inheritance: plasmids and transposones.	15	14
Unit 3	DNA and RNA as genetic material, structure and replication of DNA. Central Dogma of Molecular biology. RNA synthesis, transcription (reverse transcription).	15	14
Unit 4	DNA damage and repair, Mutations (at DNA level), Genetic Code. Gene expression and regulation. RNA processing. Ribozymes, DNA Sequencing. Definition and scope of biotechnology. Recombinant DNA technology : restriction enzymes, ligases. Steps in Genetic Engineering obtaining the gene, from m-RNA and DNA synthesis. Methods of introducing gene into host-cell-vectors, direct methods, electrical methods, Recording gene expression.	15	14
Unit 5	Application of Biotechnology for removal of marine pollution. Pharmacological activities of the chemical compounds of the marine organisms and their uses as drugs. Marine Drugs and Pharmaceuticals : Pharmacological and Pharmaceutical applications of marine drugs. Use of marine plant and animal extracts as medicinal agents.	15	14

Break up of Continuous Internal Evaluation:

1. Marks.
2. Marks.
3. Marks.

Total Marks: 30 Marks.

Reference/Text-Books/Additional Reading:

1. Conn, FE, & Stump, PK, *Outlines of Biochemistry*, Wiley Eastern, LTD, (1989).
2. Lehninger, Nelson, & Cox, *Principles of Biochemistry* (2nd ed.) CBS Publ. (1993).
3. Trehan, K, *Biochemistry*, Wiley Eastern LTD. (1990).
4. De Robertis, Cell and Molecular Biology, Lea & Febiger USA, (1988).
5. King, B, *Cell Biology,* Allen & Unwin, (1986).
6. Stent, GS, & Calender, R, *Molecular Generics*, WH Freeman & Co USA, (1978).
7. Gupta, PK, *Genetics,* Rastogi Publ. Meerut, (1997).
8. Ignacimutthu, *Basic Biotechnology*, Tata Mc Grew Hill, (1995).
9. Kumar, HD, *A Text Book of Biotechnology*, East West, New Delhi (1994).
10. Gupta, PK, *Elements of Biotechnology,* Rastogi & Co,. Meerut, (1994).
11. Mitra, S, *Genetic Engineering*, Mac millan (1990).

M.Sc. Marine Sciences
Semester : II
Paper No: 6

Title of the Paper: **Tools, Techniques and Biostatistics.**
Credits: 5 Marks: 100 Marks
Marks: Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching hrs.	Marks/ Weight
Unit 1	Analytical methods and techniques used in chemical oceanography conductivity, colorimetric, chromatography, Nelson water sampler and use of Grab (Sediments collection), Sacchi discs. Flame photometry, spectrophotometers, spectroscopy (NMR and Mass atomic absorption). Principle and operation of HPLC and Electron microscope.	15	14
Unit 2	Population and sample, Random sampling. Use of random numbers, methods of collection of biological data, data scales, classification, construction of frequency distribution and diagrammatic representation of data, measures of central tendency and suitability if their application.	15	14
Unit 3	Dispersion and its measures – Range, mean deviation, standard deviation, coefficient of variation preliminary concept of probability, addition and multiplication laws of probability, Application of Bayes thermo, False positive and False negative tests, Sensitivity of a test.	15	14
Unit 4	Simple correlation analysis, Its applications, Linear Regression and its utilities, Two lines of regressing, rank correlation, statistical hypothesis, tests of hypotheses, Type I and Type II errors, Chi-square test with their application.	15	14
Unit 5	t test and its applications, F test, One way and Two way ANOVA, principles of experimental design, Non-parametric tests and their advantages, Wilcoxon's signed ranks test, Mann Whitney U test for two independent sample.	15	14

Break up of Continuous Internal Evaluation:

1. Marks.
2. Marks.
3. Marks.

Total Marks: 30 Marks.

