MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI

Centre for Marine Science and Technology

M.Sc., Marine Science (Integrated)

(Choice based credit system)

with effect from the academic year 2017-2018 onwards

Semester	Part I, II, III, IV & V	Subject status	Subject title	Hours/ Week	Credits	Marks			Passing minimum	
						Internal	External	Total	External	Total
I	I	Language	Tamil	4	4	25	75	100	30	40
	II	Language	English	4	4	25	75	100	30	40
	III	Core 1 - Theory	Animal Diversity – I Invertebrata	4	4	25	75	100	30	40
	III	Core 2 - Theory	Animal Diversity – II Chordata	4	4	25	75	100	30	40
	III	Major Practical - I	Paper I & II Practical	4	2	50	50	100	30	40
	III	Allied - Theory	Capture fisheries	3	3	25	75	100	30	40
	III	Allied - Practical	Allied practical – I	4	2	50	50	100	30	40
	IV	Common paper	Environmental studies	2	2	25	75	100	30	40
					25					

MSU/ 2017-18 / CMST-Integrated M.Sc., Marine Science/ Semester – I / Core-1

ANIMAL DIVERSITY - I - INVERTEBRATA

4 Hrs. /Week **4x15=60Hrs/Semester** **12Hrs/Unit** **4 Credits**

OBJECTIVE:

To elucidate the importance of taxonomy, to know the methods of nomenclature, to realize the differences between Protozoa and Metazoa and to study the structure, functional organization, adaptations and the economic importance of lower and higher Invertebrates.

UNIT I

Introduction to Principles of Taxonomy – Binominal Nomenclature.

Protozoa: Mastigophora, Rhizophora, Ciliophora, Sporozoa and Mycetazoa with examples.
General Characters and classification up to classes with the examples.
Type study: *Paramecium:* morphology – nutrition – Osmoregulation – Excretion – Reproduction (binary fission and conjugation).
General Topic: Life cycles of (a) Spirogyra (b) Euglina

Porifera: Calcariae, Hexatinellidae and Demospongiae with examples.
General Characters and classification up to classes with examples.
Type study:- Scypha (Syeonsponge) – External morphology – Body wall – Reproduction.
General topic: Canal system in sponges.

UNIT II

Cnidaria: Hydrozoa, Scyphozoa and Anthozoa with examples.
General characters and classification up to classes with examples.
Type study:- Hydra – External Characters (structure of the colony) – life history.
General Topics: Corals, Coral reefs and their significance.

Ctenophora: Tentaculata and Nuda with examples.

Platyhelminthes: Turbellaria, Trematoda and Cestoda with examples.
General characters and classification up to classes with examples.
Type study: *Lirea fluice* - External morphology and life cycle of *Fasciola hepatica*.
General topic: Parasitic adaptations of Platyhelminthes.

UNIT III

Nematoda: Rotifera, Gastrotricha, Kinorhyncha, Nematomorpha and Nematoda with examples. General characters and classification up to classes with examples.
Type study: *Ascaris lumbricoides* (Round worm): External morphology, life cycle, pathogeny, Parasitic adaptations and control measures. Economic importance of Aschelminthes.

Annelida: Polychaeta, Oligochaeta, Hirudinea, Archiannelida, Echiuroidea, Sipunculoidea, Priapulida and Myzostomaria with examples.
General characters and classification up to classes with examples. External characters
Type study: Nereis.
General topics: Metamerism in Annelida and Feeding in Polychaetes.

UNIT IV

Arthropoda: Meristomata, Arachnida, Crustacea, Myriopoda and Insecta with examples.
General characters and classification up to classes with examples.
Type study: Penaeus: External characters–Appendages–compound eye -Reproductive system and Life cycle.
General topic: Larval forms of crustacean, mouth parts of insects..

UNIT V

Mollusca: Aplacopora, Monoplaceopora, Polyplacoda, Gastropoda, Scaphopoda, Pelicipoda, Cephalopoda with examples.
General characters and classification up to classes with examples.
Type study: Sepia: External characters – shell – mantle cavity – Anatomy, Digestive system and Reproductive system.
General topic: Economic importance of Molluscs.

Echinodermata: Astreroideae, Ophuroideae, Echiniodeae, Holothuroideae, Ophiocistiodea and Pelmatozoa. General characters and classification up to classes with examples.
Type study: Star fish: External characters – Water vascular system.
General topic: Larval forms of Echinoderms and their phylogenetic significance.

REFERENCE BOOKS: Animal Diversity – I : Invertebrata

1. Arora, M.P.Non – Chordates ,Himalaya Publishing House, Ramdoot, Dr.Bhalero Marg (Kelewadi) Gurgan, Mumbai-400004.
2. Barrington, E.J.W.,Invertebrate structure and function.Boston – Houghton. Miffin and ELBS, London.
3. Bhamrah,H.S.et.al. A text book of Invertebrates. Alilnol Publications Private Limited,4374/4B.Ansari Road, Dayaganj,New Delhi – 110002.
4. Brusca, Invertebrates, ANE Books, Avantika,Niwas,19 Doraiswamy Road,

T.Nagar,Chennai-600 017.
5. Ekambaranatha Iyer,M.: A Manual of Zoology Part I. Invertebrata, S. Viswanathan (printers and Publishers)Pvt.Ltd,Chennai.
6. Jan,A. Pechenik, Biology of the Invertebrates, Tata McGraw-Hill Publishing Company Limited,No.444/1 Sri Ekambara Naicker Industrial state,Alalpakkam, Porur,Chennai-600 016.
7. Jordan,E.L.and P.S. Verma. Invertebrate Zoology (14^{th} Edition).S. Chand and Company Limited,7361 Ram Nagar,Qutab Road,New Delhi-110055.
8. Kotpal R.L. Modern Text Book of Zoology, INVERTEBRATES (9^{th} Edition). Rastogi Publications, Gangotri, Shivaji Road, Meerut-250 002.
9. Mahanta Rita and I.K. Bhattacharyya. Invertebrate Zoology. Kalyani Publishers, B1/1299, Rajaendar Nagpur, Ludhiana-141008.
10. Parker and Haswell. A text Book of Zoology, Invertebrates Volume I. AITBS Publishers and Distributors,J5/6 Krishna Nagar, Delhi-110051
11. Verma, A. Invertebrates: Protozoa to Echinodermata. Naros Publishing House Private Limited.35-36 Greams Road, Thousand Lights, Chennai - 600006.

Lab course - ANIMAL DIVERSITY - I - INVERTEBRATA

1. Dissection and mounting – cockroach/Peneaus/Pila/Silk worm – nervous system, digestive system, trachea, salivary apparatus.

2. Museum specimens / slides/ models/ charts – Paramacium, plasmodium, Euglena, Obelia colony, Ascaricus male & female, Earthworm, honey bee, Naupilus, Mysis, Zoea, corals, sponges, sepia, loligo, octopus, sea cucumber, starfish, polycheates.

MSU/ 2017-18 / UG-Colleges /Part-III (B.Sc. Zoology) / Semester – I / Core - 2

ANIMAL DIVERSITY – II: CHORDATA

4 Hrs/week **4x15=60 Hrs/Semester** **12 Hrs/Unit** **4 Credits**

OBJECTIVE: To exemplify the intermediary position of Prochordates between invertebrates and vertebrates, and to study the structure, functional organization, adaptations and the economic importance of lower and higher chordates with special reference to marine organisms.

UNIT I:

Introduction to Chordata: General characters (Diagnostic characters and additional characters) and Classification up to classes with examples.

Prochordates: Hemichordata, Urochordata, Cephalochordata with examples.
General characters and classification up to orders with examples.
Type study: Ascidian - External features-Digestive and Excretory system
External features and biological significance of Balanoglossuss

Agnatha: Ostracodermi, Cyclostomata.
Petromyzon- External morphology; Ammocoetes Larva.
General topic: Origin of Vertebrates.

