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| M.SC., COASTALAQUACULTURE |
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| **SYLLABUS****FROM THE ACADEMIC YEAR****2023 - 2024** |
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| **TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION, CHENNAI – 600 005** |
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**contents**

1. PO and PSO Description
2. PG – Template
3. Methods of Evaluation & Methods of Assessment
4. Semester Index.
5. Subjects – Core, Elective, Nonmajor, Skill Enhanced, Ability Enhanced, Extension Activity, Environment, Professional Competency
6. Course Lesson Box
7. Course Objectives
8. Units
9. Learning Outcome
10. Refence and Text Books
11. Web Sources
12. PO & PSO Mapping tables

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| **TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION** |
| **Programme** | **M.SC., COASTALAQUACULTURE** |
| **Programme Code** |  |
| **Duration** | **PG - Two Years** |
| **Programme Outcomes (Pos)** | **PO1: Problem Solving Skill**Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.**PO2: Decision Making Skill**Foster analytical and critical thinking abilities for data-based decision-making.**PO3: Ethical Value**Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.**PO4: Communication Skill**Ability to develop communication, managerial and interpersonal skills.**PO5: Individual and Team Leadership Skill**Capability to lead themselves and the team to achieve organizational goals.**PO6: Employability Skill**Inculcate contemporary business practices to enhance employability skills in the competitive environment.**PO7: Entrepreneurial Skill**Equip with skills and competencies to become an entrepreneur.**PO8: Contribution to Society** Succeed in career endeavors and contribute significantly to society.**PO 9 Multicultural competence** Possess knowledge of the values and beliefs of multiple cultures and a global perspective.**PO 10: Moral and ethical awareness/reasoning**Ability to embrace moral/ethical values in conducting one’s life.  |
| **Programme Specific Outcomes****(PSOs)** | **PSO1 – Placement**To prepare the students who will demonstrate respectful engagement with others’ ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.**PSO 2 - Entrepreneur**To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.**PSO3 – Research and Development**Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.**PSO4 – Contribution to Business World**To produce employable, ethical and innovative professionals to sustain in the dynamic business world.**PSO 5 – Contribution to the Society**To contribute to the development of the society by collaborating with stakeholders for mutual benefit. |

**Template for P.G., Programmes**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Semester–I** | **Credit** | **Hours** | **Semester-II** | **Credit** | **Hours** | **Semester-III** | **Credit** | **Hours** | **Semester–IV** | **Credit** | **Hours** |
| 1.1. Core-I  | 5 | 7 | 2.1. Core-IV  | 5 | 6 | 3.1. Core-VII | 5 | 6 | 4.1. Core-XI  | 5 | 6 |
| 1.2 Core-II  | 5 | 7 | 2.2 Core-V  | 5 | 6 | 3.2 Core-VII  | 5 | 6 | 4.2 Core-XII | 5 | 6 |
| 1.3 Core – III  | 4 | 6 | 2.3 Core – VI | 4 | 6 | 3.3 Core – IX | 5 | 6 | 4.3 Project with viva voce | 7 | 10 |
| 1.4 Discipline Centric Elective -I | 3 | 5 | 2.4 Discipline Centric Elective – III | 3 | 4 | 3.4 Core – X  | 4 | 6 | 4.4Elective - VI (Industry / Entrepreneurship) 20% Theory80% Practical  | 3 | 4 |
| 1.5 Generic Elective-II:  | 3 | 5 | 2.5 Generic Elective -IV:  | 3 | 4 | 3.5 Discipline Centric Elective - V  | 3 | 3 | 4.5 Skill Enhancement course / Professional Competency Skill  | 2 | 4 |
|  |  |  | 2.6 NME I | 2 | 4 | 3.6 NME II | 2 | 3 | 4.6 Extension Activity | 1 |  |
|  |  |  |  |  |  | 3.7 Internship/ Industrial Activity | 2 | - |  |  |  |
|  | **20** | **30** |  | **22** | **30** |  | **26** | **30** |  | **23** | **30** |
| **Total Credit Points -91** |

**Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credits and Hours Distribution System**

**for all Post – Graduate Courses including Lab Hours**

**First Year – Semester – I**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – I | 5 | 7 |
| Core – II | 5 | 7 |
| Core – III | 4 | 6 |
| Elective – I | 3 | 5 |
| Elective – II | 3 | 5 |
|  |  | **20** | **30** |

**Semester-II**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – IV | 5 | 6 |
| Core – V | 5 | 6 |
| Core – VI | 4 | 6 |
| Elective – III | 3 | 4 |
| Elective – IV | 3 | 4 |
| Skill Enhancement Course [SEC] - I | 2 | 4 |
|  |  | **22** | **30** |

**Second Year – Semester – III**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – VII | 5 | 6 |
| Core – VIII | 5 | 6 |
| Core – IX | 5 | 6 |
| Core (Industry Module) – X | 4 | 6 |
| Elective – V | 3 | 3 |
| Skill Enhancement Course - II | 2 | 3 |
|  | Internship / Industrial Activity [Credits] | 2 | - |
|  |  | **26** | **30** |

**Semester-IV**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – XI | 5 | 6 |
| Core – XII | 5 | 6 |
| Project with VIVA VOCE | 7 | 10 |
| Elective – VI (Industry Entrepreneurship)  | 3 | 4 |
| Skill Enhancement Course – III / Professional Competency Skill | 2 | 4 |
| Extension Activity | 1 | - |
|  |  | **23** | **30** |

**Total 91 Credits for PG Courses**

|  |
| --- |
| **METHODS OF EVALUATION** |
| **Internal Evaluation** | Continuous Internal Assessment Test  | **25 Marks** |
| Assignments / Snap Test / Quiz |
| Seminars  |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | **75 Marks** |
| **Total** | **100 Marks** |
| **METHODS OF ASSESSMENT** |
| **Remembering (K1)** | * Thelowestlevelofquestionsrequirestudentstorecallinformationfromthecoursecontent
* Knowledgequestionsusuallyrequirestudentstoidentifyinformationinthetextbook.
 |
| **Understanding (K2)**  | * Understandingoffactsandideasbycomprehendingorganizing,comparing,translating,interpolatingandinterpretingintheirownwords.
* Thequestionsgobeyondsimplerecallandrequirestudentstocombinedatatogether
 |
| **Application (K3)** | * Studentshavetosolveproblemsbyusing/applyingaconceptlearnedintheclassroom.
* Studentsmust usetheir knowledgetodetermineaexactresponse.
 |
| **Analyze (K4)**  | * Analyzingthequestionisonethatasksthestudentstobreakdownsomethingintoitscomponentparts.
* Analyzingrequiresstudentstoidentifyreasonscausesormotivesandreachconclusionsorgeneralizations.
 |
| **Evaluate (K5)** | * Evaluationrequiresanindividualtomakejudgmentonsomething.
* Questionstobeaskedtojudgethevalueofanidea,acharacter,aworkofart,orasolutiontoaproblem.
* Studentsareengagedindecision-makingandproblem–solving.
* Evaluationquestionsdonothavesinglerightanswers.
 |
| **Create (K6)** | * Thequestionsofthiscategorychallengestudentstogetengagedincreativeandoriginalthinking.
* Developingoriginalideasandproblemsolvingskills
 |

**PROGRAMME OUTCOMES (PO) - PROGRAMME SPECIFIC OUTCOMES (PSO) MAPPING**

|  |
| --- |
| **PROGRAMME SPECIFIC OUTCOMES (PSO)** |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **PSO1** | **3** | **3** | **3** | **3** | **3** |
| **PSO2** | **3** | **3** | **3** | **3** | **3** |
| **PSO3** | **3** | **3** | **3** | **3** | **3** |
| **PSO4** | **3** | **3** | **3** | **3** | **3** |
| **PSO5** | **3** | **3** | **3** | **3** | **3** |

**Level of Correlation between PO’s and PSO’s**

*(Suggested by UGC as per Six Sigma Tool – Cause and Effect Matrix)*

Assign the value

**1 – Low**

**2 – Medium**

**3 – High**

**0 – No Correlation**

**M.Sc. Coastal Aquaculture**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Course Title** | **Credit** | **Hour** | **Marks** |
| **CIA** | **ESE** | **Total** |

**Semester-I**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| CORE I | Fundamentals of Marine Biology and Oceanography | **5** | **7** | 25 | 75 | 100 |
| CORE II | Nutrition and Biochemistry | 5 | 7 | 25 | 75 | 100 |
| CORE III | Physiology, Cytology and Genetics | 4 | 6 | 25 | 75 | 100 |
| ELECTIVE I | Aquarium Keeping andManagement(Elective) | 3 | 5 | 25 | 75 | 100 |
| ELECTIVE II | Elective (IDE) | 3 | 5 | 25 | 75 | 100 |
|  | Practical – I  |  |  | 40 | 60 | 100 |
|  | Practical–II |  |  | 40 | 60 | 100 |
|  | **Total** | **20** | **30** |  |  |  |

**Semester-II**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| CORE IV | Biology and Culture ofCrustaceans | **5** | 6 | 25 | 75 | 100 |
| CORE V | Biology and Culture of Finfishes | **5** | 6 | 25 | 75 | 100 |
| CORE VI | Biology and Culture of Mollluscs and Seaweeds | **4** | 6 | 25 | 75 | 100 |
| ELECTIVE III | Health management in Aquaculture systems | **3** | 4 | 25 | 75 | 100 |
| ELECTIVE IV | Post Harvest Technology | **3** | 4 | 25 | 75 | 100 |
|  | Practical–III |  |  | 40 | 60 | 100 |
|  | Practical–IV |  |  | 40 | 60 | 100 |
|  | Practical–V |  |  | 40 | 60 | 100 |
|  | NME | **2** | 4 |  |  |  |
|  | TOTAL  | **22** | 30 |  |  |  |

**Semester-III**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| CORE VII | Instrumentation and AnalyticalMethods | **5** | 6 | 25 | 75 | 100 |
| CORE VIII | Biotechnology and AppliedMarineBiology | **5** | 6 | 25 | 75 | 100 |
| CORE IX | Aquaculture Information, | **5** | 6 | 25 | 75 | 100 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| CORE X | Economics & Extension | **4** | **6** | 25 | 75 | 100 |
| Elective V  | Elective (DE) | **3** | **3** | 25 | 75 | 100 |
|  | Practical–VI |  |  | 40 | 60 | 100 |
|  | Practical–VII |  |  | 40 | 60 | 100 |
|  | NME | **2** | **3** |  |  |  |
|  | Internship / Industry Activity  | **2** | **-** |  |  |  |
|  | **Total** | **26** | **30** |  |  |  |

|  |
| --- |
| **Semester - IV** |
| Core XI | Plant and Animal cellCultureTechnology | 5 | 6 | 25 | 75 | 100 |
| Core XII | Aquaculture Engineering | 5 | 6 | 25 | 75 | 100 |
|  | Project Work with viva voce  | 7 | 10 |  |  |  |
| Elective VI | Elective (DE) | 3 | 4 | 25 | 75 | 100 |
|  | Skill Enhancement Course – III / Professional Competency Skill | 2 | 4 |  |  |  |
|  | Extension Activity | 1 | - |  |  |  |
|  |  | **23** | **30** |  |  |  |
|  | **Total Credits** |  | **91** |  |  |  |

**Elective Courses**

**Department Electives (DE)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Title** | **Hours/Week** | **C** | **Marks** |
| **L** | **P** | **CIA** | **ESE** | **Total** |
| **Disaster Management** | **3** |  | **3** | **25** | **75** | **100** |
| **Remote Sensing** | **3** |  | **3** | **25** | **75** | **100** |
| **Microbial Technology** | **3** |  | **3** | **25** | **75** | **100** |
| **Marine Food Technology** | **3** |  | **3** | **25** | **75** | **100** |

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# EMESTERI

**FUNDAMENTALSOFMARINEBIOLOGYANDOCEANOGRAPHY**

**Credits–4**

**Hours:4**

**LearningObjective(LO):**

**LO1:** To learn various coastal environment i.e., marine, brackish, estuarine, mangroves,lagoons and coral reefs. To distinguish various physico – chemical features related to these coastal environments.

**LO2:** To learn about the basic concepts of physical, chemical and biological oceanography. **LO3:** To understand the classification, method of collection, analysis and biomass estimationofplankton.Togatherknowledgeontheplanktonicblooms,primaryproduction,carbon Sequestration by marine algae.

**LO4:** To know the classification of benthos and their various adaptations to varied habitats. **LO5:** To glean knowledge about living and non-living resources of marine environment and to learn various types of marine pollution.

**UNITI:Ocean–General**

Classificationof coastal environment –marine, brackish,estuarine, mangroves, lagoons and coral reefs – their physico – chemical features.

**UNITII:Oceanography**

Basic concepts in physical, chemical and biological oceanography. Sea as a biological environment.

**UNITIII:Plankton**

Classification of plankton, methods of collection, preservation, analysis and biomass of phytoplankton and zooplankton. Phytoplankton blooms, primary production – methods of estimation. Carbon Sequestration by marine algae.

**UNITIV:Benthos**

Benthos – classification, methods of sampling and biomass estimation, adaptations of benthic forms.

**UNITV:Resources-Pollution**

Resources of marine environment – commercially important finfish, shellfish, algal resources – Non- living resources – minerals, salts, petroleum and natural gas, Drug from the seas.

Marine pollution types – sewage, hydrocarbons, pesticides, heavy metals, thermal, oil radioactivity.

**Practical**

* 1. Phytoplankton – Methods of collection, identification of common forms, estimation of standing crop and primary production, Methods of estimation.
	2. Zooplankton–collection,estimation,identificationofmajorgroupsandbiomassanalysis.
	3. Benthos–collection,qualitativeandbiomassanalyses
	4. Analyses of water qualities Salinity

DissolvedOxygen Nutrients

pH

BODandCOD H2S and Ammonia

* 1. Identification of commercially important fin and shell fishes, algae especially medicinally

importantalgae,mangroves,animalsetc(Snakes,Corals,Spongesetc).