Reference/Text-Books/Additional Reading:

1. Christian, GD, & O'Reilly, *Instrumental Analysis*, (2nd ed.) Alhyn & Bacon, (1986).
2. Skoog, DA, & Leary, JJ, *Principles of Instrumental Analyses* Saunders, (1992).
3. Rajaram, V, *Computer programming in fortran*, Prentice Hall, (1983).
4. Zar, J, *Biostatistics,* Prentice Hall, (1984).
5. Arora, PN, *Biostatistics*, Prabhat Book Centre, Gwaliar, (1989).
6. Bailey, NTJ, *Statistics methods in Biology*, Cambridge Univ., Press (Low price edition), (1994).
7. Gupta, GB, *Introduction to Statistica*l Methods, (7th ed.) oliver & Boyd. (1975).
8. Ghan, IA & Khanum, A. *Fundamentals of Biostatistics*, Vkaaz. Publ. Hyderabad, (1995).
9. Lewis, A. Biostatistics. East West Press, New Delhi. (1971).
10. Chatterjee, S.and Price, B. Regression Analysis by Examples, John Wiley, New York. (1977).

M.Sc. Marine Sciences
Semester : II
Paper No: 7

Title of the Paper: Marine Biodiversity, Conservation and Tourism.

Credits: 5 Marks: 100 Marks

Marks: Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching hrs.	Marks/ Weight
Unit 1	Marine Birds: Distribution and types, Economic Importance. Marine Reptiles: Distribution, types and status, Economic Importance. Marine Mammals: Mammals adaptation for marine life, distribution and Economic Importance.	15	14
Unit 2	Fauna and Flora of the islands of the worlds. Their Classification, distribution and their Conservation. Economic and ecological Importance of these species.	15	14
Unit 3	Marine Tourism of India and Abroad, Famous Beaches of India, Eco-tourism and recreational tourism, marine Amusement parks and their impact on Tourism., various causes affected to Eco-tourism.	15	14
Unit 4	Definition and Classification of Plankton, Characteristic features and adaptation of plankton, abundances and distribution of plankton, Phyto and Zoo plankton, Importance of Plankton, Ecology of plankton. primary production in estuary and Sea. Method of collection, preservation and analysis of plankton.	15	14
Unit 5	Plankton and fisheries, indicator species, planktonic larvae, Biology and economic importance. Red water and related phenomenon of discoloured waters, bioluminescence. Vertical migration of plankton and associated phenomena, biological indicators, plankton as fish food. Factors controlling productions, plankton hydrograph, plankton production and upwelling.	15	14

Break up of Continuous Internal Evaluation:

4. Marks.
5. Marks.
6. Marks.

Total Marks: 30 Marks.

Reference/Text-Books/Additional Reading:

1. John E. Reynolds, Biology of Marine Mammals (2001)
2. R.Santhanam, N.RAmanathan, K.Venkataramanujum Phytoplankton of the Indian seas (2005)
3. Mitra,A. Introduction to Marine Phytoplankton Narendra Publishing House,Delhi (1999)
4. Mitra , A. ed Introduction to Marine Plankton Daya Publication, New Delhi (2001)
5. Gunther, A. A Guide to Reptiles & Fishes Daya Publication, New Delhi (2001)
6. Kumar Arvind ed Ecology of Plankton Daya Publication, New Delhi (2002)
7. Nicol, JAC The Biology of Marine Animals Pitman(2002)
8. James L. Sumich, John F. Marrisey Introduction to the Biology of Marine life
9. Kartik Shanker, B C Choudhury Marine Turtles of the Indian Subcontinent University Press.

M.Sc. Marine Sciences
Semester : II
Paper No : 8

Title of the Paper: **Practical**
Credits: 18 Marks: 100 Marks

Sr. No	Practical	No. of Practical	Hrs. required
01	Biochemistry: Analysis of fat, photosynthesis of marine algae.	04	12
02	Estimation of DNA, RNA	02	06
03	Estimation of Protein, reducing sugar, Amino acid, carbohydrates etc.,	06	18
04	Preparation various modals of amino acids by Ball & Stick models.	01	03
05	Study of various exercise of genetics from text books	02	06
06	Study of various instruments used in laboratory e.g. Laminar flow, conductivity meter, colorimeter, Nephalon Turbidometry (NTU),	06	18
07	Principle and methodology of flame photometer, chromatography, spectrophotometer, Spectroscopy (NMR and mass atomic absorption.)	04	12
08	Paper Chromatography	01	03
09	Use of Nelson Water Sampler, GPS and Grab.	03	09
10	Diagrammatic representation of Data- Histogram, Frequency Polygon, Frequency Curve, Ogive curve, bar chart, Pie diagram.	01	03
11	Measures of Central tendency and dispersion.	01	03
12	Correlation and Regression Analysis.	01	03
13	t Test- testing single mean and difference of two means using (1) Independent samples and (2) Paired Samples.	02	06
14	Chi-square test (1) Goodness of fit test (2) Testing Independence of two attributes (characters).	02	06
15	One way Analysis of Variance.	01	03
16	Two way Analysis of Variance.	01	03
17	Wilcoxon's and Mann- Whitney U test.	01	03
18	Collection, identification and preservation of plankton (qualitative and quantitative.	06	18
19	Phyto plankton –Zooplankton, Benthos observation at group level	03	09
20	Determination of phytoplankton pigments.	01	03