UNIT II:

Pisces: Gnathostomata, Placodermi, Chondrichthyes, Osteichthyes with examples.

General characters and classification up to sub-classes with examples

Type study: Scoliodon (shark) -External characters- Placoid scales-Digestive system-Respiratory system-Receptor Organs- Urinogenital system.

General topics: (i) Economic importances of fishes. (ii) Reproductory organs in fishes (iii) Fish breeding

UNIT III:

Amphibia: Labyrinthodontia, Lepospondyli, Phyllospondyli, Apoda, Urodela, Anura with examples.

General characters and classification up to orders with examples.

External features and biological significance of the following examples:
Type study: *Rana hexadactylata* (Green frog)
General topic: Parental care in Amphibians

Reptilia: Anapsida, Parapsida, Diapsida, Synapsida with examples
General characters and classification up to orders with examples

Type study: Turtle

General Topics: (i) Identification of poisonous and non-poisonous snakes of South India (ii) Poison apparatus- Biting mechanism- venom- First aid for snake bite-Antivenom.

UNIT IV:

Birds:- Archaeornithes, Neornithes with examples

General characters and classification up to subclasses with examples.

Type study: *Columba livia* (Pigeon)-External characters-Flight muscles - Digestive system-Respiratory system-Urinogenital system

General topics: (i) Migration of Birds (ii) Flight adaptations in Birds
(iii) Beaks and feets in Birds.

UNIT V:

Mammalia: Protheria, Metatheria, Eutheria with examples

General characters and classification up to subclasses with examples.

Type study: Rat –External morphology – Digestive system – Respiratory system- Heart- Structure of Brain- Reproductive system.

General topics: (i) Aquatic mammals (ii) Placentation in mammals.
(iii) Stomach in mammals

REFERENCE BOOKS: Animal Diversity II - Chordata

1.Alexander, R.M. The Chordates Cambridge University Press.

2.Bhamrah, H.S. *et al.* A text book of chordates.Anmol publication Limited, 4374/4B Ansari Road,Daryaganj, New Delhi 110002.

3.Ekambaranatha Ayyar,M. and T.N.Ananthakrishnan. A Manual of Zoology Vol.II(chordate).S.Viswanathan (Printers and Publishers)Pvt.Ltd.,Chennai.

4.Jordan E.L. and P.S Verma.Chordata Zoology (11th Edition).S.Chand and Company Limited, 7361 Ram Nager,Qutab Road,New Delhi-110 055.

5.Kardong, K. Vertebrates:Comparative Anatomy,Function,Evolution.Tata Mc Graw Hill publishing Company Limited,444/1.Sri Ekambara Naicker Industial estate,Alapakkam,Porur,Chennai-600 116.

6.Kotpal.R.L.Modem Text Book of Zoology-vertebrates.Rastogi Publications, Gangotri,Shivaji Road,Meerut-250 002.

7.Kulshrestha,S.K.Comparative Anatomy of Vertebrates,Anmol Publishers a.Private limited,4374/14B,Ansari Road,Daryaganj.New Delhi-110 002.

8.Mahanta Rita and I,K.Bhattacharyya.Vertebrate Zoology,Kalyani publishers,B-1/1299,Rajinder Nagar,Ludhiana-141008.

9.Nigam,H.C.Biology of Chrodates.Vishal Publishing Company,Books Market,Old Railway Road,Jalandhar-144008.

10.Pough,R.H., C.M.Janis and J.B. Heiser. Vertebrate life.Pearson Education (Singapore) Pvt.Limited;Indian Branch-482 FIE Patpaganj,Delhi-110092.

11.Prasad, S.N.and Kashyap Vasantika,P.Text Book of Vertebrate Zoology,New Age International publishers,4835/24 Ansari Road,Daryaganj,New Delhi-110002.

12.Young,J.L.Life of Vertebrates.Oxford at the clarendon press,London.

Lab course ANIMAL DIVERSITY – II: CHORDATA

1. Disection and mounting – shark placoid scales, fish/frog arterial system, brain, reproductive system (demonstration only)

2. Museum specimens – slides/models/charts, Amphioxis, Balanoglossus, Asidians, Pelromyzon, Hippocampus, Rachophorus, Ambystoma, Chameleon, Cobra, Kingfisher, Bat.

3. Identification of wet land birds

4. Field visit – biodiversity study of different places in peninsular coast, gulf of mannar biodiversity

5. Visit to Zoo and Aquarium

*students should write an illustrated study tour report and same to be submitted for evaluation at the time of practical examination (5marks)

MSU/ 2017-18 / CMST-Integrated M.Sc., Marine Science/ Semester – I / Allied

CAPTURE FISHERIES – Allied paper I

(4 Hrs. / Week) 4x15=60Hrs/Semester 12 Hrs/Unit Credits 3

OBJECTIVE:

To highlight the recent trends and types of capture fisheries to students.

UNIT I

Capture fisheries – Inland Capture Fisheries – Scope and importance of Capture Fisheries in India and World. Present yield and Estimates of Potential. Inland capture fishery resources of Indian Fisheries of major and minor carps. Cat fishes and other groups. Problems and management.

UNIT II

Cold water fishery resources – Fisheries of trout, Mahaseer and other Cold water Species. Lacustrine fisheries – Species, Catch, Fishing gears, Potential and Problems of Development and management. Estuarine fisheries. Fisheries of Brackish water lakes and back waters – Problems and Management.

UNIT III

Salient features of cultivable species of fishes and shell fishes.Marine fishery resources of India – Fisheries of Sardine, Lesser Sardine, Anchovies, Other Clupeoids, Mackerel, Ribbon fishes, Tunnies, Carangids and Cephalopods.

UNIT IV

Mid water and Demersal fisheries – Fisheries of Elasmobranches, Bombay duck, Cat fishes, Silver Bellies, Sciaenids, Pomfrets, Thread fins, Thread fin breams and Perches, Flat fishes, Prawns lobsters, Crabs, Mussels Oysters and Clams.

UNIT V

Biological aspect of fishery managements, Principles of Conservation, Development and Management Concept and practice.Population dynamics – Concept of recruitment and yield, problems of over fishing, MSY,MEY and OSY

PRACTICALS

1. Identification of commercial fresh water and marine prawns.
2. Visit to a Prawn farm.
3. Visit to a fish processing industry.
4. Visit to a Landing centers.
5. Raceway culture system.
6. Field visit to observe fishing and to collect field data regarding species composition,Craft, Gear and Field problems regarding riverine, esturine,reservoir and cold water fisheries.
7. Study of fishery development programmes.
8. Study of fishery management problem – Laws,Acts and Field problems.

REFERENCE BOOKS

1. Fish and Fisheries of India Jhingran V.G. 1982 Hindustan Publishing Corporation India Delhi Rev.Ed.
2. Prawns and Prawn fisheries of India Kurian C.V and V.C Sebastian 1982.Hindustan Publishing corporation (India) Delhi Rev.Ed.
3. Marine Fisheries.Bal D.V and K.V Rao 1990.Narendra Publishing House Delhi Rev.Ed.
4. Cold water fisheriesof India.Jhingran V.G and K.L Sehgal 1979.Barrackpore Inland fisheries soceity of India.
5. Fisheries Development in India.Srivastava U.K and Dharma Reddy 1983.Concept publishing co.,New Delhi.
6. Introduction to the practice of fishery science,Royce 1984 Academic press,London.
7. Fishery Science its methods and Applications,Rounsefell,G.A and W.H Everhart 1953 John.Wiley,New York.

MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI

Centre for Marine Science and Technology

M.Sc., Marine Science (Integrated)

(Choice based credit system)

with effect from the academic year 2017-2018 onwards

Semester	Part I, II, III, IV & V	Subject status	Subject title	Hours / Week	Credits	Marks			Passing minimum	
						Internal	External	Total	External	Total
II	I	Language	Tamil	4	4	25	75	100	30	40
	II	Language	English	4	4	25	75	100	30	40
	III	Core 3 - Theory	Developmental Biology	4	4	25	75	100	30	40
	III	Core 4 - Theory	Marine Ecology	4	4	25	75	100	30	40
	III	Major Practical - II	Paper 3 & 4 Practical	4	2	50	50	100	30	40
	III	Allied - Theory	Culture fisheries	3	3	25	75	100	30	40
	III	Allied - Practical	Allied practical – II	4	2	50	50	100	30	40
	IV	Common paper	Value based education	2	2	25	75	100	30	40
					25					

MSU/ 2017-18 / CMST-Integrated M.Sc., Marine Science/ Semester – II / Core - 3

DEVELOPMENTAL BIOLOGY

(4 Hrs /Week) 4x15=60 Hrs/Semester 12Hrs/Unit Credits 4

OBJECTIVE: To understand the sequential changes from cellular grade of organization to organ grade of organization in the development of multicellular organisms.

UNIT I

History and basic concepts of Development -Definition and Scope of Gametogenesis – Spermatogenesis – Oogenesis – Vitellogenesis - Structure of Sperm and Egg. Fertilization: Pre and Post fertilization events – significance; Parthenogenesis.

UNIT II

Stages of development – Zygote – Blastula, Gastrula, Neurula - Cell fate commitment – Potency – Concept of embryonic stem cells – Lineages of 3 germ layers – fate map – Germ cell speciation and migration – Eg. Chick / Frog / Zebrafish.

UNIT III

Early development – Cleavage- Gastrulation – Axis specification – Dorsoventral and

exterior posterion, Body plan patterning

UNIT IV

Late development - Organogenesis – Eg. Rat. Development of eye, ear, heart and brain. Metamorphic events in frog and its hormonal regulation.

UNIT V

Implantation of embryo in humans, placenta in humans and its function, manipulation of reproduction in humans – infertility (Male and Female), IUI , IVF, Artificial insemination , test tube babies, Amniocentrosis.

Birth control, contraceptive devices- surgical and hormonal methods.

REFERENCE BOOKS: Developmental Biology

1. Arora, M.P. Embryology. Himalayan Publishing House, Ramdoot, Dr. Bhalero Marg (Kelewadi) Girgaon, Mumbai – 400004.
2. Arumugam, N.Developmental Biology. Saras Publications, 114/35G, A.R.P camp Road, Nagercoil.
3. Balinsky, B.J.Introduction to Embryology, W.B.Saunders, Philadelphia,USA.
4. Berry,A.K. An Introduction to Embryology,EMKAY Publications,Post Box No.9410, B – 19 East Krishna Nagar,Swami Payanand Marg,Delhi – 110 051.

5. Beryl, N.J. Developmental Biology,Tata McGraw Hill Publishing Company Limited, 444/1 Sri Ekambara Naicker Industrial Estate, Alapakkam, Porur, Chennai -600 116.
6. Developmental Biology: R.M.Twyman.Bios scientific publishers, Ltd. New Delhi (2001).
7. Diwan, A.P. Mammalian Embryology, Anmol Publications Private Limited,4374/4B Ansari Road , Daryaganj, New Delhi-110 002.
8. Diwan,A.P.Avian Embryology, Anmol Publications Private Limited,4374/4B Ansari Road , Daryaganj, New Delhi-110 002.
9. Gilbert,Developmental Biology,ANE Books India, Avantika Niwas, 19,Doraiswamy Road,T.nager,Chennai-600 017.
10. Goel,S.C.Principles of Animal Developmental Biology,Himalaya Publishing House,Ramdoot,Dr.Bhalerao Marg (Kelewadi)Girgaon,Mumbai – 400 004.
11. Jain,P.C. Elements of Developmental Biology (Chordate Embryology).vishal Publishing Company,Books Market,Old Railway Road,Jalandhar – 144 008.
12. Jangir, O.P.Developmental Biology – A Manual.Agrobios (India),Behind Nasrani Cinema,Chopasani Road,Jodhpur – 342 002.
13. Nelson, E.Comparative Embryology of Vertebrates.Tata McGraw Hill Publishing Company Limited,No. 444/1 Sri Ekambara Naicker Industrial Estate, Alapakkam,Porur, Chennai – 600 116.
14. Ramesh Mathur and Meenakshi Metha. Embryology.Anmol Publications Private Limited,4374/4B,ansari road,Daryaganj,New Delhi – 110 002.
15. Rao, K.V. Developmental Biology. A Modern Synthesis.Oxford & IBH Publishing company Private Limited, S-155 Panchshila Park, New Delhi 110017.
16. Sastry.K.V. and Vineeta Shukal, Developmental Biology Rastogi Publications Gangotri, Shivaji Road, Meerut-250 002.
17. Slack,Essential Developmental biology. ANE Books India. Avantika Niwas, 19,Doraiswamy Road,T.Nager,Chennai-600 017.
18. Subramomam, T.Developmental Biology. Narosa Publishing House Private Limited, 35 – 36 Grams Road, Thousand Lights, Chennai – 600 006.
19. Verma.P.S. and V.K. Agarwal. Chordate Embryology (10^{th} Edition).S. Chand & Company Ltd.7361 Ram Nagar,Qutab Road,New Delhi – 110055.

Developmental Biology - Lab course

1. Mounting and observation of Live sperm and egg of a vertebrate
2. Isolation of zebrafish embryo
3. Zebrafish staging
4. Organogenesis in zebrafish
5. Staging of zebrafish for somite and motor neuron development.
6. Museum specimens / slides/ models/ charts – sperm, ovum, chick embryo, 24, 48, 72, 96 hours.
7. Placenta in mammals – Discoidal, cotyledonary, zonary placenta, diffuse placenta.

MSU/ 2017-18 / CMST-Integrated M.Sc., Marine Science/ Semester – II / Core - 4

MARINE ECOLOGY

(4 Hrs. / Week) **4x15=60Hrs/Semester** **12 Hrs/Unit** **Credits 4**

OBJECTIVE:

To introduce the organisms, habitat and ecosystem that makeup marine realm – to understand the marine biodiversity, ecology, communities and marine conservation. Students will be given field experience and conduct biodiversity studies of different marine ecosystem and conservation projects.

UNIT I

Marine environmental systems

Marine environment ecological factors- light, temperatre, salinity, pressure. Classification of marine environment – pelagic environment- planktonic and nektonic adaptations. Benthic environment – internal, interstitial and deep sea adaptation.

UNIT II

Marine Biodiversity – Photosynthetic communities – Seaweed, Seagrass, mangroves, phytoplanktons, Chemosynthetic ocean communities – marine herbivores , marine detrivores. Animal association in marine environment – endocism, inquilinism, phoresis, epizoism, mutualism, commensalism, symbiosis, parasitism – Marine zoogeography with reference to Indian Artic and Antartic oceans.

UNIT III

Marine ecosystem concepts, principal components – marine food chains – tropic structure - food web- ecological pyramids – energy flow – evolution and management system – Competition and succession – Intra and interspecific competition.

UNIT IV

Population ecology – Group attributes – population growth – density variations, concept of carrying capacity – Dispersal, prey-predator relationship – density dependent and independent factors.

UNIT V

Ecology of coastal marine communities – Estuaries and salt marsh communities – Mangrove, coral reef, sea grass, soft-sediment – Rocky sediment – intertidal and subtidal. – Threats to marine ecosystem – Pollution, overexploitation, habitat destruction – Conservation – Laws, CITES, In situ/ex situ Conservation.