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8. RaviMishra,2002.Marineenvironment.Anmolpublications,NewDelhi,299pp.
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**CourseOutcomes**

Attheendofthecourse,thestudentwillbeableto

|  |  |
| --- | --- |
| CO1: | Understandthe classificationofvariouscoastal environments andtheir physico – chemical characteristics. |
| CO2: | Understandbasic oceanography. | concepts | in | physical, | chemical | and | biological |
| CO3: | Comprehend the classification, method of collection, analysis andbiomass estimation of Plankton- bloom forming plankton, primary production and Carbon sequestration of marine plankton |
| CO4: | KnowtheclassificationandimportanceofPhylumMollusca. |

|  |  |
| --- | --- |
| CO5: | Tohavethoroughunderstandingonthelivingandnon-livingresourcesofmarineenvironmentbesidestoknowvarioustypesofmarinepollution. |

**OutcomeMapping**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CO/ PO** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PSO 7** |
| **CO 1** | **3** | **3** | **3** | **3** |  | **3** |  |  |  | **3** | **3** |  |
| **CO 2** | **3** |  | **3** |  |  | **3** |  | **3** |  |  | **3** |  |
| **CO 3** | **3** | **3** | **3** |  | **3** | **3** |  |  | **3** |  | **3** | **3** |
| **CO 4** | **3** |  | **3** |  | **3** | **3** |  |  | **3** | **3** | **3** | **3** |
| **CO 5** | **3** |  | **3** | **3** | **3** | **3** |  | **3** | **3** | **3** | **3** | **3** |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | **3** |  |  |  | **3** | **3** |  |
| **CO2** | **3** |  | **3** |  |  | **3** |  |
| **CO3** | **3** |  |  | **3** |  | **3** | **3** |
| **CO4** | **3** |  |  | **3** | **3** | **3** | **3** |
| **CO5** | **3** |  | **3** | **3** | **3** | **3** | **3** |
| **Total** | **15** |  | **6** | **9** | **9** | **15** | **9** |

# SEMESTERI

**NUTRITIONANDBIOCHEMISTRY**

**Credits–3**

**Hours:3**

**LearningObjective(LO):**

**LO1:** To learn aquaculture nutrition and importance of various ingredients in the nutrition offin and shellfish.

**LO2:**Toknowvariousfeedingredientsusedinfishfeedpreparationandformulation.

**LO3:**Tounderstandvarioustypesoffeedusedinaquacultureandfeedstorage.

**LO4:** To learn about the different types of live feed used in aquacultureand their mass scale production.

**LO5:**Togleanknowledgeonthecarbohydrate,protein,fatandenzymes.

**UNIT1:Nutrition**

Aquaculture nutrition - an Overview, proteins, amino acids, lipids and fatty acids, carbohydrates and carotenoids -their importance in the nutrition of fin and shellfish, role of vitamins and minerals.

**UNIT2:Feedingredientsandfeedformulation**

Ingredients – conventional and non – conventional, their nutritive value, feed formulationmethods,binders,waterstabilityoffeed,useofattractantsinfeeds,importance of anabolic agents – antioxidants and mould inhibitors, anti – nutritional factors – other additives.

**UNIT3:TypesofFeed,Feedstorageandevolution**

Different types offormulated feeds– pellets - dry feed, wet feed, floating feed, lakes, micro particulate and microencapsulated diets, storage and quality control. Determination of energy content in feeds, FCR andenergy budget.

**UNIT4:Livefeed**

Methodsofcollectionoflivefoodorganisms,identification,isolationand maintenance of phytoplankton, mass culture of phytoplankton and zooplankton (*Brachionus, Copepods*and *Moina*), culture of *Artemia*, production of cyst and their utilization.

**UNIT5:Biochemistry**

Carbohydrate,proteinandfat;enzymes–classification,factorsinfluencingenzyme activity, role of enzyme in food processing.

**Practical**

1. Formulationandpreparationofartificialfeedsforfinfishandshrimps
2. Determinationoffoodintakeanddigestibilitycoefficient
3. Cultureoflive–feedorganisms(Phytoplanktonandzooplankton)
4. Estimation of the following in the feed ingredients and feeds: Carbohydrates by Colorimetric method

Proteins by Colorimetric method Use of Spectrometer

1. Chromatographicseparationoffreeaminoacidsandcarbohydratesbyascending, descending and circular paper chromatographic techniques
2. ChromatographicseparationoflipidsbyT.L.C.
3. Estimationofmoistureandlipidcontent
4. Electrophoreticseparationofprotein

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**CourseOutcomes**

Attheendofthecourse,thestudentwillbeableto

|  |  |
| --- | --- |
| CO1: | Understandvariousaspectsofaquaculturenutrition. |
| CO2: | Know the various the types of feed ingredients used in feed formulationbesides various steps involved in it. |
| CO3: | Understanddifferenttypesoffeedusedanditsstorageinaquaculture. |
| CO4: | Havethoroughunderstandingonthetypesoflivefeedandtheirmass scale productionin aquaculture |
| CO5: | Understandbiochemicalmake-upoffeedsusedinaquaculture |

**OutcomeMapping**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CO/ PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | **3** |  | **3** | **3** |  | **3** |  | **3** |  |  |  |  |
| **CO2** | **3** |  | **3** |  |  | **3** |  | **3** |  |  |  |  |
| **CO3** | **3** |  | **3** |  | **3** | **3** |  |  |  |  |  | **3** |
| **CO4** | **3** |  | **3** | **3** |  | **3** |  |  |  |  |  | **3** |
| **CO5** | **3** |  | **3** | **3** | **3** | **3** |  | **3** |  |  |  | **3** |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | 3 |  | 3 |  |  |  |  |
| **CO2** | 3 |  | 3 |  |  |  |  |
| **CO3** | 3 |  |  |  |  |  | 3 |
| **CO4** | 3 |  |  |  |  |  | 3 |
| **CO5** | 3 |  | 3 |  |  |  | 3 |
| **Total** | **15** |  | **9** |  |  |  | **9** |

# SEMESTERI

**PHYSIOLOGY,CYTOLOGYANDGENETICS**

**Credits–4**

**Hours:4**

**LearningObjective(LO):**

**LO1:**Tolearnthephysiologyoffishrespirationanddigestion.

**LO2:**Toknowtheosmoregulationandhormonesinreproductioninfinandshellfishes.

**LO3:**Tounderstandthephysiologicalrhythmsinmarineanimals.

**LO4:** To understand the different types of cells and tissues and also to learn the methodology adopted in chromosome preparation.

**LO5:**Togatherknowledgeonthegeneticsaspectsinvolvedinaquaculture.

**UNIT1:Physiology-General**

Introduction to physiology, physiology of respiration – respiratory organs, mechanism of ventilation, respiratory pigments and gaseousexchange mechanism, physiology of igestion– enzymes and their role in food conversion processes.

**UNIT2:Osmoregulation**

Ionic regulation – mechanism of excretion – ammoniotelic, uricotelic and ureotelic in organismsofcoastalbiotopes,hormonesof19reproduction in fin andshellfish.

**UNIT3:Biorhythms**

Physiological rhythms in marine animals – circadian, tidal and lunar rhythms, reproductive and behavioural rhythms, physiological changes during rhythms.

**UNIT4:Cytology**

Types of cells and tissues – cytoplasmic inclusion at ultrastructural level, nucleus and nuclearcomponents,nuclearenvelope,celldivisions,chromosomepreparation- methodology.

**UNIT5:Genetics**

Principles of genetics, interactions and environmental influences, practical applicationof genetics – hybridization of fishes, recent trends and techniques in hybridization, selective breeding, cross breeding, development of disease resistance and high quality of new strains, transgenic fish production.

Chromosome manipulation, its role in aquaculture, androgenesis, gynogenesis, sex reversal and tripoidy, cryopreservation andconservation of germplasm. Transgenic fish.

**Practical**

1. Estimationonoxygenconsumptionandrateofrespirationinafishoracrab
2. Effectofhydrogen–ionconcentrationonamylaseactivityofthecrystallinestyle
3. Effectoftemperatureandsalinityonrespirationofafishoracrab
4. Effectoftemperature–therateofparticletransportinabivalve
5. Therateofparticlefilterationinbivalves
6. Hormonestudy–displayofendocrineorgansinacrustacea
7. Bloodcellcountsandhaemoglobinestimation
8. Typesofcells–studyfromslides
9. Mitosis–Meiosis–giantchromosomes
10. Preparationofchromosomeinfishes
11. Inductionofploidy

# REFERENCEBOOKS

1. Kirpichnikov,V.S.,1979.GeneticBasesofSelectioninFish.Springer–Verlag, Berlin, 410 pp.
2. Dass,P.andA.G.Jhingran,1989.FishGeneticsinIndia.TodayandTomorrowPrinters and Publishers, New Delhi, 266 pp.
3. Nagabhushanam,R.,1989.TextBooksofAnimalPhysiology.OxfordIBH PublishingCo. Pvt. Ltd, New Delhi, 634 pp.
4. Trygve Gjedrem, 1990. Genetics in Aquaculture III (Journal of Aquaculture, Vol. 85). Elsevier Inc, New York, 340 pp.
5. DeRobertis,E.D.P.andE.M.F.DeRobertis,1996.CellandMolecularBiology.Waverly Pvt. Ltd., New Delhi, 734 pp.
6. Old, R.W. and S.B. Primrose, 1998. Principles of Gene Manipulation- an Introductionto Genetic Engineering. Blackwell Science Inc, New York, 474 pp.
7. Karp, Gerald,2005.Cellandmolecularbiology:ConceptsandExperimentsJohn – Wiley and Sons, New York, 780pp.
8. Pandian,T.J.,2011.SexdeterminationinFish,Saenllpublishers/CRCPress.New York.

**CourseOutcomes**

Attheendofthecourse,thestudentwillbeableto

|  |  |
| --- | --- |
| CO1: | Haveanunderstandingonthephysiologyoffishrespirationanddigestion. |
| CO2: | Haveknowledgeontheosmoregulationandhormonesofreproductioninfin and shellfishes. |
| CO3: | Understandthephysiologicalrhythmsinvolvedinmarineanimals. |
| CO4: | Knowvarioustypesofcellsandtissuesbesidesthemethodologyadoptedforchromosomepreparation. |
| CO5: | Tounderstandvariousaspectsandapplicationofgeneticsinaquaculture. |

**OutcomeMapping**

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| **CO/ PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PSO 7** |
| **CO1** | **3** |  | **3** | **3** |  | **3** |  | **3** |  |  |  |  |
| **CO2** | **3** |  | **3** |  |  | **3** |  | **3** |  |  |  |  |
| **CO3** | **3** |  | **3** |  |  | **3** |  | **3** |  |  | **3** |  |
| **CO4** | **3** |  | **3** | **3** |  | **3** |  | **3** |  |  | **3** |  |
| **CO5** | **3** |  | **3** | **3** |  | **3** |  | **3** |  |  | **3** |  |

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|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | **3** |  | **3** |  |  |  |  |
| **CO2** | **3** |  | **3** |  |  |  |  |
| **CO3** | **3** |  | **3** |  |  | **3** |  |
| **CO4** | **3** |  | **3** |  |  | **3** |  |
| **CO5** | **3** |  | **3** |  |  | **3** |  |
| **Total** | **15** |  | **15** |  |  | **9** |  |

# SEMESTERI

**AQUACULTUREENGINEERING**

**Credits–3**

**Hours:3**

**LearningObjective(LO):**

**LO1:**Tolearnthecriteriainvolvedinselectionofsiteforbrackishwaterfarming. **LO2:** To know the general principles and procedures of elementary engineering survey, planning of survey in coastal region for shrimp farming

**LO3:**Tounderstandthecomponentsofabrackishwatershrimpfarm.

**LO4:**Tohaveknowledgeonthedifferenttypesofpumpsandaerators.

**LO5:** To gather knowledge on the site selection, farm designing, construction of different types of open-sea farming practices.

**UnitI**

Principlesoffishfarmengineering–siteselection–technicalconsiderations–

topographysoiltype,watersupply,qualityanddynamics.

Non-technicalconsiderations–socio-economic,politicalandlegalaspects.

**UnitII**

Generalprinciplesandproceduresofelementaryengineeringsurvey,planningof

surveyincoastalregion,computationofarea.

**UnitIII**

Requirements of a brackishwater farm. Pond – its types, size, shape, design; Dyke – types, size and shape; Inlet and Outlet structures – types and design; supply and drainage canals – design and construction, operation andmaintenance of farms.

**UnitIV**

Watersupplytofishfarm–controllingdevicesofflow,pumptypes–aerating equipments and filtration systems.

**UnitV**

Opensea–farming–siteselection,Constraintsandprospectsofopenseafarming–

Culture in Cages, Pens, rafts rack and raceways: design, construction, repairing and maintenance. This paper is focussed mainly on the site selection farm designing, construction and different types of farming practices.

**Practical**

1. Surveyofsitesandtopographystudies
2. Study of soil characteristics in selected sites – Physical properties of soil – Texture – Permeability – Resistance – Chemical properties of soil – pH – Organic carbon –

N.P.K.–Hydrogensulphide

1. SurveyofWaterpotentialsandwaterqualitycharacteristics
2. Measurementofvelocityanddischargeoftidalchannel
3. Fieldvisittostudythecomponentsofabrackishwaterfarmsystem
4. Drawingoflayoutofthefarmvisited
5. Observations/operationofpumps,aerators,feedingtrays,etc

# REFERENCEBOOKS

1. Pillay, T.V.R., 1972. Coastal Aquaculture in the Indo – Pacific Region. Fishing News (Book) Ltd., London, 497 pp.
2. Bardach, J.E., J.H. Ryther and W.O. McLarney, 1972. Aquaculture: Farming and Husbandry of Freshwater and Marine Organisms. Wiley Interscience, New York, 868 pp.
3. Korringa,P.,1976.FarmingMarineFishesandShrimps.ElsevierPublishingCompany, Amsterdam, 208 pp.
4. Chen,T.P.,1976.AquaculturePracticesinTaiwan.FishingNews(Books)Ltd., London, 160 pp.
5. Shigeno, K., 1978. Problems in Prawn Culture. Amerind Publishing Co. Pvt. Ltd., New Delhi, 103 pp.
6. Gerwick, JR. B.C., 2007. Construction of Marine and Offshore Structures, CRC press, NewYork, 813 pp.
7. Grover,T.K.,2007.BasicMarineEngineering,Anmol,NewDelhi,275pp.
8. Pandey,B.N.,S.Deshpandeand P.N.Pandey,2007.Aquaculture,APH,NewDelhi, 236 pp.
9. Bhuejl,R.C.,2008.StatisticsforAquaculture,Wiley–Blackwell,NewYork,222pp.
10. Holmer,M.,2008.Aquacultureintheecosystem,Springer,Newyork,326pp.
11. Ramakrishnan,T.V.,2008.OffshoreEngineering,Gene–TechBooks,NewDelhi, 347 pp.

