

# UNIVERSITY OF MUMBAI



## **Syllabus for M.Sc. Semester III &IV (Part II)**

**Program: M.Sc.**

**Course : Botany**

**Specialization: Marine Botany**

(Credit Based Semester and Grading System with  
effect from the academic year 2015–2016)

**M.Sc. Part - II Botany, Specialization Marine Botany Syllabus CBGS  
To be implemented from the Academic year 2015-2016**

**SEMESTER III**

Course Code	UNIT	TOPIC HEADINGS	Credits	L / Week
<b>PSBOMB303</b>	<b>Paper Title: <u>Marine Botany - General Aspects</u></b>			
	<b>I</b>	<b>Marine Plant Groups</b>	<b>4</b>	<b>1</b>
	<b>II</b>	<b>Micro and Macroalgae</b>		<b>1</b>
	<b>III</b>	<b>Biodiversity of Mangroves</b>		<b>1</b>
	<b>IV</b>	<b>Ecology of Mangroves</b>		<b>1</b>

<b>PSBOMB304</b>	<b>Paper Title: <u>Physiology and Biochemistry of Marine Plants</u></b>			
	<b>I</b>	<b>Algal Physiology</b>	<b>4</b>	<b>1</b>
	<b>II</b>	<b>Mangroves - Physiology</b>		<b>1</b>
	<b>III</b>	<b>Mineral Nutrition</b>		<b>1</b>
	<b>IV</b>	<b>Regeneration in Mangroves, Research in India</b>		<b>1</b>

<b>PSBOMB303</b>	<b>Marine Botany - General Aspects</b>	<b>2</b>	<b>4</b>
<b>PSBOMB304</b>	<b>Physiology and Biochemistry of Marine Plants</b>	<b>2</b>	<b>4</b>

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**SEMESTER IV**

Course Code	UNIT	TOPIC HEADINGS	Credits	L / Week
PSBOMB403	<b>Title of the Paper: <u>Marine Ecology</u></b>			
	I	Physical Oceanography and Biotic Factors	4	1
	II	Marine Chemistry		1
	III	Microbial Ecology		1
	IV	Marine Pollution and Conservation of Ecosystems.		1

PSBOMB404	<b>Title of the Paper: <u>Applied Marine Botany</u></b>			
	I	Analytical Methods	4	1
	II	Collection and Cultivation		1
	III	Utilization of Marine Algae		1
	IV	Marine Bioresources		1

PSBOMB401	Marine Ecology		2	4
PSBOMB402	Applied Marine Botany		2	4

# Semester III Detailed Syllabus

## Theory

Course Code	Title	Credits
<b>PSBOMB303</b>	<b><u>Marine Botany: General Aspects</u></b>	<b>4</b>
<p><b><u>Unit I: Marine Plant Groups</u></b></p> <ul style="list-style-type: none"> <li>● <b>Introduction and classification</b>, brief idea of Plankton, Nekton, Benthos. Marine Phytoplankton- Dino -flagellates, Nano-plankton, Ultra-plankton, coccoliths.</li> <li>● <b>Marine Fungi, Actinomycetes, Lichens and Bacteria in brief.</b></li> <li>● <b>Fossil mangroves</b> – General account</li> </ul>		<b>1</b>
<p><b><u>Unit II: Micro and Macroalgae</u></b></p> <ul style="list-style-type: none"> <li>● Taxonomy, cytology, ultrastructure, salient features of Cyanophyceae, Bacillariophyceae, Chlorophyceae, Rhodophyceae and Phaeophyceae.</li> <li>● Life cycles of <i>Pinnularia</i>, <i>Caulerpa</i>, <i>Sargassum</i>, <i>Fucus</i></li> </ul>		<b>1</b>
<p><b><u>Unit : III Biodiversity of Mangroves</u></b></p> <ul style="list-style-type: none"> <li>● Brief introduction to creek, estuary, lagoon and delta formations. Definition of ‘Mangrove’, distribution- biogeography of Indian Mangroves, east and west coast mangroves, Mangrove forests.</li> <li>● Salient features of important mangrove families such as Rhizophoraceae, Sonneratiaceae, Avicenniaceae, Myrsinaceae, Acanthaceae.</li> <li>● Salt marshes, sea grasses and sand dune vegetation.</li> </ul>		<b>1</b>
<p><b><u>Unit : IV Ecology and Mangroves</u></b></p> <ul style="list-style-type: none"> <li>● Diversity, distribution, zonation structure.</li> <li>● Ecological significance. Anatomical, physiological, morphological adaptations, vivipary and its role</li> </ul>		<b>1</b>