REFERENCE BOOKS:

1. Agarwal, A.K. Ecology and Environmental Biology. Student Edition, Agrobios (India) Behind Nasrani Conema, Chopasani Road, Jodhpur -342 002.
2. Arora, M.P. Ecology. Himalaya Publishing House, Ramdoot, Dr.Bhalerao Marg, Girgaon, Mumbai- 400 004.
3. Clarke, G.L. Elements of Ecology, John Wiley & sons Inc. New York.
4. Junega, Kavita. Ecology. Anmol Publications Private Limited, 4371/4B Ansari Road, Daryagani, New Delhi – 110002.
5. Kotpal, R.L and N.P. Bali. Concepts of Ecology Vishal Publishing Company,Books Market, Old railway road, Jalandhar – 144 008.
6. Madhab, C.Dash. Fundamentals of Ecology. Tata McGraw Hill Publishing Company Limited,No.444/1.Sri Ekambara Naicker Industrial Estate, Alapakkam, Porur, Chennai –600 116.
7. Odum , E.P. Fundamentals of Ecology. International Student Edition, W.B. Saunders Company, Philadelphia, USA.
8. Purohit, S.S. A Text book of Environmental Science, Student Edition, Agrobios (India), Behind Nasrani Cinema, Chopasani Road, Jodhpur – 342 002.
9. Singh, H.R. and Neeraj Kumar. Ecology and Environmental Science, Vishal Publishing Company, Books Market, Old Railway Road,Jalandhar – 140 008.
10. Singh, S.P.Animal Ecology,6th Edition, Rastogi Publications, Gangotri, Shivaji Road, Meerut – 250 002.
11. Verma, P.S. and Agawal 1986, Environmental Biology, S. Chand & Co Ltd.,

Lab course - MARINE ECOLOGY

1. Identification of intertidal species and distribution pattern in intertidal zone – specimen preservation & submission
2. Plankton collection and mounting – Phyto & Zoo plankton
3. Determination of temperature, salinity and dissolved oxygen
4. Museum specimens slides, models and charts – secchi disc, grab sampler, water sampler, plankton net.
5. Mutualism (hermit crab & sea anemone), Commensalism (Echenesis & shark), Parasitism (sacculina & crab), predation – cyclomorphosis (Daphnia)
   Marine ecosystem, food cain and food web(chart)

6. Study tour (compulsory) – mangroves & coral reef ecosystem – observation and study of organism in their natural habitat

   *students should write an illustrated study tour report and same to be submitted for evaluation at the time of practical examination (5 marks)

MSU/ 2017-18 / CMST-Integrated M.Sc., Marine Science/ Semester – II / Allied

CULTURE FISHERIES –
Allied paper II

(4 Hrs. / Week) **4x15=60Hrs/Semester** **12 Hrs/Unit** **Credits 3**

OBJECTIVE:

To highlight the recent trends and types of culture fisheries to students.

Unit 1:

Need and significance of aquaculture in India – principles of aquaculture – compatible species in aquaculture – site selection for aquaculture

Unit II

Water quality criteria in aquaculture – pond preparation and stocking of fis for aquaculture – live fish transportation. Coastal aquaculture – species used in aquaculture

Unit III

Sea farming or mariculture – types of aquaculture system (pond, cage, pen, raft, monoculture, polyculture, intergrated culture).

Unit IV

Live feed culture – microalgae, rotifer, artemia, daphnia. Formulated feeds – types – ingredients – feed formulation

Unit V

Diseases in aquaculture – microbial diseases, parasitic diseases – disease control – through feed and vaccination – harvest and post harvest techniques

References

1. Aquaculture principles and practices by TVR Pillay,1990. Fishery new Books Publi.
2. Aquaculture by Bardak
3. Fish and fisheries of India by V.G. Jhingran, 1991, Hindustan Publishing Corporation.
4. CRC Handbook of Mariculture. Vol 1 Crustacean aquaculture. James P. Mevey & J. Robert Moore

Lab course - CULTURE FISHERIES

1. Assessment of water quality parameters in fish pond / shrimp pond: pH, salinity, ammonia, Temperature and Dissolved oxygen.
2. Live feed culture.
3. Microalgal culture
4. Disease diagnosis in fish pond / shrimp pond.

MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI

Centre for Marine Science and Technology

Common Course Structure for P.G. Integrated Programmes of the University Departments

M.Sc., Marine Science (Integrated)

(With effect from the academic year 2017-2018 onwards

Semester	Part I, II, III, IV & V	Sub .No.	Subject Status	Subject Title	Course/ paper	Hrs./ week	L Hrs/ week	T Hrs/ week	P Hrs/ week	C Credits
III	I	17	Language	Tamil /Other Languages		4	4	-	-	4
	II	18	Language	English		4	4	-	-	4
	III	19	Core -5	Molecular Cell Biology		4	4	-	-	4
	III	20	Major Practical - III	Practical: Molecular Cell Biology		4	-	-	4	2
	III	21	Allied - III	Botany: Ethnobotany		3	3	-	-	3
	III	22	Allied – Practical III	Practical: Ethnobotany		4	-	-	4	2
	IV	23	Non Major Elective - I	Beekeeping (Or) Live feed culture		2	2	-	-	3
		24	Mandatory paper	Yoga		2	2	-	-	2
				Subtotal		27	19	-	8	24
	I	25	Language	Tamil /Other Languages		4	4	-	-	4
	II	26	Language	English		4	4	-	-	4
	III	27	Core -6	Fundamentals of Genetics		4	4	-	-	4

IV	III	28	Major Practical - IV	Practical : Fundamentals of genetics		4	-	-	4	2
	III	29	Allied - IV	Botany Embryology, Plant Anatomy, physiology & Biotechnology		3	3	-	-	3
	III	30	Allied Practical- IV	Practical: Embryology, Plant Anatomy, physiology & Biotechnology		4	-	-	4	2
		31	Non major Elective - II	Vermitechnology (Or) Community & Social preventive medicine		2	2	-	-	3
		32	Mandatory Paper	Computers for Digital Era		2	2	-	-	2
	IV	33	Extension activity	NCC,NSS,YRC,YWF		-	-	-	-	1
				Subtotal		27	19	-	8	24

MSU/ 2018-19 / CMST-Integrated M.Sc., Marine Science/ Semester –III / Core/Ppr-5

MOLECULAR CELL BIOLOGY

Objective: To understand the structure and function of the cell. This study gives a thorough knowledge on the basic of the fundamental unit of life, that is the cell.

L T P C
4 0 0 4

UNIT I

Cell types – Prokaryotic and Eukaryotic, Microscopy – detailed study of compound microscope, phase contrast and electron microscope. Cytological techniques : Fixation and staining – types of stains. (10 L)

UNIT II

Ultrastructure and functions of the following cell organelles: Plasma membrane, mitochondria, golgi apparatus, endoplasmic reticulum, ribosomes, lysosomes and centriole.

(10 L)

UNIT III

Nuclear components: Ultrastructure and functions of nucleus, nuclear membrane, nucleolus, Chromosomes and their types. Cancer cells and Carcinogenesis: Definition, types, causes, properties and treatment, oncogenes and cell signaling.

(12 L)

UNIT IV

DNA: DNA as genetic material, Base pairs, constancy of DNA structure and Replication, Hybridization, Cell division – mitosis & mitotic apparatus, Meiosis & Synaptonemal complex. DNA as a tool in taxonomy. Mitochondrial DNA and DNA barcoding of Marine animals.

(14 L)

UNIT V

Different types of RNA, transcription, functional unit of gene, promotergene, coding sequences, processing of ribosomal RNA, inhibitors of transcription various steps in protein synthesis. Genetic code – Codons , anticodons and control of gene expression.