**CourseOutcomes**

Attheendofthecourse,thestudentwillbeableto

|  |  |
| --- | --- |
| CO1: | Knowcriteriaforselectionofsiteforbrackishwaterfarming. |
| CO2: | Comprehendthegeneral principles andprocedures of elementary engineering survey, planning of survey in coastal region for shrimp farming |
| CO3: | Knowvariouscomponentsofabrackishwaterfarm. |
| CO4: | Havethoroughunderstandingonthevarioustypesofpumpsandaerators. |
| CO5: | Know various steps involved in site selection, farm designing, construction of different types of open-sea farming practices. |

**OutcomeMapping**

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| **CO/ PO** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PSO 7** |
| **CO 1** | **3** |  | **3** | **3** |  | **3** |  |  |  | **3** | **3** |  |
| **CO 2** | **3** | **3** | **3** |  |  | **3** |  |  |  | **3** | **3** |  |
| **CO 3** | **3** | **3** | **3** |  | **3** | **3** |  |  |  | **3** | **3** |  |
| **CO 4** | **3** |  | **3** | **3** | **3** | **3** |  |  |  | **3** | **3** |  |
| **CO 5** | **3** |  | **3** | **3** | **3** | **3** |  |  |  | **3** | **3** |  |

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|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | 3 |  |  |  | 3 | 3 |  |
| **CO2** | 3 |  |  |  | 3 | 3 |  |
| **CO3** | 3 |  |  |  | 3 | 3 |  |
| **CO4** | 3 |  |  |  | 3 | 3 |  |
| **CO5** | 3 |  |  |  | 3 | 3 |  |
| **Total** | **15** |  |  |  | **15** | **15** |  |

# SEMESTERI

**AQUARIUMKEEPINGANDMANAGEMENT**

**Credits–3**

**Hours:3**

**LearningObjective(LO):**

**LO1:**Toascertaintheglobalstatus,criteriaforselectionandcommonornamentalfishes.

**LO2:**Tolearnaboutthefabricationanddesigningofaquariumtank.

**LO3:**TounderstandtheAerationandfiltrationsystemsinvolvedinaquariummaintenance.

**LO4:**TolearnabouttheSettingupatropicalmarineaquarium.

**LO5:** To gather knowledge about the basic health management practices in ornamental fish keeping.

**UnitI-Introduction**

Freshwater and marine aquaria – global status of aquarium fish keeping – advantages and benefits of fish keeping –criteria of choosingaquarium fishes –common aquarium fishes– collection techniques.

**UnitII**-**Indooraquarium**

Tankdesigns–fabricationoftanks–choosingtherighttank–buyingandlocatinga

tank.

**UnitIIIAerationandfiltration**

Airpumps–air operatedfilters –biofilters –Heatingdevices–aquariumthermostats – water quality maintenance – lighting methods.

**UnitIV**-**Settingupanaquarium**

Tropicalmarinesetup–aquascaping–basecovering–addingdecorativematerials–

plants.

**UnitV–HealthManagement**

Basic diets –diseasesandhealthmanagement –treatmenttosick fishes –guidelines for exhibiting fishes – photographing aquarium fishes.

**Practical**

1. Identificationofcommonmarineandfreshwateraquariumfishes
2. Identificationofcommonornamentalaquaticplantspecies.
3. Fabricationtechniqueofglassaquariumtank
4. Operationofaquariumequipmentandaccessories
5. Conditioningandpackingliveaquariumspecies
6. Cultureoflivefeedorganisms
7. Breedingoflivebearers
8. Breedingofegglayers
9. Identificationandtreatmentofcommonornamentalfishdiseases
10. DemonstrationofSettingupofhi-techaquariumtank
11. Fieldvisitstocommercialornamentalfishbreedingfarms

# REFERENCEBOOKS

1. JohnDawes,1995.LivebearingFishes(AguidetotheirAquariumcare,Biology and Classification) Cassell Pvt., London, 240 pp.
2. Lieske, E, Myers, R. 1996. Coral Reef Fishes, Princeton University Press, Prenceton, New Jersey, 400 pp.
3. Nick Dakin, 1996. The Interpet questions & Answers Manualof the MarineAquarium. Interpet publishing, 206 pp.
4. Walter H. Adey and Karen Loveland, 1998. Dynamic Aquaria Building Living Ecosystems. Academic Press,New Delhi, 498 pp.
5. SebastianJ.Kuravamveli,2002.TheAquariumHandbook.AmityAquatechPvt. Ltd., Cochin – 28.
6. Sundararaj, V. and J.M. Sathish, 2005. Tropical Marine Aquarium. Yegam Publications, Chennai, 144 pp.
7. Greg Jennings, 2006. 500 Freshwater aquarium fish: a visual reference to the most popular species hardcover,Firefly Books, Limited, 528 Pages.
8. Matthew L. Wittenrich, 2007. The Complete Illustrated Breeder's Guide to Marine Aquarium Fishes - Microcosm/TFH(ca), 304 Pages.
9. Vincent Hargreaves, 2007. Complete Book of the Freshwater Aquarium: A Comprehensive Reference Guide to More Than 600 Freshwater Fish And Plants, Plus How to Set Up And Maintain an Aquarium, Thunder Bay Press, 304 Pages.
10. Julian Sprung, et al., 2009. Marine Aquarium Handbook: Beginner to Breeder (3rd Edition),Microcosm, 351 Pages.

**CourseOutcomes**

Attheendofthecourse,thestudentwillbeableto

|  |  |
| --- | --- |
| CO1: | Knowtheworldstatusandcriteriaforselectionofornamentalfishes. |
| CO2: | Havethoroughknowledgeonthefabricationanddesigningofaquariumtank. |
| CO3: | UnderstandtheAerationandfiltrationsystemsinvolvedinaquariummaintenance. |
| CO4: | KnowledgeontheSettingupatropicalmarineaquarium. |
| CO5: | Thoroughunderstandingonthebasichealthmanagementsofornamentalfishes. |

**OutcomeMapping**

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| **CO/ PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PSO 7** |
| **CO1** | **3** |  | **3** | **3** |  | **3** | **3** |  | **3** |  | **3** |  |
| **CO2** | **3** |  | **3** |  |  | **3** | **3** |  | **3** |  | **3** |  |
| **CO3** | **3** |  | **3** |  | **3** | **3** | **3** |  | **3** |  | **3** | **3** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **3** | **3** |  |  |  | **3** | **3** |
| **CO5** | **3** | **3** | **3** | **3** | **3** | **3** | **3** |  |  |  | **3** | **3** |

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|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | 3 | 3 |  | 3 |  | 3 |  |
| **CO2** | 3 | 3 |  | 3 |  | 3 |  |
| **CO3** | 3 | 3 |  | 3 |  | 3 | 3 |
| **CO4** | 3 | 3 |  |  |  | 3 | 3 |
| **CO5** | 3 | 3 |  |  |  | 3 | 3 |
| **Total** | **15** | **15** |  | **9** |  | **15** | **9** |

# IISEMESTER

**BIOLOGYANDCULTUREOFCRUSTACEANS**

**Credits–3**

**Hours:3**

**LearningObjective(LO):**

**LO1:**Tolearnthehistoricalbackground,presentstatus,candidatespecies,culture importance, production of crustacean aquaculture.

**LO2:** To study the different stages of molting and its importance and to gather knowledge on various aspects in shell fish hatchery management.

**LO3:** To understand various types of culture practices: traditional, extensive, semi-intensive and intensive management practices of *Penaues monodon, P.indicus*and*Litopenaeusvannamei*.

**LO4:** To learn the culture and seed production techniques of giant freshwater prawn, lobsters and crabs.

**LO5:** To understand the production and economics ofpenaeid and non-penaeid shrimps in extensive and semi-intensive system

# UNIT1

AnoverviewofCrustaceanculture–historicalbackground,generalreviewand present status of culture of shrimps, lobsters and crabs and freshwater prawns in India and abroad. Important areas of culture, species of crustaceans cultured in different regions of the world and India, production and its trend.

# UNITII

Moulting – different stages of moulting, its influence on growth, interaction with reproduction and endocrine control of moulting.

Collection of brood stock and transportation, breeding under controlled conditions, brood stock development and management techniques of induced breeding. Hatcheryproductionofseed,typesofhatcheries,componentsofahatchery -Nurserymanagement andFeeding schedule.

# UNITIII

Field culture – traditional culture practices prevailing in India and in other countries, advantages and disadvantages of these practices. Culture of *Penaues monodon, P.indicus*and *P.vannamei.*

Extensive,semi–intensiveandintensivecultures-theirmanagementpractices.

**UnitIV**

Culture of freshwaterprawn *Macrobrachium*spp. and its seed productionCulture of lobsters and crabs in India and elsewhere – prospects and constraints.

**UnitV**

Productionandeconomics-Shrimpsand*Macrobrachium*cultureinextensiveand

semi–intensivesystems.

**Practical**

1. Collectionandidentificationofprawns,shrimps,lobsterandcrabseedsfromnature by using different nets.
2. Identificationoflarvalformsofshrimp,prawnandcrabfromplanktoncollection
3. Techniqueofinducedbreedingandrearingofeggsthroughlarvalandpostlarval stages to stocking size, counting methods of eggs and nauplii in a hatchery.
4. Studyofhatcheryfacilitiesliketanks,pumps,aerators,filtersetc.inprawnhatcheries.
5. Determinationofstockingdensity,techniquesoffieldcultureoperationand monitoring of the stocked prawn through demonstration and field visits.
6. Recordingandmaintenanceofdatainaprawnandshrimpfarms.
7. Fieldvisittoobserveharvestingoperation,recordingofdataofproductionestimation.
8. Visittoseafoodprocessingunit.
9. VisittoCIBAtoseeseabassculturetechnologyandfeedmilletc.
10. Identificationofmalesandfemalesincommerciallyimportantfishes.
11. Hypophysationtechnique.

# REFERENCEBOOKS

1. Pillay, T.V.R., 1972. Coastal Aquaculture in the Indo – Pacific Region. Fishing News (Book) Ltd., London, 497 pp.
2. Bardach, J.E., J.H. Ryther and W.O. McLarney, 1972. Aquaculture: Farming and Husbandry of Freshwater and Marine Organisms. Wiley Interscience, New York, 868 pp.
3. Korringa, P., 1976. Farming Marine Fishes andShrimps. Elsevier PublishingCompany, Amsterdam, 208 pp.
4. Chen, T.P., 1976. Aquaculture Practices in Taiwan. Fishing News (Books) Ltd.,London, 160 pp.
5. Shigueno,K.,1978.ProblemsinPrawnCulture.AmerindPublishinCo.Pvt.Ltd., New Delhi, 103 pp.
6. Josianne.,G Stottrup and Lesley A. McEroy, 2003. Live feeds in Marine aquaculture. Black well publishing, 313 pp.
7. David, A. Bengtson, 2003. Status of Marine aquaculture in relation to live prey: past, present and future, Black well publishing , 1-13.
8. Arnaud Muller, Feuga, Jeanne Moal and Raymond Kaas, 2003. The Microalgae of Aquaculture, 206 – 243.
9. Eva.E.Plaganyi,2007.ModelsforanEcosystemapproachtofisheries.Organization of the United Nations, 108pp.

**CourseOutcomes**

Attheendofthecourse,thestudentwillbeableto

|  |  |
| --- | --- |
| CO1: | GetanoverviewofCrustaceanAquaculture. |
| CO2: | Knowledge on the moulting and various aspects involved in shell fish hatchery management. |
| CO3: | Knowledge onvarious culture practices: traditional, extensive, semi-intensiveandintensivemanagementpracticesof*Penauesmonodon,P.indicus*and*Litopenaeusvannamei.* |
| CO4: | Understandingonthecultureandmethodofseedproductionofgiantfreshwaterprawn,lobstersandcrabs. |
| CO5: | Betterunderstandingontheproductionandeconomicsofpenaeidandnon-penaeidshrimpsinextensiveandsemi-intensivesystems |

**OutcomeMapping**

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| **CO/ PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PSO 7** |
| **CO1** | **3** |  | **3** | **3** |  | **3** |  | **3** |  |  | **3** |  |
| **CO2** | **3** |  | **3** | **3** |  | **3** |  | **3** | **3** |  | **3** |  |
| **CO3** | **3** |  | **3** | **3** | **3** | **3** |  |  | **3** |  | **3** | **3** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **3** |  |  | **3** |  | **3** | **3** |
| **CO5** | **3** | **3** | **3** | **3** | **3** | **3** |  |  |  |  | **3** | **3** |

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| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | 3 |  | 3 |  |  | 3 |  |
| **CO2** | 3 |  | 3 | 3 |  | 3 |  |
| **CO3** | 3 |  |  | 3 |  | 3 | 3 |
| **CO4** | 3 |  |  | 3 |  | 3 | 3 |
| **CO5** | 3 |  |  |  |  | 3 | 3 |
| **Total** | **15** |  | **6** | **9** |  | **15** | **9** |

# SEMESTERII

**BIOLOGYANDCULTUREOFFINFISHES**

**Credits–3**

**Hours:3**

**LearningObjective(LO):**

**LO1:**Tolearnthelifehistory,foodandfeeding,ageandgrowthandreproductionof cultivable finfishes.

**LO2:**To understand the distribution, resource assessment, collection and transportation of finfish seed.

**LO3:**Toknowvariousaspectsofhatcherymanagementpractices

**LO4:**Tounderstandvariousaspectsinfinfishculturepractices

**LO5:** To learn polyculture and also to understand various steps involved in ornamental fish culture.

**UNITI:Finfishbiology**

Biology of cultivable finfishes - Life history – food and feeding – age & growth – reproduction

**UNITII:Seed**

Seed production - distribution and abundance, methods for resource assessment and collection of seeds.packing and transportation.