### References :-

1. Chapman VJ (1976). Coastal Vegetation. 2nd edition. Pergamon Press. New York.
2. Desikachary, T.V. (1975). Marine Plants. N.C.E.R.T. New Delhi.
3. Kumar H.D. Introduction to Phycology.
4. Kumar H.D and Singh H.N. (1990). Algae. Affiliated East West Press Pvt. Ltd. Publ. New Delhi.
5. McConnaughey, B.H. (1974). Introduction to Marine Biology.
6. Ranade, D.R. and Gadre, R.V. (1988). Microbial Aspects of Anaerobic Digestion. Laboratory Manual. M.A.C.S. Pune.
7. Sambamurthy, A.V.S.S. (2005). A Text Book of Algae.
8. Santhanam, R.; Ramnathan, N.; Venkataramanjan, K. and Jegathanam, G. (1987). Phytoplankton of Indian Seas, and Aspects of Marine Botany. Daya Publication Home. Delhi.
9. Sen Neera and Kumudranjan Naskar, (2003). Algal Flora of Sunderbans.
10. Sharma O. P. (1986) A Text Book of Algae Tata McGraw Hill Publication Publications
11. Stein, J.R. (1973). Handbook of Phycological Methods. Cambridge University Press.

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12. Trainor, F.R.. Introductory Phycology.
13. Vashishta, B.R.(1995). Algae. S. Chand and Co.Ltd. New Delhi.

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Course Code	Title	Credits
<b>PSBOMB304</b>	<b><u>Physiology and Biochemistry of Marine Plants</u></b>	<b>4</b>
<p style="text-align: center;"><b><u>Unit I: Algal Physiology</u></b></p> <ul style="list-style-type: none"> <li>• <b><u>Photosynthesis in Marine Algae</u></b> – Fine structure and properties of algal plastids, photosynthetic pigments in different algal groups, carbon fixation, photosynthesis in marine macro-algae –light absorption, effect of low light condition, photosynthetic rate. C<sub>3</sub> versus C<sub>4</sub> characteristics in marine algae.</li> <li>• <b><u>Storage and Structural Components in Algae</u></b> :- Seaweed polysaccharides, chemical structure, properties and extraction of agar, carrageenan and alginic acid. Low molecular weight compounds in algae.</li> </ul>		<b>1</b>
<p style="text-align: center;"><b><u>Unit II: Mangroves Physiology</u></b></p> <ul style="list-style-type: none"> <li>• <b><u>Photosynthesis in Mangroves</u></b> – Stomatal behaviour, carbon fixation, initial products of photosynthesis, enzymes, role of aspartate, accumulation of free amino acids, photorespiration.</li> <li>• <b><u>Bioactive Compounds in Mangroves</u></b> :- A brief idea of occurrence and importance of these compounds.</li> <li>• Effect of flooding on growth of halophytes.</li> </ul>		<b>1</b>
<p style="text-align: center;"><b><u>Unit : III Mineral Nutrition</u></b></p> <ul style="list-style-type: none"> <li>• <b><u>Mineral Nutrition</u></b> – Nutrient requirement- essential elements, vitamins for growth of algae. Availability in sea water, uptake, factors affecting, metabolic role of essential nutrients.</li> <li>• <b><u>Salt Regulation in Halophytes</u></b> – Salt glands and salt secretion. Ultrastructure of salt glands. Sodium Pumps, selective ion absorption.</li> <li>• <b><u>Salinity and Metabolism</u></b> – Influence of salinity on photosynthesis, induction of CAM, membrane transport under salinity, effect of salinity on growth and phytohormones.</li> </ul>		<b>1</b>
<p style="text-align: center;"><b><u>Unit : IV Mangroves- Regeneration, Research in India</u></b></p> <ul style="list-style-type: none"> <li>• <b><u>Regeneration in Mangroves</u></b> – methods of natural and artificial regeneration in mangroves.</li> <li>• <b><u>Marine Algal Research in India</u></b> :- Important Research centres in India and their work.</li> <li>• <b><u>Mangrove Research in India</u></b> :- Major research centres in India and their</li> </ul>		<b>1</b>