(14 L)
(Total :60 L)

MAJOR PRACTICAL III (Core 5: Molecular Cell Biology)

1. Mitosis in Onion root tip cells /garlic root cells.
2. Meiosis in grasshopper testis
3. Giant chromosomes in Chironomous larva.
4. Preparation of a) Squamous epithelium, b) Human blood smear and, c) Frog blood smear.
5. DNA/RNA quantification from marine samples.
6. PCR amplification and Gel electrophoresis (Demonstration)
7. Models & Charts: DNA, RNA, Ribosomes, Nucleus, Mitochondria, Golgi apparatus, Endoplasmic reticulum and Protein synthesis.

REFERENCE BOOKS:

1. Cell Biology (ELBS CAMLOT Press), Ambrose, E.J & Dorothy, M.E
2. Cell & Molecular Biology, (W.B. Saunders & co. Philadelphia): De Robertis & De Robertis
3. Cell Biology (W.B.Saunders & Co, Philadelphia): Dr. Robertis, E.D.P, Nowinski, W.N & Saez, F.A
4. Cell& Molecular Biology (Academic press, New York): Dupraw, E.J
5. Essentials of Cell Biology (Allyn & Bacon Inc, Boston). Giese. A.C
6. Cell Physiology (WB.Saunders & co, Philadelphia): Dyson, R.D
7. Elements of Cytology (Feeman Book co, Kamia Nager, New Delhi): Norman. S.Cohn
8. The Cell (Prentice Hall Inc., Engle Wook Cliffs, New Jersey), Swanson, C.P & Webster, B

ALLIED -III
BOTANY: ETHNOBOTANY

Objective: To understand the relationship between plants and people .This study gives a full knowledge about the habit and habitat of plants and the possible usage to human.

L T P C
3 0 0 3

UNIT I

General Characteristics of Algae – Distribution, Structure and Life History of Volvox. General Characteristics of Fungi – Distribution, Structure and Life History of polyporus – Economic Importance of Algae, Fungi and their products.

(9 L)

UNIT II

General Characteristics of Lichens; Structure and Reproduction of Usnea. General Characteristics of Bryophytes; Structure and Reproduction of *Funaria.*

(8 L)

UNIT III

General Characters of Pteridoyhytes – Structure and Reproduction of *Lycopodium;* General Characters of Gymnosperms – Structure and Reproduction of Pinus; Economic Importance of Pteridophytes and Gymnosperms.

(9 L)

UNIT IV

Plant Nomenclature – Bentham and Hooker's System of Classification, Merits and Demerits of Bentham Hooker's system; Critical study of the following Families and their Economic importance – Rutaceae, Asclepiadaceae, Euphorbiaceae and Poaceae.

(10 L)

UNIT V

Ethnobotany: study of herbal medicines, medicinal plants, Economically important medicinal plants e.g. *Aloe vera, Piper nigrum, Phyllanthus niruri, Coleus amboinicus, Catharanthus roseus, Gymnema sylvestre,* medicinal Aquatic plants and culture of micro and macroalgae in general.

(9 L)

(Total: 45 L)

ALLIED PRACTICAL -III

BOTANY: ETHNOBOTANY

1. Dissection of medicinal plant parts – Flower, Stem and root
2. Microalgae collection, identification and micro slide preparation of atleast 10 microalgae.
3. Microalgal culture of any one species (Demonstration)
4. Macro algal culture – one species (Demonstration)
5. Identification of coastal medicinal plants – atleat 5
6. Identification of mangrove medicinal plants – atleast 5
7. Identification of Seaweeds :
   - Red seaweeds – any 5
   - Brown seaweeds – any 5
   - Green seaweeds - any 5
8. Identification of any 5 traditional medicinal plants
9. Types of root system
10. Spotter: Algae & algal products – spirulina, agar agar, alginates, carageenan

REFERENCES

1. A Text Book of Algae. R. M. Johri, SnehLata and KavitaTyagi. Dominant Publishers and Distributors Pvt. Ltd. ISBN: 978 – 93 – 80642 – 71 -0, 2013.
2. A Text Book of Fungi. R. M. Johri, SnehLata and KavitaTyagi. Dominant Publishers and Distributors Pvt. Ltd. ISBN: 978 – 93 – 80642 – 00-0, 2011.
3. Botany. V. Verma, Ane books Pvt Ltd, ISBN: 8190832204, 2010.
4. Recent Progress in Medicinal Plants. V.K. Singh, J.N.Govil, ShamimaHashmi and Gurdip Sing. StudiumPress LLC, USA, ISBN: 1- 930813- 12-0, vol: 7, 2003.
5. Medicinal Plants. Moshrafuddin Ahmed. MJP Publishers, ISBN: 978 – 81 – 8094 – 073 – 6, 2015

NON MAJOR ELECTIVE – I

BEE KEEPING

Objective: To understand the life cycle, culture and maintenance of honey bee for bee keeping.

L T P C
2 0 0 3

UNIT I

Types of bees: Rock bee, Indian bee, Little bee and Dammer bee – Life history of *Apis indica*.

(6 L)

UNIT II

Food of the bee – honey and pollen, Relationship of Plants and Bees, Arranging an apiary position – space – direction.

(6 L)

UNIT III

Acquiring bees – Care of newly captured colonies, Newton's bee hive and its architecture Different kinds of cells.

(6 L)

UNIT IV

Primitive hives – different types; Disadvantages of primitive hives; Appliances used in apiaries.

(6 L)

UNIT V

Honey – Extraction of honey – preservation and storage of honey – Properties, Chemical composition, Nutritive value, medicinal values – Honey as daily Food.

(6 L)

(Total : 30 L)

REFERENCE BOOKS:

1. Bee keeping in India – Sardar Singh – KAR, Delhi.
2. Bee keeping in South india – Cherian M.C. & Ramachandran, Govt. Press, Chennai.
3. Handbook of Bee keeping Sharma P.L. & Singh S., Chandigarh.
4. Apiculture – J.Johnson and Jeyachandra, Marthandam, Tamilnadu.

Or

LIVE FEED CULTURE

Objective: To understand the techniques for the isolation, culture, harvest and feeding of both phyto and zooplanktons as live form for larval and young ones of culturable fishes.

L T P C

2 0 0 3

UNIT I

Introduction to Live Feed: Definition, advantages, nutritional value, larval stages and feeding, Habit and habitat of Plankton. (6 L)

UNIT II

Aquaculture importance of Phytoplankton: Isolation, stock culture and outdoor mass culture of phytoplankton, Culture media preparation, Culture methods, Photobioreactors, Harvest and feeding of Phytoplanktons, Life cycle and culture of phytoplankton. (6 L)

UNIT III

Important Phytoplankton in aquaculture: Culture, harvest and feeding of *Chactoceroces sp, Nanochloropsis sp, Tetraselmis sp, Skelonema sp.* (6 L)

UNIT IV

Aquaculture importance of Zooplankton: Isolation and stock culture maintenance, outdoor massculture, different culture systems, Feeding of Zooplanktons, Live feed and inert feed, Harvest, Feeding and preservation of Zooplanktons. (6 L)

UNIT V

Life cycle and culture of Aquaculturally important Zooplanktons: Rotifer, Cyclops, Moina, Daphnia, Paramecium and Artemia. (6 L)

(Total: 30 L)

References

1. Hand book on Ingredients for Aquaculture Feeds, Joachim W. Hertrampf and Felicitas Piedad – Pascual, Kluwen Academy publisher, ISBN: 978-81-8128-919-3, 2008.
2. Live Feeds in Marine Aquaculture, Josianne Slottrup and Lesley Anic Evoy, ISBN: 0632054956, 2003.
3. Live Food in Aquacultre, Atsushi Hagiwara, Springer Science & Business media.
4. Manual on the production and use of Live food for Aquaculture, Patrick Lavens and Patrick Sorgeloos, Laboratory of Aquaculture and Artemia Reference center, University of Ghent, ISBN: 92-5-103934-8, 1996.
5. Live Feed culture, Trainers training Centre, Central Marine Fisheries Research Institute, India, Marine, Fisheries Research Institute, 1998.
6. Algae, Laura Barsanti, Paolo Gualtieri, CRC Press Taylor & Francis Group LLC, ISBN10: 0-8493-1467-4, 2006.
7. Introduction to Marine Plankton, Abhijit Mitra, Kakoli Banerjee, Avijit Gangopadhyay, Daya publishing house, ISBN: 978-81-7035-324-9, 2013.