**UNITIII:Hatchery**

Typesoffishhatcheries–Fishhatcherycomponents.

Artificialproductionofseed,breedingundercontrolledconditions,techniques induced breeding, egg incubation and larval rearing procedures and systems. Hatchery production of seeds, packing and transport of brooders and seeds.

**UNITIV:FinfishCulture**

Culturepracticesinpondsofimportantfinfishspecies,preparationandmanagement of nursery andgrow – out ponds, eradication of undesirable organisms, nursery technique,pond fertilization, stocking, feeding and provision for removal of metabolites.

**UNITV:Polyculture**

Polyculture – species selection for polyculture, criteria and characteristics of species selected for polyculture,stocking density and ration, feeding and management.

**Ornamentalfishculture**

Ornamental fish culture. Production and economics – optimal size for harvesting, methods of harvesting economics.

**Practical**

1. Identificationoffisheggsandlarvaefromplanktoncollection
2. Collectionandidentificationofseedsfromwildusingdifferentgearsandseed resource survey.
3. Identification of important cultivablespeciesandcommonornamentalfishes.
4. Techniquesofinducedbreeding–dissection,preservationanddemonstrationof pituitary gland in alcohol and glycerol, rearing of eggs and larvae.
5. Observationonthemanagementpracticesofnurseryandstockingponds,stocingdensity.
6. Fieldvisittofinfishculturesystemsandsubmissionofreport
7. Harvest,datarecording,growthandproductionestimation.
8. Methodsoftransportofseedsandbrooders.

# REFERENCEBOOKS

1. Bardach, J.E., J.H. Ryther and W.O. McLarney, 1972. Aquaculture: Farming and Husbandry of Freshwater and Marine Organisms. Wiley Interscience, New York, 868 pp.
2. Pilly, T.V.R., 1972. Coastal Aquaculture in the Indo – Pacific Region. Fishing News (Books) ltd., London, 497 pp.
3. Hornell,J.,1984.MarineFishFarmingforIndia.ShanthiBooks,Madras,India,International Books and Periodicals Supply, 83 pp.
4. Shanmugam, K., 1990. Fishery Biology and Aquaculture. Leo Pathippagam, Madras,India, 342 pp.
5. Santhanam,R.,N.RamanathanandG.Jegadeesan,1990.CoastalAquaculturein India, CBS Publication, Delhi – 32, 180 pp.
6. Khanna,S.S.andH.R.Singh,2003. Atextbookoffishbiologyandfisheries. Narendra Publishing House, New Delhi, 524pp.
7. GurdarshansinghandH.Bhaskar,2003.Anintroductiontofishes.CampusBooks International, New Delhi, 436pp.
8. NickDakin,2004.TheMarineAquarium.OxfordPublishing,London,206pp.
9. Sundararaj,V.andJ.M.Satheesh,2005.TrophicalMarineAquarium,Yegam Publications, Chennai, 140 pp.

**CourseOutcomes**

Attheendofthecourse,thestudentwillbeable to

|  |  |
| --- | --- |
| CO1: | Gettinganoverviewofbiologyoffinfishes |
| CO2: | Knowledgeontheresources,collectionandtransportationfinfishseed. |
| CO3: | Understandingonthetechniquesandmanagementpracticesinfinfishhatchery |
| CO4: | Havethoroughknowledgeonthevariousaspectsoffinfishculture. |
| CO5: | Gatherknowledgeonthepolycultureandornamentalfishculture |

**OutcomeMapping**

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| **CO/ PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PSO 7** |
| **CO1** | **3** |  | **3** | **3** |  | **3** |  | **3** |  |  | **3** |  |
| **CO2** | **3** |  | **3** | **3** |  | **3** |  | **3** | **3** |  | **3** |  |
| **CO3** | **3** |  | **3** | **3** | **3** | **3** |  |  | **3** |  | **3** | **3** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **3** |  |  | **3** |  | **3** | **3** |
| **CO5** | **3** | **3** | **3** | **3** | **3** | **3** |  |  |  |  | **3** | **3** |

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|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | 3 |  | 3 |  |  | 3 |  |
| **CO2** | 3 |  | 3 | 3 |  | 3 |  |
| **CO3** | 3 |  |  | 3 |  | 3 | 3 |
| **CO4** | 3 |  |  | 3 |  | 3 | 3 |
| **CO5** | 3 |  |  |  |  | 3 | 3 |
| **Total** | **15** |  | **6** | **9** |  | **15** | **9** |

# SEMESTERII

**BIOLOGYANDCULTUREOFMOLLUSCSANDSEAWEEDS**

**Credits–3**

**Hours:3**

**LearningObjective(LO):**

**LO1:** Tolearnlifehistory,foodandfeeding,ageandgrowthandreproduction ofcultivable molluscs.

**LO2:** To understand the distribution, resource assessment, collection and transportation of molluscan seed (spat).

**LO3:**Toascertainvarioustypesandaspectsinvolvedinmolluscanhatcherymanagement

**LO4:**Tounderstandvariousstepsinvolvedinmolluscanaquaculture.

**LO5:**Tolearntheseaweedculturepractices.

**UNIT1:Biology-molluscs**

Biology of cultivable molluscs – life history, food and feeding, age and growth and reproduction.

**UNIT2:SeedfromNature**

Naturalseedresources,utilization,idealconditionforseedfallinnature,distribution of seed, time of seed abundance, seed collection techniques for different species,transportation, seed quality and selection.

**UNIT3:Hatchery**

Hatchery production of molluscan seed - need for hatcheries for molluscs, brood stock management, induced maturationandspawning,larvalrearing& microalgalculturefor feeding spat settlement, ideal spat collectors, rearing of juveniles to stockable size, waterquality management, transportation.

**UNIT4:Culture**

Culturetechnology–cultureoperations,rearing,transportation,monitoringof growth, monitoring of environmental parameters, causes of mortality, different culture techniques and various steps involved in detail and problems encountered on the culture of clams, cockles, edible oyster, pearl oyster and mussel, economic importance of molluscs.

**UNIT5:Seaweeds**

General introduction to seaweeds – criteria for selection of candidate speciesin India, biology – life history, growth, reproduction of *Ulva*, *Laminaria* and *Gracilaria.*

**Culture:**

Seaweed culture – technology for higher yields, products from seaweeds (agar, alginand carageenan) and extraction methods, production and ecomomics of seaweed culture, economic importance of seaweeds.

**Practical**

1. Collectionofmolluscanseed–materials,preparationandlayingofspatcollectors, observation of spat fall.
2. Farmvisittowitnessseeding,growth,measurement,thinning,harvestingand*insitu*

measurementsofproduction.

1. Inductionofspawningbyphysical,chemicalandbiologicaltechniques.
2. Identificationoflocallyavailableseaweeds.
3. Demonstrationofalginandagarextraction.
4. Fieldvisittoobservethecultureofseaweedsandthetechniqueofharvest.
5. Submissionoffieldreport.
6. Identificationofmalesandfemalesincommerciallyimportanthypophytechnique

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2. Milne, P.H., 1972. Fish and Shellfish Farming in the Coastal Water. Fishing News (Books), London, 208 pp.
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4. Dawes,C.J.1988.MarineBotany.JohnWilley&Sons,NewYork,480pp.
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8. RobertR.Stickney,2000.EncyclopediaofAquaculture.JohnWiley&Sons,Inc., New York, 1063 pp.
9. Krisnamurthy.VandM.Balusamy,2010.PhaeophyceaeofIndiaandneighborhood. Madras Christian College publishing, Chennai, 193pp.

**CourseOutcomes**

Attheendofthecourse,thestudentwillbeableto

|  |  |
| --- | --- |
| CO1: | Understandtheoverviewofmolluscanbiology. |
| CO2: | Knowtheresources,collectionandtransportationmolluscanseed. |
| CO3: | Thoroughunderstandingonthemolluscanhatcheryanditstypes. |
| CO4: | Understandingonvariousaspectsofmolluscanaquaculture. |
| CO5: | Knowledgeaboutseaweedcultureanditsimportance. |

**OutcomeMapping**

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| **CO/ PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PSO 7** |
| **CO1** | **3** |  | **3** | **3** |  | **3** |  | **3** |  |  | **3** |  |
| **CO2** | **3** |  | **3** | **3** |  | **3** |  | **3** | **3** |  | **3** |  |
| **CO3** | **3** |  | **3** | **3** | **3** | **3** |  |  | **3** |  | **3** | **3** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **3** |  |  | **3** |  | **3** | **3** |
| **CO5** | **3** | **3** | **3** | **3** | **3** | **3** |  |  |  |  | **3** | **3** |

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|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | 3 |  | 3 |  |  | 3 |  |
| **CO2** | 3 |  | 3 | 3 |  | 3 |  |
| **CO3** | 3 |  |  | 3 |  | 3 | 3 |
| **CO4** | 3 |  |  | 3 |  | 3 | 3 |
| **CO5** | 3 |  |  |  |  | 3 | 3 |
| **Total** | **15** |  | **6** | **9** |  | **15** | **9** |

# SEMESTERII

**HEALTHMANAGEMENTINAQUACULTURESYSTEMS**

**Credits–3**

**Hours:3**

**LearningObjective(LO):**

**LO1:**Toknowaboutimportanceofmarinemicrobiologyandpathologyinaquaculture system.

**LO2:** Tolearnmethodsofisolationandcultureofmicroorganisms.To gleanknowledgeon the microbialnutrition and influence of environmentalfactors on microbialgrowth and activity, structure and biology of bacteria and viruses

**LO3:**Tounderstandtheincidenceofvariousdiseasesoffinandshellfishes

**LO4:**Toknowtheadoptionofmoderntechniquesemployedindiseasediagnostics

**LO5:**Tolearnthepreventivemeasures/quarantineproceduresadoptedagainstdiseases.

**UNIT1:Microbiology**

General introduction to marine microbiology and pathology – their importance in aquaculture system – Health management in aquaculture system**.**

**UNIT2:Methods:IsolationandCulture**

Methods of studying the coastal microorganisms – methods of collection of water, sediment,finfishandshellfishsamples,isolationandculture ofbacteria,enumeration,total and viable counts, identification of bacteria based on their morphological, physiological and biochemical characteristics.

Microbial nutrition, influence of environmental factors on microbial growth andactivity, structure and biology of bacteria and viruses.

Role of microorganisms in the cycling of minerals – sulphur cycle, nitrogen cycle and phosphorus cycle, probiotics.

**UNIT3:Diseases–Finfishes**

Diseasedevelopmentfactorsinvolved,abioticandbiotic.

Detailedstudyondiseasesoffinfish(foodfishes)–viral,bacterial,fungal,parasitic (protozoan & metazoan), environmental and nutritional diseases.

Diseasesofornamentalfishes.

**UNIT4:Diseases–Shellfishes**

Detailed study onshellfish diseases (shrimp, lobster, molluscs) –viral, bacterial, fungal, parasitic (protozoan & metazoan), environmental and nutritional diseases.

Larvalhealthmonitoringwithspecialreferencetoshrimpsandfishes.

Modern techniques employed in diagnosis of diseases in cultivable organisms with specialreferencetoshrimps,WSSVsamplecollectionandpreparationfordifferent techniques (microbiology, immune studies)

**UNIT5:Diseases–Prevention**

Prevention of diseases – Good management procedure (GMP) - environmental and physical methods, chemical methods, biological methods.

Salinitypracticesandprophylacticmeasures–inhatcheriesandgrowoutponds, disinfectionprocedures,waterqualitystandardsandtheirlevelsassociatedwithfish

health and disease, common chemicals and antibiotics in use, toxic substances damaging fishhealth.

Immunemechanismsandimmunizationofcultivableorganisms.

**Practical**

1. PreparationofMedia
2. Microbialpopulationenumerationinwaterandsedimentofpondsandfinand shellfish samples.

Pond water samples Pond sediment samples

1. Isolationofpathogensfromdiseasedspecimens
2. Separationofmixedcultures,differenttypesofstreaking–phasestreaking,continuous streaking, ‘T’ streaking and radial streaking.
3. EstimationofColiforms–MPNmethod.
4. Identificationofbacteria,staining–negative,simpleandgram,motilitytest– Hanging drop method (or) using Semisolid medium,

Biochemical tests – oxidase, catalase, triple sugar iron agar, decarboxylase, arginine, lysine, ornithine, indole, oxidation fermentation test, nitrate reduction test, methyl red test, voges test, proskauer test, citrate test, starch hydrolysis, gelatin hydrolysis, casein hydrolysis.