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contribution. .	
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**References :-**

1. Chapman, V.J. (1976) : Coastal Vegetation. IInd edition. Pergamon Press. New York.
2. Ring, M. (1982) : The biology of Marine Plants. Edward Arnold Publishers, London.
3. Gerald, E. Ecophysiology of Economic Plants in Arid and Semiarid Land.
4. Jackson, D.F. (1972) Algae and Man. Plenum Press.
5. Lobban, C.S. and Harrison, P.J. (1985) : Seaweed Ecology and Physiology. Cambridge University Press.
6. Sambamurthy, A.V.S.S. (2005) : A Text Book of Algae.
7. Stein, J.R. (1973) : Handbook of Phycology and Biochemistry.
8. Stewart, W.D. (1974) : Algal Physiology and Biochemistry.
9. Waisel, Y. (1972) : Biology of Halophytes. Academic Press, London and New York.

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**Practical**

Code	Title	Credits
<b>PSBOMBP301</b>	<b><u>Marine Botany - General Aspects</u></b>	<b>2</b>
<ol style="list-style-type: none"> <li>1. Study of characteristic features of members of Chlorophyceae – <i>Enteromorpha, Chaetomorpha, Ulva, Caulerpa, Bryopsis</i> etc</li> <li>2. Study of characteristic features of Phaeophyceae – <i>Padina, Dictyota, Sargassum</i> etc.</li> <li>3. Study of characteristic features of Rhodophyceae – <i>Gracilaria, Gelidium, Hypnea</i> etc.</li> <li>4. Isolation of marine fungi and its identification</li> <li>5. Sampling and identification of phytoplankton.</li> <li>6. Demonstration of phytoplankton/algal culture technique.</li> <li>7. Study of mangrove associates- <i>Aleuropus, Halophila</i> etc</li> <li>8. Type study of mangroves from Rhizophoraceae.</li> <li>9. Type study of mangroves from Avicenniaceae and Sonneratiaceae.</li> <li>10. Type study of mangroves from Myrsinaceae and Acanthaceae.</li> <li>11. Study of sand dune plants – <i>Spinifex, Ipomoea</i> etc.</li> </ol>		
<b>PSBOMBP302</b>	<b><u>Physiology and Biochemistry of Marine Plants</u></b>	<b>2</b>
<ol style="list-style-type: none"> <li>1. Estimation of pigments from marine algae – chl <i>a, b, c, d</i>, carotenoids, phycobilins</li> <li>2. Isolation of agar agar from algal material.</li> <li>3. Extraction and estimation of alginic acid and carrageenan from marine algae.</li> <li>4. Estimation of total carbohydrates from marine algae.</li> <li>5. Determination of organic matter content from sediment.</li> <li>6. Determination of TAN of succulent marine plants like <i>Sessuvium, Lumnitzera</i></li> <li>7. Regeneration studies in some mangrove species.</li> <li>8. Determination of free amino acid content in saline and non-saline plants.</li> <li>9. Estimation of proline from saline and non-saline species.</li> <li>10. Estimation of tannins from bark/stems of different mangroves</li> </ol>		



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**Semester IV Detailed Syllabus**