Break up of Continuous Internal Evaluation:

7. Marks.
8. Marks.
9. Marks.

Total Marks: 30 Marks.

M.Sc. Marine Sciences
Semester : III
Paper No : 9

Title of the Paper: **Costal Regulation Zone, various Costal resources and use of Remote Sensing.**
Credits: 5 Marks: 100 Marks
Marks: Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching hrs.	Marks/ Weight
Unit 1	Definition and terminology of coastal Regulation zones. Estuarine zone management and ICZM. Coastal problems: formation of coast line, stability and position, erosion, accretion.	15	14
Unit 2	The ocean wealth : Sustainable exploitation of the mineral resources (for petroleum, natural gas, manganese nodules, Sulfur, fresh water, construction materials, magnesium, etc.) living resources for food, Botanical resources and non-extractive uses – energy, recreation, transportation, communication etc.	15	14
Unit 3	Coastal land development, national programmers, for coastal belt a forestation and greening of saline coast lands. Mangrove restoration effects and requirement.	15	14
Unit 4	Common Salt (NaCl) general Introduction– chemistry of the salt manufacture, the methodology of salt production, Measures for improving the quality of salt and Up gradation of salt in marine salt works using sea-water and subsoil brines. Different grades of salt. Uses of common salt Biological management in solar works. The salt industry in national economic scenario.	15	14
Unit 5	Uses of remote sensing systems and satellite technologies in detection of various marine resources.	15	14

Break up of Continuous Internal Evaluation:

1. Marks.
2. Marks.
3. Marks.

Total Marks: 30 Marks.

Reference/Text-Books/Additional Reading:

1. Barnes, RSK, *The Coastal line*, John Wiley, (1977).
2. Coastanza, R, *Ecological Economics* : The Science and Management of Sustainability, Columbia Univ., Press, NY, (1991).
3. May RM, *Exploitation of Marine Communities*, Springer Verlag, (1984). Crachnel.
4. A. P. Remote sensing application in Marine Science and Technology. D. Reidel Publishing C. (1982)
5. Robinson. I.S.Satellite Oceanography- An Introduction to Oceanographers and Remote Sensing Scientists

M.Sc. Marine Sciences
Semester : III
Paper No: 10

Title of the Paper: Fisheries

Credits: 5 Marks: 100 Marks

Marks: Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching hrs.	Marks/ Weight
Unit 1	General morphology and anatomy of bony and cartilaginous fish and shellfish	15	14
Unit 2	Economically important marine fishes and shellfishes.	15	14
Unit 3	Fishing crafts and gears types of important knots in preparation of gears. Methods of fish detection in the sea (VHF, GPS, Fish finder, INCOIS).	15	14
Unit 4	Estuarine fisheries recourses of India.	15	14
Unit 5	Gujarat Fisheries Act, Coastal Aquaculture Authority Act, Biodiversity Act.	15	14

Break up of Continuous Internal Evaluation:

1. Marks.
2. Marks.
3. Marks.

Total Marks: 30 Marks.

Reference/Text-Books/Additional Reading:

1. Bal, DV & Rao, KV, *Marine Fisheries* (2nd ed,) Tata Mc Graw Hill, New Delhi, (1989).
2. Cushing, DH, *Marine Ecology and Fisheries*, Cambridge Univ., Press. (1975).
3. Cushing, D, *Fisheries Resources of the sea and their Management*, E.L.B.S. Low Priced ed., (1975)
4. Santhanam, R, *Fisheries Science*, K. K. Fine Arts Press, Delhi, (1990)
5. Jhingran, V.G., *fish and fisheries of India* (3rd ed.), Hindustan Publishing Co., New Delhi, (1991).