1. Antibioticassay
2. Isolationoffungifromoldstockedfeeds
3. Identificationoffungi
4. Larval Health monitoring – shrimp Microbial load – bacteria, fungi, protozoa. Physiological / physical manifestations Occlusion bodies
5. Demonstrationofdiseasesymptomsthroughhistopathologicalslides
6. DemonstrationofdotplotandPCR

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1. Conroy,D.A.andR.L.Herman,1997.TextBookoffishdiseases,Narendra Publishing House, New Delhi, 301 pp.
2. Woo,P.T.K.andD.W.Bruno,1998.FishDiseasesandDisorders–Vol.3.Viral, Bacterial and Fungal Infections. CABI Publishing, New Delhi 874 pp.
3. Presscott,L.M.,Harley,J.P.and D.A.Klein,1999.Microbiology,McGrawHillInc, NewYork pp. 962.
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6. Stickney,P.R.,2000.EncyclopediaofAquaculture.JohnWiley&Sons,Inc, NewYork, 1063 pp.
7. Cann,A.J.,2000.DNAvirusreplication.OxfordUniversityPress,London,232pp.
8. Dimmock, N.J., A.J. Easton and K.N. Jeppard, 2001."Introduction to ModernVirology Blackwell Science, NewYork, 449pp.
9. John Humphrey, J. Richard Arthur, Rohana P. Subasinhe and Michael J.Philips, 2005. Aquatic animal quarantine and health centification in Asia. FAO, Daya publishing House,145pp.
10. AquaticanimalquarantineandhealthcentrificationinAsia.FAO,Dayapublishing House,145pp.

**CourseOutcomes**

Attheendofthecourse,thestudentwillbeableto

|  |  |
| --- | --- |
| CO1: | Gettinganoverviewofimportanceofmarinemicrobiologyand healthmanagementinaquaculturesystem. |
| CO2: | Knowingmethodsofisolation,culture,microbial,nutrition,growth,activity,structureandbiologyofcoastalbacteriaandviruses |
| CO3: | Knowledgeontheincidenceofvariousdiseasesoffinandshell fishes |
| CO4: | Knowing the adoption of various modern techniques employed in disease diagnosis. |
| CO5: | Learningaboutvariouspreventivemeasuresofdiseases |

**OutcomeMapping**

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| **CO/****PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PSO****1** | **PSO****2** | **PSO****3** | **PSO****4** | **PSO****5** | **PSO****6** | **PSO****7** |
| **CO1** | **3** |  | **3** | **3** |  | **3** |  | **3** |  |  | **3** |  |
| **CO2** | **3** | **3** | **3** |  |  | **3** |  | **3** |  |  | **3** |  |
| **CO3** | **3** | **3** | **3** |  | **3** | **3** |  |  |  | **3** | **3** |  |
| **CO4** | **3** |  | **3** | **3** | **3** | **3** |  |  |  | **3** | **3** |  |
| **CO5** | **3** |  | **3** | **3** | **3** | **3** |  | **3** |  | **3** | **3** |  |

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|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | 3 |  | 3 |  |  | 3 |  |
| **CO2** | 3 |  | 3 |  |  | 3 |  |
| **CO3** | 3 |  |  |  | 3 | 3 |  |
| **CO4** | 3 |  |  |  | 3 | 3 |  |
| **CO5** | 3 |  | 3 |  | 3 | 3 |  |
| **Total** | **15** |  | **9** |  | **9** | **15** |  |

# SEMESTERII

**POSTHARVESTTECHNOLOGY**

**Credits–4**

**Hours:4**

**LearningObjective(LO):**

**LO1:**Tolearnaboutimportanceofpreservationandprocessingofseafoodandalsoto understand the basic concepts of HACCP.

**LO2:**Tounderstandvarioustypesoffishspoilageanditscausativefactors

**LO3:**Toknowvarioustypesofdryingandcuringtechniquesusedinfishprocessingwith their merits and demerits.

**LO4:** To understand various types of freezing and canning techniques used in fish processing with their merits and demerits.

**LO5:**Tounderstandvariousfisheryby-productsandtheiruses.

**UNIT1:Importanceofpreservationandprocessing**

Cultured organisms, criteria for assessing the freshness of cultured organisms –handlingoffreshmaterials,phenomenaofrigormortis,qualityassurance,HACCP – Concepts – Plans – Hazard Analysis – Identification – Assessment.

**UNIT2:Fishspoilage**

Types of fish spoilage, causative factors – autolytic spoilage, microbial spoilage, oxidative changes.

**UNIT3:DryingandCuring**

Dehydration–conventionalandmodernmethodsofdrying(Solardriers),relative merits and demerits.

Saltcuring,picklingandsmoking–meritsanddemerits.

**UNIT4:Freezingandcanning**

Coldstorage–varioustypesoffreezers,individuallyquickfreezing(IQF),cold storage design and equipments, freeze – drying, canning – history of canning containers, canning procedures.

**UNIT5:FisheryBy-products**

Fishery by – products of commerce – processing of miscellaneous products, fish meal, oil, fish protein concentrate, fish wafers, ensilage, chitosan etc., development of diversified products.

Antibiotic residue analysis – Muddy smell - marketing – export – domestic – economics.Marketing role of MPEDA.

**Practical**

1. Fieldvisittodifferentprocessingplantandsubmissionofreport
2. QualityAnalysisinFishes
3. Proximate composition in fresh and ice stored Fishes

Moisture Protein Ash

Acidinsoluble ash Fat

Peroxidevalue

Free fatty acid Thiobarbitoric acid value

1. SensoryanalysisinFishesandPrawns
2. Prawns – Formulation of different products for export PD

PUD HL

Fillets

1. AnalysisofIndoleinPrawns
2. Icestoragestudies–observations–natureoftheeyes,gills,texture,peritonium, fibrousness, smoothness, toughness succulence.
3. pH–Fresh&StoredFishesandPrawns.
4. Shellfishpoisoninginprocessedfish.
5. Microbial Analysis Total bacterial count Coliforms Staphylococcus Streptococci
6. Preparationofcertainby–productsandmiscellaneousproducts.
7. PreparationofCoatedProducts.

# REFERENCEBOOKS

* 1. Burges,G.H.O.,C.L.Cutting,J.A.LovernandJ.J.Waterman,1965.FishHandling and Processing Her Majesty’s Stationery Office, Edinburg, 390 pp.
	2. Pillay, T.V.R., 1972. Coastal Aquaculture in the Indo – Pacific Region. Fishing News (Books), London.
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	4. Govindan,T.K.,1985.FishProcessingTechnology.OxfordandIBHpublishing Company Private Ltd, 252 pp.
	5. Gopakumar,K.1997.TropicalFisheryProducts.Oxford&IBHPublications,190pp.
	6. Chandran,K.K.,2000.PostHarvestTechnologyofFishandFishProducts.Daya Publishing House, New Delhi, 440 pp.
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	8. Malhotra,S.P.V.R.P.Sinha,2007.IndianfisheriesandAquacultureinaglobalizing economy. Narendra Publishing House, New Delhi, 385 pp.
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	10. Vickie,A.Vaclavir,ElizabethW.Christian,2009.EssentialsoffoodScience– Second edition Springer – Food Science text series, New York.

**CourseOutcomes**

Attheendofthecourse,thestudentwillbeableto

|  |  |
| --- | --- |
| CO1: | Thoroughunderstandingonvariousaspectsofprocessingandpreservationi.e., handing of fishes, rigor mortis, quality assurance, HACCP concepts etc. |
| CO2: | Knowledgeonfishspoilageanditscausativefactors. |
| CO3: | Understandingonthesummaryofdryingandcuring methodsalongwiththeirmerits and demerits. |
| CO4: | Knowledgeonfreezingandcanningmethodsalongwiththeirmeritsanddemerits. |
| CO5: | Thoroughcomprehensiononvariousfishby-productswiththeiruses. |

**OutcomeMapping**

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| **CO/ PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PSO 7** |
| **CO1** | **3** | **3** | **3** | **3** |  | **3** |  |  |  | **3** |  |  |
| **CO2** | **3** | **3** | **3** | **3** |  | **3** |  |  |  | **3** |  |  |
| **CO3** | **3** |  | **3** | **3** | **3** | **3** |  |  |  |  |  | **3** |
| **CO4** | **3** |  | **3** |  | **3** | **3** |  |  |  |  | **3** | **3** |
| **CO5** | **3** |  | **3** |  | **3** | **3** |  |  |  |  | **3** | **3** |

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|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | 3 |  |  |  | 3 |  |  |
| **CO2** | 3 |  |  |  | 3 |  |  |
| **CO3** | 3 |  |  |  |  |  | 3 |
| **CO4** | 3 |  |  |  |  | 3 | 3 |
| **CO5** | 3 |  |  |  |  | 3 | 3 |
| **Total** | **15** |  |  |  | **6** | **6** | **9** |

# SEMESTERIII

**INSTRUMENTAIONANDANALYTICALMETHODS**

**Credits–4**

**Hours:4**

**LearningObjective(LO):**

**LO1:** To study the various methods/various field instruments used in aquaculture **LO2:** To learn about the principles of the various microscopes and centrifugation **LO3:** To study on the working principle of spectrophotometers

**LO4:**Tohaveknowledgeontheelectrophoresisandchromatography

**LO5:**Togetimmenseknowledgeandskillinthepreparationofwholemount

**UNIT1:FieldEquipments**

Minor equipments – Working principles and uses ofwater and sediment samplers – secchidisc,luxmeter,turbiditymeter,pHmeter,oxygenanalyzer,refractometer, salinometer, echosounder,.

**UNIT2:MicroscopesandCentrifuge**

Microscopy–lightmicroscope,phasecontrast,electronmicroscope, and photomicrography.

Centrifugation – Centrifugal force and principles of sedimentation, sedimentation co- efficient, types of centrifuges, types of centrifugation, molecular weight determination.

**UNIT3:Spectroscopy**

Absorption and emission principles – Principles and application of colorimeters, UV visible spectrophotometers, spectroflurometer, Flame photometer, atomic absorption spectrophotometer, Inductively coupled plasma spectrometer (ICP).

**UNIT4:ElectrophoresisandChromatography**

Electrophoresis:Generalprinciples–factorsaffectingmobilityofchargedmolecules – principles and uses of electrophoresis, agarose gel electrophoresis, pulsed field gel electrophoresis, isoelectric focusing, polyacrylamide gel electrophoresis.

Chromatography:Paper, thin layer, gas chromatography high performance liquid chromatography, ion-exchange chromatography – principles and uses of each type.

**UNIT5–Microtechnique**

Microtechnique – sliding and rotary microtomes, freezing microtome, specimenfixation, dehydration, embedding and sectioning, staining of sections, whole mountpreparation.

**Practical**

1. Studyoflight,phasecontrast&electronmicroscopes
2. Photomicrography
3. Measurementsusingmicroscopes-ocular&stagemicrometer
4. Preparationofwholemount
5. PaperChromatography
6. ThinlayerChromatography
7. Electrophoresis

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4. Galan W. Ewing, 1985. Instrumental Methods of Chemical Analylsis.. McGraw– Hill Book Company, 538 pp.
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7. Gilian Mc Mohan, 2007. AnalyticalInstrumentation. A Guide to Laboratory, portable and miniaturized Instruments. John Wiley & Sons Ltd, England, 283 pp. ISBN 978 – 0470 – 027950.
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10. Springer Science & Business Media, LLC, USA, c 431 pp, ISBN– 978 – 1-4419- 9784-5

**CourseOutcomes**

Attheendofthecourse,thestudentwillbeableto

|  |  |
| --- | --- |
| CO1 | Knowledgeon theuseofdifferentfieldequipmentsinaquaculture |
| CO2 | Thoroughinformationonthemicroscopesandphotomicrographyalongwithdifferenttypesofcentrifuge,principleandtheiruseinaquaculture |
| CO3 | Understandingontheworkingprincipleanduseofspectroscopy |
| CO4 | Learningdifferenttypesofelectrophoresisandchromatography |
| CO5 | Knowledgeonthevarioustypesofmicrotome,wholemountpreparation |

**OutcomeMapping**

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| **CO/ PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PSO 7** |
| **CO1** | **3** |  | **3** | **3** |  | **3** |  |  |  | **3** | **3** |  |
| **CO2** | **3** |  | **3** |  |  | **3** |  |  |  | **3** | **3** |  |
| **CO3** | **3** |  | **3** |  | **3** | **3** |  |  |  | **3** | **3** |  |
| **CO4** | **3** |  | **3** | **3** | **3** | **3** |  |  |  | **3** | **3** |  |
| **CO5** | **3** |  | **3** | **3** | **3** | **3** |  |  |  | **3** | **3** |  |

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|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | 3 |  |  |  | 3 | 3 |  |
| **CO2** | 3 |  |  |  | 3 | 3 |  |
| **CO3** | 3 |  |  |  | 3 | 3 |  |
| **CO4** | 3 |  |  |  | 3 | 3 |  |
| **CO5** | 3 |  |  |  | 3 | 3 |  |
| **Total** | **15** |  |  |  | **15** | **15** |  |

# SEMESTERIII

**BIOTECHNOLOGYANDAPPLIEDMARINEBIOLOGY**

**LearningObjective(LO):**

**Credits–4**

**Hours:4**

**LO1:** To learn the application of genetics in aquaculture and genetic engineering in marine organisms

**LO2:** To know the application of different marine bioactive compounds, role of sea food in human health and mangrove forestry

**LO3:**Togetknowledgeondiseasediagnosisconceptsadoptedinaquaculture

**LO4:**Tolearncellandtissueculturetechniques

**LO5:** To know mass culture of microbes and utility of different marine products along with the management of marine resources.

**UNIT1:Genetics**

Applicationofgenetics,coastalaquaculture-geneticengineeringandbiotechnology in marine organisms.

**UNIT2:Pharmacology**

Application of biological concepts / systems in the seafood industries – seafood biochemistry-humanhealth–marinepharmacology,bioactivecompoundsfrommarine flora and fauna and environment – mangrove coastal forestry.

**UNIT3:Immunology**

Disease diagnosis – concepts, ELISA,dot immunobinding, western blotting, latex agglutination test, monoclonal antibodies – DNA based diagnosis of diseases, fish vaccines.

**UNIT4:Biotechnology**

Rural and industrial biotechnologies – cell and tissue culture, microbial biofertilizers, microbial enzymes, fermentation, effluent treatments, biocorrosion, biofouling.

**UNIT5:Uses**

Productionofbiologicalsystemsforcommercialutility;

Massscalecultureofmicrobes,seaweed–agaragar–otherproducts–utilization.

Peoplesparticipatoryapproach-marineresource-management.