SEMESTER IV
FUNDAMENTALS OF GENETICS

Objective: To understand the basic phenomenon in genetics and to attain a thorough knowledge on genetic variations and related problems in animals and humans.

L T P C
4 0 0 4

UNIT I

Mendelian inheritance patterns and mendelians laws of heredity. Modification of mendeliasm – complete and incomplete dominance and codominance, complementary, supplementary, lethal genes in man. Interaction of genes Multiple alleles – A, B, O blood groups, Rh factors in man – Erythroblastosis foetalis. Multiple genes (polygenic inharitence) – skin colour in man.

(10 L)

UNIT II

Linkage, crossing-over – Coupling & repulsion – mechanism of meiotic crossing over – chromosome maps – linkage maps – sex determination in Drosophila & Man – Sex chromosomes – sex linked inheritance in man – Haemophilia, Colour blindness, hypertrichosis. Sex influenced genes, sex limited genes. Non disjunction in man – detection of mutation by CLB method.

(10 L)

UNIT III

Human genetics – twins, human chromosomes, karyotypes, ideogram, simple Mendelian traits in man. Inborn errors of metabolism – phenylketonuria, Alkaptyonuria, albinism, sickle cell anaemia, chromosomal abnormalities – autosomal & sex chromosomes – syndromes in man (klinefelter's syndrome ,Tunner's syndrome & down's syndrome) Improvement of human race – Eugenics, Pedigree analysis, Medical genetics – Genetic prognosis – Genetic counceling – family history – Preventive measures – Medico – legal aspects – Effect of drug on human heredity.

(14 L)

UNIT IV

Bacterial genetics – E.coli – Transformation of genetic material in bacteria &bacteriophage, conjucation, transduction, sexduction – genetic applications of bacteria – Identification genetic material – structure, lifecycle of bacteriophages – T4 Phage – recombinations of viruses, genetic applications of viruses, Mutation – Types of mutations – gene mutation – point mutation, chromosomal aberrations – genome mutation – mutagens – Ionising mutagens – Chemical mutagens.

(14 L)

UNIT V

Extra chromosomal inheritance in paramecium – maternal predetermination in coiling of shells. Population genetics – Gene pool concept – Hardy – Weinberg Equilibrium – genes – frequencies in the population- factor affecting gene frequency – selection - mutation – drift & meiotic drive – migration. Animal breeding – Inbreeding and out breeding – heterosis.

(12 L)
(Total: 60 L)

MSU/ 2018-19 / CMST-Integrated M.Sc., Marine Science/ Semester –IV/ Major Practical -4

PRACTICALS - IV (Core 6: Fundamentals of genetics)

1. Observation of simple mendelian traits in man – to be recorded.
2. Breeding experiments : to be illustrated with beads a) Monohybrid and b) Dihybrid – Chisquare test.

3. Observation and study of polygenic inheritance of quantitative trains to be interpreted in graphs.- a. height of the student b. Weight of the student. c. Length of shells. d. Length of pods.
4. Blood group to be analyzed in a population with a minimum of 30 students.
5. Models of genetic significance to be studied – syndromes, sex – linked inheritance (colour blindness, homophelia, hypertrichosis, webbed toes).
6. Life cycle of Drosophila.

REFERENCE BOOKS

1. Strickberger : Genetics (Mac Millian)
2. Farnsworth : Genetics (Harper and Row)
3. P.K. Gupta : Genetics (Rastogi publications)
4. P.S. Verma and Agarwal: Genetics (S. Chandu & Co. Ltd)
5. Altonburg, E. : Genetics (Oxford & IBH Publishing company)
6. Burns G.W. : The science of Genetics. (Mac Millian)
7. A.C. Pai : Fountations of Genetics (McGraw – Hill)
8. J.A. Serra : Modern Genetics (3 volumes)
9. Sinnot, Dunn and Dobzhansky : Principles of Genetics (McGraw - Hill)
10. Gardener : Principles of Genetics.

ALLIED - IV
BOTANY: EMBROYOLOGY, PLANT ANATOMY, PHYSIOLOGY & BIOTECHNOLOGY

Objective: To understand the overall views about the development of embryo in plants, structure, functions and metabolism in plants and also to know about the physio - chemical functioning and technological applications of plants.

L T P C
3 0 0 3

UNIT I

Structure and development of microsporangium; Structure, types and development of megasporangium; Development of male and female gametophyte; Double fertilization; Endosperm – types; structure of dicot embryo. (9 L)

UNIT II

Tissues – simple tissues, complex tissues; primary structure of dicot and monocot dicot and mnocot Root; normal secondary thickening in dicot Stem. (9 L)

UNIT III

Absorption of water – diffusion, osmosis, imbibitions; mechanism of absorption of water Ascent of sap – Cohesion Theory; Transpiration – types, structure of stomata, mechanism of stomatal transpiration (Starch – Sugar Hypothesis); Photosynthesis – structure of chloroplast, importance of photosynthesis, mechanism of photosynthesis – Light and dark reaction (Calvin cycle).

(10 L)

UNIT IV

Algal Biotechnology: Nostoc – morphology, use as biofertilizer and mass cultivation; Fungal Biotechnology: structure and multiplication, Budding and fission of yeast, mass culture and uses.

(9 L)

UNIT V

Tissue Culture – Scope and importance – totipotency, nutrient medium (M.S medium) - Callus culture, meristem culture and their applications.

(8 L)

(Total: 45 L)

MSU/ 2018-19 / CMST-Integrated M.Sc., Marine Science/ Semester –IV/ Allied Practical -4

ALLIED PRACTICAL-IV

BOTANY: EMBROYOLOGY, PLANT ANATOMY, PHYSIOLOGY & BIOTECHNOLOGY

1. Technical description of Plant parts with reference to the families prescribed in the syllabus.
2. Dissection of fioral parts of plants belong to the families prescribed in the syllabus.
3. Make suitable Micro preparations of

a. Dicot stem
b. Monocot stem
c. Dicot root
d. Monocot root
e. Lycopodium stem
f. Pinus needle

4. To identify and to record the medicinal values and morphology of the useful parts of the plants prescribed in the syllabus.
5.To identify the slides showing
i. Mature anther
j. Ovule
k. Dicot embryo
l. Volvox
m. Nostoc
n. Yeast
o. Lycopodium cone L.S and
p. Funaria capsule L.S.

6. To identify the following specimens
a.*Polyporus*
b. *Funaria*
c. *Lycopodium* and
d. *Pinus* –male and female cone.

7. Demonstration experiment
a. Ganong's light screen
b.Bell jar experiment and
c.Suction due to Transpiration

8. Photograph – Callus culture, Meristem culture
9. To maintain a record note book for external and internal evaluation.

REFERENCES

1. Botany. V.Verma, Ane books Pvt Ltd, ISBN: 8190832204, 2010.
2. Falcon Biology. Frederick Pitter, AraspuUpadhyay, Samualhans, Birendra Mohan, Mishra, Ram Kumar and Verma. Choice international Publishers, ISBN: 81- 87659 – 84 – X, Vol: 1
3. Falcon Biology. Frederick Pitter, AraspuUpadhyay, Samualhans, Birendra Mohan, Mishra, Ram Kumar andVerma, Choice international Publishers, ISBN: 81- 87659 – 85 – 8,Vol: 2
4. Microalgae Biotechnology and Microbiology. E.W. Becker, Cambridge University Press, ISBN: 0521350204, 1994.
5. Biotechnology. KeshavTrehan. New Age International Publishers, ISBN: 81 – 224 – 0129 – 5, 1990.
6. Plant Tissue culture. Roberta H. Smith, Academic Press, ISBN: 978 – 0- 12- 415920 4, 20`13.