M.Sc. Marine Sciences
Semester : III
Paper No: 11

Title of the Paper: **Processing & preservation technology of fish and its products.**
Credits: 5 Marks: 100 Marks
Marks: Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching hrs.	Marks/ Weight
Unit 1	Edible fish products : fish ham, sausage and other fish paste products, Surimi. Importance of fish meat, fish oils.	15	14
Unit 2	Non edible fish products: fish essence and isinglass, skin, bone and teeth, collagen, glue, etc.	15	14
Unit 3	Types of spoilage of fish products, their causes and quality control and sanitation. (HACCP & EEC)	15	14
Unit 4	Processing plant : Engineering factors in processing of aquaculture products, Concept of unit operating, Layout of processing plant. Large scale operation and process equipments - cold storage, Chill storage, Canning and freezing plant. Fish processing technology. Handling of fishes; preservation technologies; freezing, icing, solid CO_2, liquid nitrogen. Canning technology, curing, salting and smoking etc.	15	14
Unit 5	Fundamentals of Biochemistry & microbiology of fishes. (TPC, E.coli, Salmonella test), Transgenic Fishes.	15	14

Break up of Continuous Internal Evaluation:
1. Marks.
2. Marks.
3. Marks.
Total Marks: 30 Marks.

Reference/Text-Books/Additional Reading:

1. A.L.Winton, and Winton K.B., 2000 *Fish & fish products* Agrobios, New Delhi.
2. Biswas K.P, *Fish, Fisheries and Technology*, Narendra Publishing House, New Delhi.
3. C.L.Cutting, *Fish Processing and Preservation*, Agro Botanical Publishers, Bikaner.
4. Bhattnagar, S. and Shammi Q.J., (2002) *Applied Fisheries* Agrobios Jodhpur.

M.Sc. Marine Sciences
Semester : III
Paper No: 12

Title of the Paper: **Practical**

Credits: 18 Marks: 100 Marks

Sr. No	Practical	No. of Practical	Hrs. required
01	Anatomy of cartilaginous and bony fish	14	42
02	Anatomy of prawn/lobster.	06	18
03	Anatomy of Sepia/Loligo/Octopus.	06	18
04	Identification of fish	03	09
05	Study of various fish products	02	06
06	Age determination from scales, hard parts and otoliths.	01	03
07	Study of various fishing crafts & gear.	02	06
08	Observation of organoleptic characteristics of given fishes	01	03
09	Quality assessment of traditional sun dried and solar tent dried fish by organoleptic, bacteriological and chemcial methods.	01	03
10	Preparation of Shark lever oil	02	06
11	Preparation of fish fillet, fish paste, FPC (Fish protein concentrate), fish meal.	02	06
12	Preparation of Chitin & Chitosan	02	06
13	Winding the net (Gill net) with using twine	01	03
14	Study on the chemical composition of fish like moisture, lipid, ash, protein and non-protein.	03	09
15	Technique of fish salting and determination of salt concentration with time interval.	01	03.
16	Estimation of fecundity and gut contents in fishes.	02	06
17	TPC, E-coli and Salmonella test of fish	03	09
18	Estimation of Ca, MG, Cl and So4 from seawater, salt and brine water.	12	36
19	Study of maturation stages of gonads in different size of fishes	01	03
20	Study of viral, bacterial and fungal pathogens from permanent slide.	01	03

Break up of Continuous Internal Evaluation:

1. Marks.
2. Marks.
3. Marks.

Total Marks: 30 Marks.

M.Sc. Marine Sciences
Semester : IV
Paper No : 13

Title of the Paper: Marine pollution, ocean management, effect of climate change on sea level.

Credits: 5 Marks: 100 Marks

Marks: Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching hrs.	Marks/ Weight
Unit 1	Major marine pollutants: sewage, industry effluents, agricultural discharges, shrimp farm discharges, oil pollution, thermal and radioactive pollution. solid dumping, effects of mining and dredging operation.	22.5	21
Unit 2	Micro and macro-fouling, corrosion of metals and alloys in the sea, effects of bio-fouling and bio-deterioration on marine structures, protection methods of corrosion and bio-fouling. Deterioration of wood and synthetic substances in the sea.	15	14
Unit 3	Lethal and sub lethal effects on pollutions of marine organisms, evaluation of toxicity, tolerance of heavy metals and pesticides. Bioassay of various toxic factors. Indian standard of different pollutants ISO 2490 GPSC, CPSC standard.	15	14
Unit 4	Ocean management : History of important expeditions in past for assessing wealth of the seas. The relative importance of three oceans of Indian coast.	7.5	07
Unit 5	Climate change and sea-level rise, Global impacts of Sea-level rise, Management strategies to counter sea-level rise, regional experience of sea-level rise.	15	14

Break up of Continuous Internal Evaluation:

1. Marks.
2. Marks.
3. Marks.

Total Marks: 30 Marks.