**Practical**

1. Visittobiotechnologyindustries/Laboratories
2. ELISAtest
3. AmplificationofDNA
4. Gelelectrophoresis
5. Cellandtissueculture
6. Chromosomestudies

# REFERENCEBOOKS

1. David H. Attaway and R. Oskar, 1993. Marine Biotechnology. Vol. I. Pharmaceutical&BioactiveNaturalProducts.PlenumPress, NewYork & London, 500 pp.
2. Dubey,R.C.,1993.ATextBookofBiotechnology.S.Chand&Com.Ltd.,New Delhi, 702 pp.
3. Singh,B.D.,1998.Biotechnology.KalyaniPublishers,Ludiana,N.D.,NoidaU.P., 694 pp.
4. Glick,B.R.andJ.J.Pasternak,1998. MolecularBiotechnology:Principlesand applications of recombinant DNA, ASM Press, NewYork, 683 pp.
5. MiltonFingerman,R.NagabushanamandMary–FrancesThompson,1999.Recent Advances in Marine Biotechnology, Vol. 1,2,3.
6. PatVaughan,2000.MethodsinMolecularBiology:DNARepairprotocols: Prokaryotic Systems, 209pp.
7. Rodney,J.Y.Ho,Milogibaldi,2003. BiotechnologyandBiopharmaceuticals,Wiley Liss publication, New Jersy, 556 pp.
8. Bhatia, S.C.2005.Text bookofBiotechnology,Atlantic Publishers,New Delhi,492 pp.
9. BirBahadur,2005.EssentialsofBiologyandBiotechnology.PharmaBook Syndicate,594 pp.
10. Ghose, T.K and P. Ghose, 2008. Biotechnology in India. Part– I Springer Publishing, India, 292 pp.

**CourseOutcomes**

Attheendofthecourse,thestudentwillbeableto

|  |  |
| --- | --- |
| CO1 | Learninggenemanipulationtechniquesinvolvedintheaquaculturepractices |
| CO2 | Understandingon thepharmacologicalroleofdifferentmarineorganisms |
| CO3 | Knowledgeonthevariousdiseasediagnosisconcepts usedinaquaculture |
| CO4 | Learningcellandtissueculturetechniquesandotherbiologicalproductsof biotechnology |
| CO5 | Gatheringknowledgeondifferentmarineresourcesandtheirmanagement |

**OutcomeMapping**

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| **CO/ PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PSO 7** |
| **CO1** | **3** |  | **3** | **3** |  | **3** |  | **3** |  | **3** |  |  |
| **CO2** | **3** | **3** | **3** |  |  | **3** |  | **3** |  | **3** |  |  |
| **CO3** | **3** | **3** | **3** |  | **3** | **3** |  |  | **3** | **3** |  | **3** |
| **CO4** | **3** |  | **3** | **3** | **3** | **3** |  |  | **3** | **3** |  | **3** |
| **CO5** | **3** |  | **3** | **3** | **3** | **3** |  | **3** | **3** | **3** |  | **3** |

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|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | 3 |  | 3 |  | 3 |  |  |
| **CO2** | 3 |  | 3 |  | 3 |  |  |
| **CO3** | 3 |  |  | 3 | 3 |  | 3 |
| **CO4** | 3 |  |  | 3 | 3 |  | 3 |
| **CO5** | 3 |  | 3 | 3 | 3 |  | 3 |
| **Total** | **15** |  | **9** | **9** | **15** |  | **9** |

# SEMESTERIII

**AQUACULTUREINFORMATION,ECONOMICSANDEXTENSION**

**Credits–4**

**Hours:4**

**LearningObjective(LO):**

**LO1:**Toknowaboutvariouslandleasingpolicies;maritimestatesandprocessinvolvedin registration of land and other technical considerations.

**LO2:**Tounderstandvariousrolesoffinancialandinsuranceinstitutionsandstepsinvolved in getting financial support and insurance cover.

**LO3:**Togatherknowledgeondatacollectionandprocessingindifferentaquaculture practices.

**LO4:**Tolearntheuseofinternetandothermediaasatoolforcollectionofdatain aquaculture and also to ascertain the role of WTO and IPR issues in aquaculture.

**LO5:**Tounderstandtheextensioneducation,ruraldevelopment,socio–economics, marketing, internal and external markets and trade, demand and supply.

**UNIT1:Registration**

Land leasing polices of maritimestates,setting – up of aquaculture farm in practice how to go about, purchase of land, registration, registration in MPEDA / BFDA for getting subsidy and technical guidance, getting electric connection and other practical considerations.

**UNIT2:Funds**

Roleoffinancialinstitutions–availingbankloan–formalitiestobefollowed.

Role of insurance companies – formalities to be followed for getting insurance cover and preparation of claim for loss.

**UNIT3:Data**

Data base collection and Data processing:Data collection in different aquaculture practices - Traditional, extensive, semi-intensive and intensive culture- Relative economic model for the different practices.

**UNIT4:Information**

Aquaculture information – Internet, information collection of aquaculture practices – Dissemination processes – WTO, IPR issues in aquaculturefarming.

**UNIT5:Extension**

Fishery extension – principles of extension, theory of motivation, extension methodsand evaluation. Extension education.

Status of extension activities, transfer of technology, behavioural pattern of fishermentostructuralchanges,adoptionofvillagesforintegratedruraldevelopment,socio – economics, marketing, internal and external markets and trade, demand and supply.

**Practical**

1. Visitoffishermenco-operativesociety.
2. Visittoaquaculturefarms.
3. Incomestatementanalysis.
4. Preparationoffarmplansandbudgets.
5. Preparationleaflets,folders, pamphlets,circularletter, poster,chartsetcforfisheries extension activities.
6. Preparingandpracticingascriptforradiotalkandpublicspeaking.
7. Trainingtogetlicense,SubsidyandfromtheGovernment.
8. IdentificationoffishesforIntegratedfarming.
9. EstimationofAmmonia,Hydrogensulphideandorganicmatter
10. IdentificationofZeoliteandlimeusedinaquaculture.
11. Submissionoffieldreport.

# REFERENCEBOOKS

1. Bardach,F.E.,J.H.RytherandW.O.McLarney,1972.Aquaculture:Farmingand Husbandry of Freshwater and Marine Organisms. Wiley Interscience, New York.
2. Brown,E.,1976.WorldFishFarming:CultivationandEconomics.
3. JamesHornell.,1984.MarineFishfarmingforIndia,InternationalBooks&Periodicals Supply service, 81 pp.
4. MPEDA,1995.Seafishes,Specialpublications,63pp.
5. MPEDA,1995,ShrimpHatchery,65pp.
6. BarryA.Costa,Pierce,2002.EcologicalAquaculture,Theevolutionofthebluerevolution, Black Well Science, 382 pp.
7. Pillay.T.V.R.andM.V.Kutty,2005.Aquacultureprinciplesandpractices,Fishing News (Books), London. 624pp.
8. Tucker, C.S and Hargreaves, J.A, 2008. Environmental best management practices for aquaculture, Wiley Blackwell, New York.
9. Handbookonaquafarmingshrimp,lobster,mudcrab-MPEDA-Kochi,72pp.

**CourseOutcomes**

Attheendofthecourse,thestudentwillbeableto

|  |  |
| --- | --- |
| CO1 | Knowledgeonlandleasingpoliciesforaquacultureandothertechnical consideration involved in setting up of a aquaculture farm |
| CO2 | Learningaboutdifferentfinancialandinsuranceagenciesandstepsinvolvedin getting financial support and insurance coverage. |
| CO3 | Knowledgeondatacollectionandprocessingindifferentaquaculturepractices. |
| CO4 | Thoroughknowledgeontheuseofinternetandothermediaasatoolforcollectionofdatainaquaculture. |
| CO5 | Knowledgeonextensioneducation,ruraldevelopment,socio–economics,marketing,internalandexternalmarketsandtrade,demandandsupply. |

**OutcomeMapping**

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| **CO/ PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PSO 7** |
| **CO1** | **3** |  | **3** | **3** |  | **3** |  |  |  |  |  |  |
| **CO2** | **3** |  | **3** |  |  | **3** |  |  |  |  |  |  |
| **CO3** | **3** |  | **3** |  | **3** | **3** |  |  |  |  |  | **3** |
| **CO4** | **3** |  | **3** | **3** | **3** | **3** |  |  |  |  |  | **3** |
| **CO5** | **3** |  | **3** | **3** |  | **3** |  |  |  |  |  | **3** |

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|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | 3 |  |  |  |  |  |  |
| **CO2** | 3 |  |  |  |  |  |  |
| **CO3** | 3 |  |  |  |  |  | 3 |
| **CO4** | 3 |  |  |  |  |  | 3 |
| **CO5** | 3 |  |  |  |  |  | 3 |
| **Total** | **15** |  |  |  |  |  | **9** |

# SEMESTERIII

**BIOENTREPRENEURSHIP**

**LearningObjective(LO):**

**Credits–4**

**Hours:4**

LO1: To learn various aspects of accounting/ finance in building an entrepreneurship. LO2: To gain insights on marketing strategies in Aquaculture

LO3:Toknowusageofinformationtechnologyindevelopinganentrepreneurship

LO4:TolearnaboutvariousaspectsofHumanResourceDevelopmenti.e.,leadership, motivation, teamwork, appraisal etc.

LO5:Togatherinformationonprimaryaspectsofentrepreneurshipandroleofdifferent knowledge centre and R & D institute for technology transfer.

**UnitI:AccountingandFinance**

Takingdecisiononstartingaventure;Assessmentoffeasibilityofagiven venture/new venture; Approach a bank for a loan; Sources of financial assistance; Making a business proposal/Planfor seekingloansfrom financialinstitution and Banks; Funds from bank for capital expenditure and for working; Statutory and legal requirements for starting a company/venture;Budgetplanningandcashflowmanagement;Basicsinaccounting practices: concepts of balance sheet, P&L account, and double entry bookkeeping; Estimationof income, expenditure, profit, income tax etc.

**UnitII:Marketing&Negotiations/Strategy**

Assessment of market demand for potential product(s) of interest; Market conditions, segments; Prediction of market changes; Identifying needs of customers including gaps in the market, packaging the product; Market linkages, branding issues; Developing distribution channels; Pricing/Policies/Competition; Promotion/ Advertising; Services Marketing

With financiers, bankers etc.; With government/law enforcement authorities; With companies/Institutions for technology transfer; Dispute resolution skills; External environment/changes; Crisis/ Avoiding/Managing; Broader vision–Global thinking

**UnitIII:InformationTechnology**

How to use IT for business administration; Use of IT in improving business performance; Available software for better financial management; E-business setup, management.

**UnitIV:HumanResourceDevelopment(HRD)**

Leadership skills; Managerial skills; Organization structure, pros & cons of different structures; Team building, teamwork; Appraisal; Rewards in small scale set up.

**UnitV:FundamentalsofEntrepreneurship&RoleofknowledgecentreandR&D**

SupportmechanismforentrepreneurshipinIndia

Knowledge centres like universities and research institutions; Role of technology and upgradation; Assessment of scale of development of Technology; Managing Technology Transfer; Regulations for transfer of foreign technologies; Technology transfer agencies.

**Practical CaseStudy**

1. Candidates should be made to start a ‘mock paper company’, systematically following all the procedures.
	* Themarketanalysisdevelopedbythemwillbeusedtochoosetheproductor services.
	* A product or service is created in paper and positioned in the market. As a product or services available only in paper to be sold in the market through the existing links.At this juncture, the pricing of the product or the service needs to be finalized, linking the distribution system until the product or services reaches the end consumer.
	* Candidates who have developed such product or service could present the same as a projectworktothePanelofExperts,includingrepresentativesfromindustrysector. Ifthepresentedproductorserviceisfoundtohaverealpotential,thecandidates would be exposed to the next level of actual implementation of the project.
2. Go to any venture capital website (like sequoiacap.com) and prepare a proposal for funding from venture capital.

# REFERENCEBOOKS

1. Hine, D. and J. Kapeleris, 2006. Innovation & Entrepreneurship in Biotechnology, An International Perspective- Concepts, Theories and Cases, Edward Elgar Publishing Limited, UK 259pp.
2. Patzelt,H.andT.Brenner(Eds.),2008.Handbookofbioentrepreneurship InternationalHandbook Series onEntrepreneurship, Springer Science +Business media LLC, 294pp.

**CourseOutcomes**

Attheendofthecourse,thestudentwillbeableto

|  |  |
| --- | --- |
| CO1 | Understandingontheroleoffinanceandaccountinginanentrepreneurship. |
| CO2 | Knowledgeonvariousaspectsofmarketing. |
| CO3 | Knowingtheusefulnessofinformationtechnologyinanenterpriseandotherrecenttechniquesofe-business. |
| CO4 | Learningleadership,managerialskillsandotherconceptsrelatedtohumanresourcedevelopment. |
| CO5 | GatheringknowledgeonfundamentalofentrepreneurshipandroleofknowledgecentresandR&Dinstitutesintechnologytransfer. |

**OutcomeMapping**

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| **CO/ PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PSO 7** |
| **CO1** | **3** | **3** | **3** | **3** |  | **3** |  |  |  |  |  |  |
| **CO2** | **3** | **3** | **3** |  |  | **3** |  |  |  |  |  |  |
| **CO3** | **3** |  | **3** |  | **3** | **3** |  |  |  |  |  |  |
| **CO4** | **3** |  | **3** | **3** | **3** | **3** |  |  |  |  |  |  |
| **CO5** | **3** |  | **3** | **3** | **3** | **3** |  |  |  |  |  |  |

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|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | 3 |  |  |  |  |  |  |
| **CO2** | 3 |  |  |  |  |  |  |
| **CO3** | 3 |  |  |  |  |  |  |
| **CO4** | 3 |  |  |  |  |  |  |
| **CO5** | 3 |  |  |  |  |  |  |
| **Total** | **15** |  |  |  |  |  |  |

# SEMESTERIV

**PLANTANDANIMALCELLCULTURETECHNOLOGY**

**Credit:4**

**Hours:4**

**LearningObjective(LO):**

LO1: To learn structure and organization of animal cell, cell proliferation, cell differentiation, cell adhesion, senescence and cell transformation.