MSU/ 2018-19 / CMST-Integrated M.Sc., Marine Science/ Semester –IV/ Non-Major Elective -II

NON MAJOR ELECTIVE

VERMITECHNOLOGY

Objective: To reach a thorough knowledge on the physiology and lifecycle of earth worm and also to understand the use of earth worm for the human welfare and to prepare a commercial culture system.

L T P C
2 0 0 3

UNIT I

Earthworm taxonomy- Morphological and anatomical- classification of earthworms- Food habits- Digestive system- excretion- reproduction and life cycle- earthworm as farmer's friend.

(6 L)

UNIT II

Types of earth worms- exotic and native species- South Indian and North Indian species used in vermi composting- collection and preservation of earthworms for vermicomposting- culture techniques of earthworms

(6 L)

UNIT III

Vermicompost production- Requirements- different methods of vermicomposting- Heap method- Pot method and Tray method- Changes during vermicomposting

(6 L)

UNIT IV

Role of earthworms in soil fertility - Use of vermicompost for crop production- use of earthworms in land improvement and land reclamation- Economics of vermicompost and vermiwash production Earthworms as animal feed- Medicinal value of earthworm meal- Role of earthworms in solid waste, sewage and faecal waste management and vermifilters Earthworms as bioreactors.

(6 L)

UNIT V

Interaction of earthworms with other organisms- Influence of chemical; inputs on earthworm activities- Large scale manufacture of vermicompost, Packaging of vermicompost and its marketing- Financial supporting- government and NGO's for vermiculture work.

(6 L)

(Total: 30 L)

REFERENCE BOOKS

1. Invertebrate Zoology – Ekambaranatha Ayyar
2. Earthworm in Agriculture – S.C. Talishakar and Dosani, Agrobios publications, Near Nasarani cinema, Jodhpur- 342002
3. Vermicompost for sustainable Agriculture – P.K. Gupta Agobios 2nd edition.
4. Organic farming for sustainable Agriculture – A.K. Dahama, Agrobios.
5. A hand book of organic farming – A.K. Sharma, Agrobios publication.
6. Earthworm ecology – Clive A Edwards, St.Lucie press – CRC press Washington DC.
7. Biology of Earthworm – Edward and Lofti – Chapman and Hall publication.
8. Vermicology – Sultan A Ismail – Orient Longman press.
9. Vermi Culture Biotechnology – U.S. Bhawalker BERI, PUNE.

(Or)

COMMUNITY AND SOCIAL PREVENTATIVE MEDICINE

Objective: To offer a thorough knowledge on community health which include drug addiction, sexually transmitted diseases, child abuse and old age problems.

L T P C
2 0 0 3

UNIT I

Community and Health

Meaning and concept – Biomedical, Ecological, Psychological, social and holistic. Determinants of health & indicators of health. Concept of community health, Role of primary health centres.

(6 L)

UNIT II

Drug Addition:

In India today – incidence among college students – common drugs in vogue – their side effects, control and management of drug addition

Alcholism

Its effect on various organs like heart, lungs, liver, pancreas, brain and intestine – chronic alcoholism – alcoholic withdrawal syndrome – its control and treatment.

(6 L)

UNIT III

Sexually transmitted diseases

Gonorrhoea – Syphilils – AIDS – causative agent, causes – symptoms – diagnosis – treatment and control measures.

(6 L)

UNIT IV

Child abuse

Definition – causes – effects – legal measure for eradication

(6 L)

UNIT V

Problems of old age

Concept of ageing, Housing and health care of the aged. Problems – Cardiovascular – alimentary – Locomotion and joints – welfare service ;provided to the aged by the Government.

(6 L)

(Total: 30 L)

REFRENCE BOOKS

1. Social Problems in India – Ram Akuja
2. Social Preventive Medicine – Park & Park
3. Ageing and Aged – Paul Chowthry
4. Indian Social Problem – G.R. Madan.

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MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI

Centre for Marine Science and Technology

Common Course Structure for P.G. Programmes of the University Departments

M.Sc., Microbiology

(With effect from the academic year 2017-2018 onwards

Semester	Sub. No.	Subject Status	Subject Title	Course / paper	Hrs./ week	L Hrs/ week	T Hrs/ week	P Hrs/ week	C Credits
I	1	Core -1	Biochemistry		4	4	-	-	4
	2	Core-2	Cell and Molecular Biology		4	4	-	-	4
	3	Core-3	General Microbiology		4	4	-	-	4
	4	Core-4	Microbial physiology & metabolism		4	4	-	-	4
	5	Major Practical - I	Practical: Core -1 & Core-2		4	-	-	4	2
	6	Major Practical –II	Practical: Core -3 & Core-4		4	-	-	4	2
	7	Elective -I	Biostatics & computer application (Or) Aquatic Microbiology		3	3	-	-	3
	8	Elective - II	Bioinformatics (Or) Fish procession & Quality assessment Technology		3	3	-	-	3

			Subtotal		**30**	**22**	**-**	**8**	**26**
II	9	Core -5	Bacteriology & Virology		4	4	-	-	4
	10	Core-6	Mycology & Phycology		4	4	-	-	4
	11	Core-7	Immunology		4	4	-	-	4
	12	Core-8	Microbial Genetics		4	4	-	-	4
	13	Major Practical - III	Practical : Core-5 & core-6		4	-	-	4	2
	14	Major Practical - IV	Practical : Core-7 & core-8		4	-	-	4	2
	15	Elective – III	Food Microbiology (Or) Microbial Genomics & proteomics		3	3	-	-	3
	16	Supportive Course I (EDC)	Marine Microbial Technology (or) Marine Pharmacology		3	3	-	-	3
			Subtotal		**30**	**22**	**-**	**8**	**26**
III	17	Core -9	Recombinant DNA Technology		4	4	-	-	4
	18	Core-10	Bioprocess Technology		4	4	-	-	4
	19	Core-11	Medical Microbiology		4	4	-	-	4
	20	Core-12	Bioremediation		4	4	-	-	4
	21	Practical V	Practical : Core-9 & core-10		4	-	-	4	2
	22	Practical VI	Practical : Core-11 & core-12		4	-	-	4	2

	23	Elective IV	Bioethics & Biosafety (Or) Nano science & Technology		3	3	-	-	3
	24	Supportive course II (EDC)	Applied Marine Biotechnology (Or) Ornamental fish culture		3	3	-	-	3
					30	**22**	**-**	**8**	**26**
IV	25	Project	Project & Viva voce						**12**
		Total credits (Min:90)			**90**	**66**	**-**	**24**	**90**

MSU/2018-19/CMST-M.Sc., Microbiology/Semester-I/Core/Ppr-1

Biochemistry (MMC11) **L T P C**

4 0 0 4

Objective: The objective of this paper is to teach the structure and function of the biomolecules and their molecular nature. This paper also focuses light on the energy cycle, bioenergetics and metabolism of bio molecules.

Unit I : Biomolecules : Carbohydrates – General account - classification and properties ; Proteins – Classification & general properties, Orders of protein structure, Classification of aminoacids ; Lipids – Classification and general properties;

(12 L)

Unit II : Nucleic acids, structure – Composition properties and functions – Types of nucleic acids, Biosynthesis of nucleic acids.

(10 L)

Unit III : Enzymes : Kinetics and inhibition, Naming and classification of enzymes ; Enzymes co-factors, Mechanism of enzyme action, Kinetics of enzyme catalysed reaction – Michaelis – Menten equation, Factors affecting enzyme activity and enzyme inhibition.