Reference/Text-Books/Additional Reading:

1. Banerji, SK, *Environmental Chemistry*, Prentice Hall, (1993).
2. Geyer, RA, *Marine Environmental Pollution* Vol. I & II, Elsevier, (1981).
3. Johnson, R, *Marine Pollution*, Academic Press, (1976).
4. Ram Prakash & Sood, PP, *Toxicity and Monitoring of xenobiotics,* Venus Publ. Co,. New Delhi, (1995).
5. Rhodes et al, *The Use of Saline Waters for Crop Production* FAO Published by Scientific Publishers, Jodhput, (1994).
6. Sethi et al, *Environmental Pollution,* Commonwealth Publ. New Delhi, (1991).
7. Sharma, SK & Gupta, IC, *Saline Environmental and Plant* Growth, Agro-Botanical Publishers, Bikaner, (1986).

M.Sc. Marine Sciences
Semester : IV
Paper No: 14

Title of the Paper: Culture and Cultivation of Marine Biota.

Credits: 5 Marks: 100 Marks

Marks: Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching hrs.	Marks/ Weight
Unit 1	Culture / Cultivation of commercially important marine algae	15	14
Unit 2	Culture / Cultivation of commercially important animals.	15	14
Unit 3	Sewage fed Fisheries, brackish water fish culture and culture in salt pan.	15	14
Unit 4	Site selection: Selection of site using the criterion of topography, water supply, tides, soil characteristics, meteorological condition, types and density of vegetation, infrastructural facilities. Layout planning and design : Layout of its farm, design of ponds, canals, inlets and outlet structures, pumps and generators.	15	14
Unit 5	Maintenance of marine aquarium	15	14

Break up of Continuous Internal Evaluation:

1. Marks.
2. Marks.
3. Marks.

Total Marks: 30 Marks.

Reference/Text-Books/Additional Reading:

1. Bardch, JE, et al, *Aqua Culture*, John Wiley, Interscience, (1972).
2. Fast, AW & Lester, GJ, *Marine Shrimp Culture*: Principles and Practices, (1992).
3. Srivastaval et al., (eds.), *Brackish Water Aqua Culture Development in India*, Concept Publ. Co. New Delhi, (1987).
4. Denila, L. (1976). Layout design, construction and levelling of fish ponds. Eadings on pond construction and management, Tigbauan, Iloilo, Philippines.
5. Jamandro, T. J. and Rabanal, H. R. (1975). Engineering aspects of brackishwatr aquaculture in the South Chaine Sea Region. SCS/75/WP/16.
6. Wheaton, F. W. (1987). Aquaculture Engineering. Robert E. Krieger Publ. Floride.

M.Sc. Marine Sciences
Semester : IV
Paper No : 15

Title of the Paper: Conservation and Management of Marine Biota.

Credits: 5 Marks: 100 Marks

Marks: Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching hrs.	Marks/ Weight
Unit 1	EIA referred to coastal area.	15	14
Unit 2	Fish and Prawn Marketing	15	14
Unit 3	Fish diseases and prawn diseases in aquaculture	15	14
Unit 4	Status of endangered marine fauna and their conservation, marine protected areas of India.	15	14
Unit 5	Fishing community and their socio economic problems	15	14

Break up of Continuous Internal Evaluation:

1. Marks.
2. Marks.
3. Marks.

Total Marks: 30 Marks.

Reference/Text-Books/Additional Reading:

1. Das & Das, *fish and Prawn Diseases in India*, Fish Soc., of India, Barrack Port, West Bengal, (1997).
2. Amlacher, E. *Text Book of Fish Diseases* Narendra Publishing House, New Delhi.
3. Anderson, D.P., *Text Book of Fish Immunology* Narendra Publishing House, New Delhi.
4. Biswas K.P, *Fish, Fisheries and Technology*, Narendra Publishing House, New Delhi.
5. Ninawe / Diwan, *Women Empowerment in Fisheries* Narendra Publishing House, New Delhi.
6. Sinha V.R.P. *Fisheries Research Planning and Management in Developing Countries*, Narendra Publishing House, New Delhi.
7. Biswas K.P., Prevention and Control of Fish and Prawn Diseases 2nd edi. Narendra Publishing House, New Delhi.
8. Sundaraj , V. Cultivable Aquatic Organism, Narendra Publishing House, New Delhi.