LO2:Togetknowledgeoncellculturemedia,celllinesandcellseparation.

LO3:Toknowaboutadherent&nonadherentcelllines,culturemethods,subculture, cryopreservation, contamination of animal cells.

LO4:Togetanoverviewonplanttissueculture.

LO5:Togatherknowledgeontheexplant,surfacesterilization,plantgrowthhormones, micropropagation,somatichybridization,planttransformationandapplicationsofplant tissue culture.

**UnitI**

Structureandorganizationofanimalcell-Cellproliferation–Celldifferentiation–

Celladhesion–Senescence–Celltransformation

**UnitII**

Cellculturemedia:Components,physicochemicalproperties–Serum:Components,

advantages and disadvantages, serum free media – Use of Antibiotics – Primary cell culture: Initiationofcellculture,mechanicalandenzymaticdisaggregation–Celllines: Development, characterization, maintenance – Cell separation

**UnitIII**

Adherent&nonadherentcelllines–Culturemethods–Subculture– Cryopreservation – Contamination in animal cell culture – Quantification and cytotoxicity – Embryonic stem cells – cancer stem cells.

**UnitIV**

Plant tissue culture – Introduction, cellular totipotency, basic requirements for plant tissue culturelaboratory, tissueculturemedia(constituentsandpreparations),types ofculture – cell, protoplast, callus, suspension culture and its applications.

**UnitV**

Explant,surfacesterilization,plantgrowthhormones,micropropagation(directand

indirect method), somatic hybridization, plant transformation technique using *Agrobacterium tumefaciens*, applications of plant tissue culture.

# REFERENCEBOOKS

1. Razdan,M.K.,2003.Introductiontoplanttissueculture(2ndEdition),Science Publishers, USA. 375 pp.
2. MartinClynes,1998.AnimalCellCultureTechniques.Ed.Springer,NY,618pp.
3. RudolfEndreb,2004.Plantcellbiotechnology–Springerpublications,NY,368pp.
4. RobertN.TrigianoandDennisJ.Gray,2004.Planttissuecultureconceptsand laboratory exercises (2nd Edition), CRC, USA, 454 pp.
5. GeraldKarp,2008.CellandMolecularBiology,WileyPress,USA,843pp.

**CourseOutcomes**

Attheendofthecourse,thestudentwillbeableto

|  |  |
| --- | --- |
| CO1 | Learningstructureandorganizationofanimalcell,cellproliferation,celldifferentiation,celladhesion,senescenceandcelltransformation. |
| CO2 | Thoroughknowledgeoncellculturemedia,celllinesandcellseparation |
| CO3 | Knowledgeonanoverviewofanimalcellculture. |
| CO4 | Learnaboutplanttissueculture. |

|  |  |
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| CO5 | Gathering knowledge about explant, surface sterilization, plant growth hormones, micropropagation,somatichybridization,planttransformationandapplications of plant tissue culture. |

**OutcomeMapping**

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| **CO/ PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PSO 7** |
| **CO1** | **3** |  | **3** | **3** |  | **3** |  |  |  | **3** |  |  |
| **CO2** | **3** | **3** | **3** |  |  | **3** |  |  |  | **3** |  |  |
| **CO3** | **3** | **3** | **3** |  | **3** | **3** |  |  |  | **3** |  |  |
| **CO4** | **3** |  | **3** | **3** | **3** | **3** |  |  |  | **3** |  |  |
| **CO5** | **3** |  | **3** | **3** | **3** | **3** |  |  |  | **3** |  |  |

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|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | 3 |  |  |  | 3 |  |  |
| **CO2** | 3 |  |  |  | 3 |  |  |
| **CO3** | 3 |  |  |  | 3 |  |  |
| **CO4** | 3 |  |  |  | 3 |  |  |
| **CO5** | 3 |  |  |  | 3 |  |  |
| **Total** | **15** |  |  |  | **15** |  |  |

**Projectwork**

**Semester-IV Credits:8**

**DepartmentElectives(DE)**

**LearningObjective(LO):**

**DisasterManagement**

**Credits:3**

**Hours:3**

LO1**:**Tostudythecoastalhazards,riskassessmentanddisastermanagementstrategiesin India.

LO2:Tostudythetypesofhazardsinfisheriessectorandotherimpactofnaturaldisasters

andassessment.

LO3:Tostudythedisastermanagementstrategiesduringthepre-disasterandpostdisaster periods.

LO4:Tostudytheresponseandrecoverysystemsatnational,stateandlocal, coordination between different agencies.

LO5:TostudythePrevalentnationalandglobalmanagementpracticesin disaster managements.

# UNITI

Basicconcepts-Basicconcepts:Hazard,risk,vulnerability,disaster,capacity building. Multi-hazard and disaster vulnerability of India.

# UNITII

Variousdisasters-Typesofnaturalandmanmadehazardsinfisheriesand aquaculture-cyclones,floods,droughts,tsunami,El-nino,algalblooms,avalanches, pollution, habitat destruction, over fishing, introduction of exotic species, landslides,epidemics, loss of bio-diversity etc. Causes, characteristics and impact of various disasters.

# UNITIII

Disaster Management strategies - Management strategies: pre-disaster, during disaster and post-disaster. Pre-disaster: prevention, preparedness and mitigation; different ways of detecting and predicting disasters; early warning, communication and dissemination, community based disaster preparedness, structural andnon-structural mitigation measures.

# UNITIV

Response and recovery systems - During disaster: response and recovery systems at national, state and local, coordination between different agencies, international best practices. Post-disaster: Methods for assessment of initial and long termdamages, reconstruction and rehabilitation.

# UNITV

Agencies in disaster management - Prevalent national and globalmanagement practices in disaster management. Agencies involved in monitoringand early warnings at district, state, national and global levels. Sea safety andhealth.

# REFERENCEBOOKS

1. HarshK.Gupta,2003.DisaterManagemnet,Universitypress,152pp.
2. DamonP.Coppola,2015.IntroductiontoInternationalDisasterManagement,Butterworth-Heinemann, 760pp.
3. I.SundarT.Sezhiyan,2007.DisasterManagement,Sarup&Sons,182pp.
4. JackPinkowski,2008.DisasterManagementHandbook,CRCPress,624pp.
5. RajivSinha, RasikRavindra,2012.EarthSystemProcessesandDisaster Management, Springer Science & Business Media, 244pp.

**CourseOutcomes**

Attheendofthecourse,thestudentwillbeable

54to

|  |  |
| --- | --- |
| CO1: | To understand coastal hazards, risk assessment and disaster management strategies in India |
| CO2: | Tounderstandthetypesofhazardsinfisheriessectorandotherimpactofnaturaldisastersandassessment. |
| CO3: | Tounderstandthedisastermanagementstrategiesduringthepre-disasterandpost disaster periods. |
| CO4: | To understand the response and recovery systems at national, state and local,coordination between different agencies |
| CO5: | TounderstandthePrevalentnationalandglobalmanagementpracticesindisastermanagements. |

**OutcomeMapping**

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| **CO/****PO** | **PO****1** | **PO****2** | **PO****3** | **PO****4** | **PO****5** | **PSO****1** | **PSO****2** | **PSO****3** | **PSO****4** | **PSO****5** | **PSO****6** | **PSO****7** |
| **CO****1** | **3** |  | **3** | **3** |  | **3** | **3** | **3** |  | **3** | **3** |  |
| **CO****2** | **3** |  | **3** |  |  | **3** | **3** | **3** |  | **3** | **3** |  |
| **CO****3** | **3** |  | **3** |  | **3** | **3** | **3** |  | **3** | **3** | **3** | **3** |
| **CO****4** | **3** | **3** | **3** | **3** | **3** | **3** | **3** |  | **3** | **3** | **3** | **3** |
| **CO****5** | **3** | **3** | **3** | **3** |  | **3** |  | **3** | **3** | **3** | **3** | **3** |

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|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | **3** | **3** | **3** |  | **3** | **3** |  |
| **CO2** | **3** | **3** | **3** |  | **3** | **3** |  |
| **CO3** | **3** | **3** |  | **3** | **3** | **3** | **3** |
| **CO4** | **3** | **3** |  | **3** | **3** | **3** | **3** |
| **CO5** | **3** |  | **3** | **3** | **3** | **3** | **3** |
| **Total** | **15** | **12** | **09** | **09** | **15** | **15** | **09** |

55

**LearningObjetives(LO):**

MarineFoodTechnology

**Credits:3**

**Hours:3**

**LO1:**Tostudythepreservationandprocessingmethodsandtypeofpreservativesinfish processing.

LO2:Tostudythepacking methods,utilizationandpreparationoffisheryby-products.

LO3: To study the spoilage of seafood caused by mircroorganisms and their controll measures. LO4:Tostudythe qulalitymanagement offisheryproductsand certification approachesfor commerical applications.

LO5: To study the product development and nutrition promotion, consumer studies qualitative and quantitative research methods.

**UnitI**

Preservation and processing – chilling methods, phenomena of rigor mortis, spoilage changes–causativefactors.Drying–conventionalmethods.Saltcuring,pickling andsmoking.Freezingandcoldstorage,Canningprocedures.Roleofpreservatives in processing.

**UnitII**

Packing –handlingfreshfish,frozenpacks, IQF,layered andshatterpacks.Fishery by–products,cannerywaste,feeds,silage,fishgelatin,fishglue,chitinand chitosan, pearl essence, fertilizer.

**UnitIII**

Seafood microbiology – factors influencing microbial growth and activity. Seafood borne pathogens – bacteria, fungi, viruses. Spoilage factors in seafood. Toxins influencing food spoilage. Microbes as food – SCP, microbial neutraceuticals.

**UnitIV**

Qualitymanagement–concepts,planning,system,qualitycontrol,quality assurance,quality improvement.Certification standards –ISOandHACCP. Principles of quality related to food sanitation, contamination, pest control, human resource and occupational hazards.

**UnitV**

Novel product development, marketing and sea food export – MPEDA, marketing, governmentpolicies,exportfinance,economicimportance.Novelproducts – nutritionpromotion,consumerstudiesqualitativeandquantitativeresearch methods

# REFERENCEBOOKS

1. Kreuzer,R.,1974.FisheryProducts,FAOFishingNews(Books)Ltd.,England,280pp.
2. Anon,1979.Handling,ProcessingandMarketingofTropicalFish.TropicalProducts Institute, London.
3. Miller,M.D.,1990.CiguateraSeafoodToxins,CRCPressNewYork.
4. Carison, V.R. and R.H. Graves, 1996. Aseptic Processing and Packing of Food : A FoodIndustry Perspective, CRC Press, New York.56
5. Gopakumar,K.,1997.TropicalFisheryProducts.Oxford&IBHPublications,NewDelhi, 190 pp.
6. Chandran,K.K.,2000.PostHarvestTechnologyofFishandFisheryProducts,Daya Publishing House, New Delhi, 440 pp.
7. Wilson,C.L.,S.Droby,2000.Microbialfoodcontamination,CRCPress,NewYork.
8. Balachandran,K.K,2001.PostHarvestTechnologyoffishandfishproducts,Daya Publishing House, New Delhi 440 pp.
9. Novak,J.S.,G.M.SapresandV.K.Juneja,2002.Microbialsafetyofminimally processed foods, CRC Press, New York.
10. Weidenborner,M.,2003.Encyclopediaoffoodmycotoxins,SpringerVerlag,USA.

**CourseOutcomes**

Attheendofthecourse,thestudentwillbeableto

|  |  |
| --- | --- |
| CO1: | Tounderstandthepreservationandprocessingmethodsandtypeofpreservativesinfishprocessing. |
| CO2: | Tounderstandthepackingmethods,utilizationandpreparationoffisheryby-products. |
| CO3: | Tounderstandthespoilageofseafoodcausedbymircroorganismsandtheircontrollmeasures. |
| CO4: | Tounderstandthequlalitymanagementoffisheryproductsandcertificationapproachesforcommericalapplications. |
| CO5: | Tounderstandtheproductdevelopmentandnutritionpromotion,consumerstudiesqualitativeandquantitativeresearchmethods |

**OutcomeMapping**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
| CO1 | 3 |  | 3 | 3 |  | 3 | 3 | 3 |  | 3 | 3 |  |
| CO2 | 3 |  | 3 |  |  | 3 | 3 | 3 |  | 3 | 3 |  |
| CO3 | 3 |  | 3 |  | 3 | 3 | 3 |  | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 |  |  |  | 3 |  | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | **3** | **3** | **3** |  | **3** | **3** |  |
| **CO2** | **3** | **3** | **3** |  | **3** | **3** |  |
| **CO3** | **3** | **3** |  | **3** | **3** | **3** | **3** |
| **CO4** |  | **3** |  | **3** | **3** | **3** | **3** |
| **CO5** | **3** | **3** | **3** | **3** | **3** | **3** | **3** |
| **Total** | **12** | **15** | **09** | **09** | **15** | **15** | **09** |

**MicrobialTechnology**

**LearningObjective(LO):**

**Credits:3**

**Hours:3**

**LO1:**Tostudytheisolationandscreeningofindustrialimportantmicrobesand strain development for commercial agents.

LO2: To study the principles of bioprocess technology and optimization for product development.

LO3: To study the recombinant protein product in microbes and their issues in commercial production.

LO4:To study the bioremediation of microbes and their significant role in toxic waste removal and ore leaching.

LO5: To study the application of microbes in food and healthcare industries, food processing and food preservation approaches.

**UnitI**

Isolationandscreeningofindustriallyimportantmicrobes;Largescale

cultivationofindustrialmicrobes;Strainimprovementtoimproveyieldofselected compounds e.g. antibiotics, enzymes or recombinant proteins.

**UnitII**

Basic principles of bioprocess as applied to selected microbes; Process optimization of selected products.