**Theory**

Course Code	Title	Credits
<b>PSBOMB403</b>	<b><u>Marine Ecology</u></b>	<b>4</b>
<p style="text-align: center;"><b><u>Unit I: Physical Oceanography &amp; Biotic Factors</u></b></p> <ul style="list-style-type: none"> <li>● <b>Physical Oceanography</b> : The role and observations in oceanography – oceans and seas, their dimension, physical properties of sea water – salinity, temperature-density in space and time, O<sub>2</sub>, CO<sub>2</sub>, nutrients, oceanic mixed layer and thermocline. Ocean currents and their movement, equatorial processes- El Nino, Indian ocean circulation.</li> <li>● <b>Biotic factors</b>- floral and faunal components. Role of phytoplanktons, water blooms and red tide phenomenon.</li> </ul>		<b>1</b>
<p style="text-align: center;"><b><u>Unit II: Marine Chemistry</u></b></p> <ul style="list-style-type: none"> <li>● <b>Major and minor elements in sea water, chlorinity, salinity</b> – Definition, significance and measurement. Solubility of gases in sea water – dissolved O<sub>2</sub>, CO<sub>2</sub>, pH, alkalinity, percentage composition of inorganic carbon, calcium carbonate precipitation.</li> <li>● <b>Micronutrient elements in sea water</b> ( P,N,Si), N:P ratios, stoichiometry and uptake and regeneration of nutrient elements.</li> </ul>		<b>1</b>
<p style="text-align: center;"><b><u>Unit : III: Microbial Ecology</u></b></p> <ul style="list-style-type: none"> <li>● <b>Microbial Ecology of Coastal Ecosystem</b> – Mycorrhizal relations, coastal vegetation and nitrogen fixation, detritus based food chain.</li> <li>● <b>Microbial Ecology of Coral Reefs</b> – occurrence, distribution and types. Calcification, reef algae, natural and anthropogenic stress, restoration and conservation of coral ecosystem, concept of marine park.</li> </ul>		<b>1</b>
<p style="text-align: center;"><b><u>Unit : IV Marine Pollution &amp; Conservation of Mangrove Ecosystem</u></b></p> <ul style="list-style-type: none"> <li>● <b>Marine Pollution</b>; types, sources and impact. Toxic metal pollution, oil, sewage, pesticide, radioactive pollution and effect of waste disposal on marine ecosystem. Biomagnification.</li> <li>● <b>Conservation of mangrove ecosystem</b>; need for conservation, human impact, role of global institutions and NGO's in India.</li> </ul>		<b>1</b>

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**References:-**

1. Svedrup,H.U., Johnson,M.W.andFlemming,R.H.(1962) The Ocean: Their Physics, Chemistry and Biology, Asia Publ.House, New Delhi.
2. Pierson,W.J.andNewmann,G.S (1966) Principles of Physical Oceanography, Prentice Hall,Inc., New Jersey. U.S.A.
3. Riley,J.P.and Chester,R (1981).Introduction to marine chemistry,.
4. Riley,J.P.and Skirrow,G. (1975) Chemical Oceanography ( Vol.1,2.3&8),.
5. Martin,D.F )1970) Marine Chemistry Vol.2..
6. Daves,C.J.(1985). Marine Botany, Physiology and Ecology of Seaweeds.
7. Dawson (1960) Marine Botany.
8. Lobban,C.S. and Harrison,P.J. (1985) Seaweed ecology and physiology. Cambridge University Press.
9. Naskar, Kumundrajan and Rathindranath Mandal (1999). Ecology and Biodiversity of Indian Mangroves.
10. Pandey,B.P, (1994) Algae S.Chand New Delhi.
11. Current Trends in Life Sciences, Vol23: Agromicrobes, Today and Tomorrow. New Delhi.