M.Sc. Marine Sciences
Semester : IV
Paper No : 16

Title of the Paper: Practical (50 Marks) + Dissertation (50 marks)

Credits: 18 Marks: 100 Marks

Sr. No	Practical	No. of Practical	Hrs. required
01	To calculate gross and net primary production by oxygen method	03	09
02	To measure the common pollutants in water samples.	02	06
03	To perform toxicity test of chemicals and metals on fish.	04	12
04	To measure biodiversity at coastal zone by quadrate methods (Simpson formula)	03	09
05	Analysis of sediment samples.	10	30
06	Biochemical identification of unknown bacteria	01	03
07	Microbial population enumeration techniques.	01	03
08	Analysis and estimation of critical pollutants in seawater, sediment and marine organism.	03	09
09	Hydrobiology of Aquaculture ponds	03	09
10	One day fishing in trawler boat with well equipped navigation equipments / Instruments (Veraval / Porbandar coast)	02	06
11	Two day farm (Shrimp culture) visit & report.	04	12
12	Visit to fish processing industry & five days training.	10	30
13	Field trip to rural areas to observe rural development due to coastal fishery.	01	03
14	Identification and classification of microorganisms from the litters of mangroves.	01	03
15	Isolation and identification of microorganisms from spoiled fishery products of fin-fishes and shell-fishes of marine and estuarine origin.	02	06
16	Analysis of fatty acid, triglyceride, galactolipid and phospholipid of mangrove leaves, sea grasses and sea weeds.	02	06
17	Quantitative estimation of protein, carbohydrate and lipid in some marine and estuarine fin-fishes and shell-fishes.	02	06
18	Identification of eggs, larvae, fry and fingerlings of marine and estuarine fin-fishes and shell-fishes.	02	06
19	Study of fish and prawn dieses from charts and photograph.	01	03
20	Identification of larval stages of fish and shrimps of commercially important.	01	03

Break up of Continuous Internal Evaluation:

1. Marks.
2. Marks.
3. Marks.

Total Marks: 30 Marks.

Dissertation (50 Marks) lieu of Practical

- Dissertation/Project commences in III semester but evaluated and grade point are to be added in 4th semester. Educational Tours/ Field works may be carried out in any semester or all semesters, but evaluated and Grade points are to be added in 4th Semester only.

Department of Marine Sciences

LIST OF COURSES PROPOSED TO BE OFFERED AS CHOICE BASED INTER DISCIPLINARY COURSES TO THE REGULAR STUDENTS REGISTERED IN OTHER PG DEPARTMENTS

(w.e.f. Academic Year commencing from June 2010)

For the interdisciplinary subjects the minimum requisites are given bellow for the students who want to study the papers of Marine Science. A test may be conducted to find suitability of applicant for a particular course, by the department/competent authority, before admitting in that course.

Faculty: **Science**
Subject: **Marine Science**
PG Department: **Department of Marine Sciences.**

Sr. No.	Semester	Course Title	Eligibility	Remarks
1	1	Ecology	1. The candidate should admitted in the PG department of science faculty in Bhavnagar University. 2. B.Sc. Degree with zoology/ botany/ microbiology/ biotechnology/ fisheries/ forestry/environmental science/agriculture/veterinary science etc.	
2	1	Oceanography	1. The candidate should admitted in the PG department of science faculty in Bhavnagar University. 2. B.Sc. Degree with physics/ chemistry/ zoology/ botany/ microbiology/ biotechnology/ fisheries/ forestry/environmental science/agriculture/ veterinary science etc.	
3	2	Biochemistry, Genetics, Molecular biology and Biotechnology.	1. The candidate should admitted in the PG department of science faculty in Bhavnagar University. 2. B.Sc. Degree with zoology/ botany/ microbiology/ biotechnology/ fisheries/ forestry/environmental science/agriculture/veterinary science etc.	
4	2	Tools & Techniques, and Biostatistics	1. The candidate should admitted in the PG department of science faculty in Bhavnagar University. 2. B.Sc. Degree with any science subject.	