**UnitIII**

Recombinantproteinproductioninmicrobes;Commercialissuespertaining to the production of recombinant products from microbes; Downstream processing approaches; Industrial microbes as cloning hosts (Streptomyces/Yeast)

**UnitIV**

Environmentalapplicationofmicrobes;Oreleaching;Toxicwasteremoval; soil remediation.

**UnitV**

Microbial application infood and healthcare industries; Food processing andfood preservation; Antibiotics and enzymes of pharmaceutical use.

# REFERENCEBOOKS

1. Peter F. Stanbury, 1999, Principles of Fermentation Technology, Butterworth- Heinemann Publishing, UK, 376 pp.
2. YoungM.M,2004.Comprehensive Biotechnology:ThePrinciples,Applications andRegulationsofBiotechnologyinIndustry,AgricultureandMedicine,Vol1, 2, 3 and 4.., Elsevier India Private Ltd, India.
3. Glazer and Nikaids, 2007, Microbial Biotechnology, 2nd Edition, Cambridge University Press, UK, 576 pp.

**CourseOutcomes**

Attheendofthecourse,thestudentwillbeableto

|  |  |
| --- | --- |
| CO1: | To understand the isolation and screening of industrial important microbes and strain development for commercial agents. |
| CO2: | To understand the principles of bioprocess technology and optimization for product development |
| CO3: | To understand the recombinant proteinproduct in microbes and their issues in commercial production. |
| CO4: | Tounderstandthebioremediationofmicrobesandtheirsignificantroleintoxicwasteremovalandoreleaching. |
| CO5: | Tounderstandtheapplicationofmicrobesinfoodandhealthcareindustries,foodprocessingandfoodpreservationapproaches. |

**OutcomeMapping**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
| CO1 | 3 |  | 3 | 3 |  | 3 | 3 | 3 |  | 3 | 3 |  |
| CO2 | 3 |  | 3 |  |  | 3 | 3 | 3 |  | 3 | 3 |  |
| CO3 | 3 |  | 3 |  | 3 | 3 | 3 |  | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 |  |  | 3 | 3 |  | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 |  | 3 | 3 | 3 | 3 | 3 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | **3** | **3** | **3** |  | **3** | **3** |  |
| **CO2** | **3** | **3** | **3** |  | **3** | **3** |  |
| **CO3** | **3** | **3** |  | **3** | **3** | **3** | **3** |
| **CO4** | **3** | **3** |  | **3** | **3** | **3** | **3** |
| **CO5** | **3** |  | **3** | **3** | **3** | **3** | **3** |
| **Total** | **15** | **12** | **09** | **09** | **15** | **15** | **09** |

# REMOTESENSING&GIS

**LearningObjective(LO):**

**Credits:3**

**Hours:3**

**LO1:** To study the principles and applications of remote sensing and types of sensors and their applications.

LO2: To study the application of remote sensing in the assessment of marine flora and ocean colour monitoring.

LO3: To study the principles and applications of GIS and mapping of marine resources by using the GIS tools.

LO4: To study the spatial Analysis, Integration and modelling strategies and concept of Web GIS.

LO5: To study the marine resources exploration, Mapping and Marine Resources information System.

**Unit–I**

Introduction to Remote Sensing: Definition of terms, Concepts and types of remote sensing; evolution of remote sensing technology- Electromagnetic spectrum- Atmospheric windows. Types of **Sensors**- passive sensors and active sensors; characteristics of optical sensors;Sensors resolution – spectral, spatial, radiometric and temporal; Thermal Remote sensing, Microwave Remote Sensing and Hyper-spectral Remote Sensing. Satellites and sensors:IRS,Landsat,NOAA,MODIS-LISS,AWIFS,AVHRR,TM,OCM,MODISand

Hypriyan.

**Unit–II**

Applicationofremotesensingintheassessmentofmangroves,coralreef,seaweed and sea grasses.Ocean Color Monitoring and productivity studies; Sea surface temperatureand Oceanographic parameters: eddies, ocean circulation, upwelling and identification of Potential Fishing Zone (PFZ),

**Unit-III**

Introduction to GIS: Definitions, Basic Concepts, Data- Types and Models: Spatial, GeometricalData–Rasterdata,Vectordata,60Non-spatial,AttributeData.Advantages

and disadvantages ofrastervector data formats. Models of data:- Basic Data Models- rasterand vector, Spaghetti model and Topology model; Advanced data models – Grid model, TIN model and DEM.

Mapscanninganddigitizing,topologybuilding,editingandcleaning.Data processing:Updation,corrections,modifications,scalechange,geometrictransformations and map projection transformations, conflation sliver removal, edge matching, interactive graphic editing, rubber sheeting.

**Unit-IV**

Spatial Analysis, Integration and Modelling: Logic operations, general arithmetic operations, general statistical operations, geometric operations, query and report generation from attribute data, geometric data search and retrieval, classification reclassification,integrated geometry and attributes, overlay, buffer zones, raster data overlay. Definition and concept of Web GIS- advantage and limitations of Web GIS, overview of Web GIS.

**UnitV**

Applications in Marine sciences: Marine resources exploration, Mapping and Marine Resources information System; GIS in Marine and Coastal Zone Management. Mapping and monitoring of pollution, changes in coastal zones, Applications in Disaster Management: Tsunami – types, causes, RS and GIS applications for post Tsunami damage assessment and rehabilitation. Creating custom GIS Software applications and user interface.

# REFERENCEBOOKS

1. Ramachandran, S., 2000. Marine remote sensing applications. Institute for Ocean Management, Anna University.
2. Lillesand, T.M. and R.W. Kefer, 2000. Remote Sensing and image interpretation. John Wiley & Sons. Inc.
3. Anji Reddy, M., 2000. Remote sensing and Geographical Information System. The Book Syndicate, Hydrabad.
4. Lucas, L.F. Janseen, Wim H. Bakker, Ben G.H. Gorte, John A. Horn, Christine Pohl, AnupmaPrakash,ColinV.Reeves,MichaelJ.C.Weir,TsehaieWoldai,2001.Principals of Remote Sensing An Introductory Text Box, 2ndedition, ITC Educational Textbook Series.
5. Rolf A de By, Martin C. Wllis, Yola Georgiadou, Wolfgang Kainz, Richard, A. Knippers, Menno-Jan Kraak, Mostafa M. Radwan, Edmund J. Sides, Yuxian Sun, Michael J.C. Weir and Cees J. van Westen, 2001. Principals of Geographic Information Systems: An introductory textbook. 2ndedition. , ITC Educational Textbook Series.
6. Yeqiao, Wang, 2009. Remote Sensing of coastal environments. Taylor & Francis, CRC Press, 457 pp.
7. Michael Kennedy, 2009. Introducing Geographic Information systems withArcGIS: A workbook approach to learning GIS, 2ndedition, Wiley publications, 624 pp.
8. PindeFuandJiulinSun,2010.WebGIS:PrinciplesandApplications.ESRI,312pp.
9. ChristianHarder,2011.UnderstandingGIS:AnArcGISProjectworkbook,ESRI,378pp.
10. Vasilis, D.Valavanis, 2011. Marine Geographical Information Systems: Theory and Applications (Advances in Geographic Information Science), Springer, 500 pp.

**CourseOutcomes**

Attheendofthecourse,thestudentwillbeableto

|  |  |
| --- | --- |
| CO1: | To understand the principles and applications of remote sensing and types of sensors and their applications. |
| CO2: | To understand the application of remote sensing in the assessment of marine flora and ocean colour monitoring. |
| CO3: | TounderstandtheprinciplesandapplicationsofGISandmappingofmarineresourcesbyusingtheGIStools. |
| CO4: | TounderstandthespatialAnalysis,IntegrationandmodellingstrategiesandconceptofWebGIS. |
| CO5: | Tounderstandmarineresourcesexploration,MappingandMarineResourcesinformationSystem. |

**OutcomeMapping**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CO/****PO** | **PO****1** | **PO****2** | **PO****3** | **PO****4** | **PO****5** | **PSO****1** | **PSO****2** | **PSO****3** | **PSO****4** | **PSO****5** | **PSO****6** | **PSO****7** |
| **CO****1** | **3** |  | **3** | **3** |  | **3** | **3** | **3** |  | **3** | **3** |  |
| **CO****2** | **3** |  | **3** |  |  | **3** | **3** | **3** |  | **3** | **3** |  |
| **CO****3** | **3** |  | **3** |  | **3** | **3** | **3** |  | **3** | **3** | **3** | **3** |
| **CO****4** | **3** | **3** |  |  |  | **3** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CO****5** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** |

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| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | **3** | **3** | **3** |  | **3** | **3** |  |
| **CO2** | **3** | **3** | **3** |  | **3** | **3** |  |
| **CO3** | **3** | **3** |  | **3** | **3** | **3** | **3** |
| **CO4** | **3** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CO5** | **3** | **3** | **3** | **3** | **3** | **3** | **3** |
| **Total** | **15** | **15** | **12** | **09** | **15** | **15** | **09** |

**InterDepartmentalElectives(IDE)**

**SoftSkillDevelopment**

**Credits:3**

**Hours:3**

**LearningObjective(LO):**

**LO1:**Tolearnthecommunicationsskills,interpretingtheverbalandnonverbalcues.

**LO2:** Tolearnthepresentationskills,preparationandparticipationofgroupdiscussions. **LO3:** To learn the technical writing skills, preparation of abstract, results, discussion and data interpretation.

**LO4:** To learn the applications of computer skills browsing search engines Hidden Web and its importance in scientific research.

**UnitI:IntroductiontoSoftSkills**

What are soft skills?-What are hard skills?-Importance of soft skills-Importance of knowing yourself-SWOT Analysis and its benefits-Developing positive attitude-Power of positive attitude-overcoming negative attitude.

**UnitII:EffectiveCommunication**

MeaningofEffectiveCommunication-Verbalandnon-verbalcommunication- Kinesis-Art of Effective Listening-Types of Listening-Barriers to Listening-Advantages of Active Listening- Art of public speech-Language and proficiency in public speech-Spoken English-Fluency-Benefits of Reading-Different types of Reading-Becoming an Effective Reader.

**UnitIII:BusinessCommunication**

Strategies of Good writing-Mechanics of Good writing-use of punctuation-Business letters-Writing Memo-Short reports-Agenda-Minutes-Business Proposals.

**UnitIV:EmployabilitySkills**

Definition of Interview-Types of Interviews-Typical Questions asked in Interviews-Job Application-CV preparation-Types of Resume-Group Discussion-Essential elements of Group Discussion-Skills required in Group Discussion-Group Discussion Etiquette

**UnitV:ProfessionalSkills**

Leadership Qualities-Decision making-Time Management-Stress Management-Problem Solving-Team Building and Team work

**SupplementaryReading:**

* AlexK.*SoftSkills*NewDelhi:S.Chand&Co.,2016
* Ghosh,B.N*ManagingSoftSkillsforPersonalityDevelopment*NewDelhi:Tata McGraw Hill, 2012
* KrishnaMohanandMeeraBanarji.*DevelopingCommunicationSkills.*NewDelhi: Macmillan,2009
* NeeraJainandShomaMukherji.*EffectiveBusinessCommunication.*NewDelhi:Tata

McGrawHill,2012

* Rao,M.S.*SoftSkills-EnhancingEmployability*:*ConnectingCampuswithCorporate*.

NewDelhi:LKPublishingHouse,2011

* Rizwi,AshrafM.*EffectiveTechnicalCommunication.*NewDelhi:TataMcGrawHill,2010

**CourseOutcomes**

Attheendofthecourse,thestudentwillbeableto

|  |  |
| --- | --- |
| CO1: | Tounderstandthecommunicationsskills. |
| CO2: | Tounderstandthepresentationskills,preparationandparticipationmethods. |
| CO3: | Tounderstand thetechnicalwritingskills. |
| CO4: | Tounderstandtheapplicationsofcomputerandbrowsingsearchengines. |

**OutcomeMapping**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CO/****PO** | **PO****1** | **PO****2** | **PO****3** | **PO****4** | **PO****5** | **PSO****1** | **PSO****2** | **PSO****3** | **PSO****4** | **PSO****5** | **PSO****6** | **PSO****7** |
| **CO****1** | **3** |  | **3** | **3** |  | **3** | **3** | **3** | **3** | **3** | **3** |  |
| **CO****2** | **3** |  | **3** |  |  | **3** | **3** | **3** |  | **3** | **3** |  |
| **CO****3** | **3** |  | **3** |  | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CO****4** | **3** | **3** | **3** | **3** | **3** | **3** | **3** |  | **3** | **3** | **3** | **3** |

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| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **CO1** | **3** | **3** | **3** | **3** | **3** | **3** |  |
| **CO2** | **3** | **3** | **3** |  | **3** | **3** |  |
| **CO3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CO4** | **3** | **3** |  | **3** | **3** | **3** | **3** |
| **Total** | **12** | **12** | **09** | **09** | **12** | **12** | **06** |

**CO-POMAPPINGSCORES**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **CoursesImpact** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | **PSO7** |
| **1** | **15** |  | **6** | **9** | **9** | **15** | **9** |
| **2** | **15** |  | **9** |  |  |  | **9** |
| **3** | **15** |  | **15** |  |  | **9** |  |
| **4** | **15** |  |  |  | **15** | **15** |  |
| **5** | **15** | **15** |  | **9** |  | **15** | **9** |
| **6** |  |  |  |  | **9** | **6** | **9** |
| **7** | **15** |  | **6** | **9** |  | **15** | **9** |
| **8** | **15** |  | **6** | **9** |  | **15** | **9** |
| **9** | **15** |  | **9** |  | **9** | **15** |  |
| **10** | **15** |  |  |  | **6** | **6** | **9** |
| **11** | **15** |  |  |  | **15** | **15** |  |
| **12** | **15** |  | **9** | **9** | **15** |  | **9** |
| **13** | **15** |  |  |  |  |  | **9** |
| **14** | **15** |  |  |  |  |  |  |
| **15** | **15** |  |  |  | **15** |  |  |
| **TotalScore** | **210** | **15** | **60** | **45** | **93** | **126** | **81** |