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Course Code	Title	Credits
<b>PSBOMB404</b>	<b><u>Applied Marine Botany</u></b>	<b>4</b>
<p style="text-align: center;"><b><u>Unit I: Analytical Methods</u></b></p> <ul style="list-style-type: none"> <li>• <b>Methods of Analysis</b> : Primary productivity measurement ( biomass harvesting, litter fall, gas exchange, modelling technique). Standing crop, species diversity index, similarity index etc.</li> <li>• <b>Mangrove survey by Remote sensing</b> application. Use of remote sensing technique in mapping of mangrove vegetation use of GPS.</li> </ul>		<b>1</b>
<p style="text-align: center;"><b><u>Unit II: Collection, Cultivation, Applications and Uses</u></b></p> <ul style="list-style-type: none"> <li>• <b>Methods of Collection and Preservation of Marine Algae</b> – Collection, chemical preservation, herbarium technique, storage of specimens.</li> <li>• <b>Laboratory culture and cultivation of algae</b> ; Use of natural and synthetic culture media, difficulties in getting axenic culture.</li> <li>• <b>Commercial Cultivation of Seaweeds</b> ; Traditional and recent methods. Mariculture of <i>Porphyra</i>, <i>Laminaria</i>, <i>Undaria</i>, <i>Gracilaria</i> etc.</li> </ul>		<b>1</b>
<p style="text-align: center;"><b><u>Unit : III Utilization of Marine Algae</u></b></p> <ul style="list-style-type: none"> <li>• <b>Utilization of Seaweeds</b>, species used as food and fodder, application to soil as a fertilizer or manure, medicinal uses, source for iodine. Industrial application of seaweeds.</li> <li>• <b>Utilization of Diatoms</b> : application and uses.</li> </ul>		<b>1</b>
<p style="text-align: center;"><b><u>Unit : IV Marine Bioresources</u></b></p> <ul style="list-style-type: none"> <li>• <b>Coastal Bioresources</b> ;- Bioresource profile, wild bioresources – food, feed, fodder, fire wood, timber, medicinal products, potential genetic resources, ornamentals.</li> <li>• <b>Domestic Bioresources</b> – crops, cereals, pulses, oil crops, horticultural crops, livestock, aquaculture, apiculture.</li> </ul>		<b>1</b>

### References

1. Biotechnology of Microalgae. Beck
2. Bhosale, L.J. (2005). Mangroves of Maharashtra. (Field Guide). Shivaji University, Kolhapur.
3. Chapman, V.J.. Coastal Vegetation. IInd edition. Pergamon Press. New York.

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6. Krishnamurthy,V.(1985). Marine Plants, ( A.G. Untawale, Asso. Editor), Seaweed research and Utilization Association, Madras.
7. Santhanam,R.; Ramnathan,N.; Venkataramanjan,K.andJegathanam,G.(1987). Phytoplankton of Indian Seas and Aspects of Marine Botany. Daya Publication Home. Delhi.
8. Tein,J.R.(1973). Handbook of Phycological Methods. Cambridge University Press.
9. Stoemer,E.F. and Smol, J.P. The Diatoms. Applications for Environment and Earth Sciences.
10. Swaminathan,M.S. Research Foundation (2003). Bioresources Status in Selected Coastal Location. National Bioresource Development Board( Dept of Biotechnology) Govt. of India.
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**Practical**

<b>Code</b>	<b>Title</b>	<b>Credit</b>
<b>PSBOMB403</b>	<b><u>Marine Ecology</u></b>	<b>2</b>
<ol style="list-style-type: none"> <li>1. Determination of EC, pH, salinity and chlorinity of sea water.</li> <li>2. Determination of nitrates from sea water.</li> <li>3. Determination of BOD of polluted sea water.</li> <li>4. Determination of oil, grease/ hydrocarbon content of polluted sea water.</li> <li>5. Determination of phosphates from sea water.</li> <li>6. Study of zonation pattern in algae and mangroves.</li> <li>7. Study of vivipary in mangroves.</li> <li>8. Study of salt glands, trichomes, sclerides in mangroves.</li> <li>9. Study of phenological events in different mangrove species.</li> <li>10. Microbe analysis of sediments ( Sulphur bacteria) from estuaries.</li> </ol>		
<b>PSBOMB404</b>	<b><u>Applied Marine Botany</u></b>	<b>2</b>
<ol style="list-style-type: none"> <li>1. Determination of primary productivity of estuarine ecosystem.</li> <li>2. Study of herbarium technique in marine algae.</li> <li>3. Study of diatoms ( cleaning,preparation and observation).</li> <li>4. Demonstration of phytoplankton/algal culture technique.</li> <li>5. Determination of total ash/mineral content from seaweeds.</li> <li>6. Effect of seaweed concentrate on seed germination and plant growth.</li> <li>7. Study of economically important mangrove species used for food, fodder, timber, medicines.</li> <li>8. Study of major faunal components from mangrove ecosystem.</li> <li>9. Determination of S.D.I. and similarity index of mangroves.</li> <li>10. Detection of bioactive compounds in some mangrove species by TLC.</li> </ol>		