Unit IV : Metabolic concepts and bioenergetics : Different terminology of metabolism, metabolic pathways, general pathways, Unifying themes of metabolic pathway – Regulation of metabolic pathway and Evolution of metabolic pathways ; Bioenergetic concept of energy, Thermodynamic principles – Electron transport and oxidative phosphorylation – ATP synthesis.

(14 L)

Unit V : Metabolism of biomolecules : Carbohydrate metabolism – Glycolysis, Pyruvate oxidation and citric acid cycle – Biosynthesis of lipids, oxidation of fatty acids, oxidation of amino acids, Biosynthesis of amino acids and biosynthesis and catabolism of protein.

(12 L)

Total (60 L)

MAJOR PRACTICAL I (Core 1: Biochemistry)

1. Enzyme assay - protease, amylase and lipase.
2. Chromatographic separation of aminoacids and carotenoids
3. Estimation of protein, carbohydrate and lipids.
4. Estimation of cholesterol and triglycerides.
5. Separation of protein by SDS electrophoresis.

References

1. Lehinger Principles of Biochemstry – David L.Nelson, Michael M.COX. Sixth edition, Macmillan 2013.
2. Biochemistry – Jeremy M Beeg, John L Tymoczko, Gregory J Gatto, Lubert stryer 8th edition, WH freeman, 2015.
3. Harpers illustrated Biochemistry – Rodwell, The McGraw-Hill, 13th edition, 2015
4. Outlines of Biochemistry – Eric E. Conn, Paul K. Stumpf, George Bruening, Roy H. Doi, Wiley Science 5th edition, 2006.
5. Biochemistry 21E – Donald Voet and Judith G. Voet. 2011, Fourth edition,

   Wiley Science

MSU/2018-19/CMST-M.Sc., Microbiology/Semester-I/Core/Ppr-2

Cell and molecular biology (MMBC12)

L T P C

4 0 0 4

Objective: The objective of this paper is to teach the organization of cell and its components and functions. It also deals with cell to cell interaction and synthesis of biomolecules. The students who studied this paper will have a thorough knowledge on molecular organization of cells and interaction of biomolecules.

Unit I : Plasma membrane – molecular components of plasma membrane – organization of Molecules – differentiation of cell membrane – cell permeability – functions of cell Membrane. Molecular models – Gap junction – intercellular communication

(12 L)

Unit II : Intracellular components: Endoplasmic reticulum and protein segregation – signal Signal hypothesis, Golgi complex and cell secretion, Lysosome and intracellular Digestion. Ribosomes – prokaryotic and eukaryotic

(12 L)

Unit III : Cell signalling: prokaryotic and eukaryotic cell signalling. Cell surface receptors – G Protein coupled receptors – structure and function, receptors – trypsin kinase and Ras MAP kinase pathway, second messengers – its types and role

(12 L)

Unit IV : DNA: structure – melting of DNA. Replication – Prokaryotic and Eukaryotic Replication. DNA Polymerase – types and properties. DNA damage and repair. Inhibitors of DNA replication. Cell cycle

(12 L)

Unit V : Transcription and Translation: prokaryotic and eukaryotic transcription – maturation And processing of mRNA, tRNA and rRNA; Prokaryotic and Eukaryotic translation Post translational modifications of polypeptide chain; Regulation of gene expression Positive, negative and attenuated regulations (lac operon-trip operon).

(12 L)

Total (60 L)

MAJOR PRACTICAL II (Core 2: Cell and Molecular Biology)

1. Function of plasma membrane (selective permeability)
2. Cell division (mitosis/ meiosis)
3. Analysis of nucleic acids (DNA/RNA)
4. Melting point determination
5. Mutagenesis by physical/chemical agent.
6. Analysis of cell viability by dye exclusion

References

1. Cell and Molecular Biology – E-M.F.De Robertis 2011, 8th Edition Lippincott Williams & Wilkins,
2. Lodish, H., A. Berk, P. Matsudaira, C. A. Kaiser, M. Krieger, M. P. Scott, S. L. Zipursky and J. Darnell, 2012. Molecular Cell Biology. Macmilllan 7th Edition, 5th Edn.
3. Molecular Biology of the gene – James D. Watson et al 7th Edn – CSHL Press 2013
4. Lewin, B., 2004. Genes. Pearson Prentice Hall, 8th Edn.
5. Cell and Molecular Biology – Phillipsheelers, Donald E. WILEY – Third Edition – 2009
6. Gerald karp – Cell Biology, 2013 – 7th Edition

MSU/2018-19/CMST-M.Sc., Microbiology/Semester-I/Core/Ppr-3

General Microbiology (MMBC13) **L T P C**

4 0 0 4

Objective: To teach the basic aspects of microbiology for the non-microbiology students who have come from other biological aspects and create an overall knowledge on microbial world.

Unit I : History and Scope of microbiology – Discovery of microorgnaisms, Spontaneous generation, Role of microorganism in disease, Industrial microbiology and microbial ecology, Scope and relevance of microbiology, Pure culture of microorganisms.

(12 L)

Unit II : Observation of microorganism : Unit of measurement, Microscopy – compound light microscope, Dark field microscope, Phase contrast microscopy, Differential interference

contrast microscopy (DK), preparation of smears for staining, simple stains, Differential stain, Special stains.

(12 L)

Unit III : Characterization, classification and identification of microorganism – Morphological, characteristics, chemical characteristics, cultural characteristics, Metabolic, Antigenic, Genetic, Pathogenecity and Ecological characters – Classification, Nomenclature and Identification. The past and present status of bacterial taxonomy.

(12 L)

Unit IV : Methods in Microbiology: Isolation and cultivation of bacteria and fungi, Sterilization methods, Microbial nutrition, Construction of culture media, Selective media.

(10 L)

Unit V : Functional anatomy of prokaryotic and eukaryotic cells – Structure external to the cell wall, Structure internal to the cell wall – Eukaryotic cells – Flagella and cilia, Cell wall, Cytoplasm and internal organelles. Microorganisms: Fungi – molds and yeasts, algae, protozoa, virus and bacteria, Control of Microorganisms – Physical agents and Chemical agents.

(14 L)

(**Total : 60 L)**

Practical

1. Grams staining.
2. Negative staining.
3. Simple staining.
4. Capsule (Spore) staining.
5. AF staining.
6. Motility of bacteria by Hanging drop method.
7. Biochemical test – IMViC
8. Bacterial growth determination by Spectrophotometer method.
9. Isolation of bacteria from soil and water.
10. Isolation of fungi from soil.

References

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2. Pelczar MJ, Chan ECS and Krieg NR. (2001). Microbiology. 5th edition. McGraw Hill Book Company.
3. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology 5th edition. McMillan.
4. Prescott, Harley and Klein's Willey JM, Sherwood LM, and Woolverton CJ. (2011). Microbiology. 8th edition. McGraw Hill Higher Education

5. Brock Biology of microorganisms -2008 – Madigan et al Pearson International Edition.

MSU/2018-19/CMST-M.Sc., Microbiology/Semester-I/Core/Ppr-4

L T P C

4 0 0 4

Microbial Physiology and Metabolism (MMC14)

Objective: To teach the basis of bioenergetics, Photosynthesis, respiration, assimilation of nitrogen and growth of microbes.

Unit I : Basic aspects of bioenergetics – entropy – enthalpy – electron carries – artificial electron donors – inhibitors – uncouplers – energy bond – phosphorylation.

(10 L)

Unit II : Brief account of photosynthetic and accessory pigments – chlorophyll – bacteriochlorophyll – rhodopsin – carotenoids – phycobiliproteins ; carbohydrates – anabolism – autotrophy – oxygenic – anoxygenic – photosynthesis – autotrophic generation of ATP ; fixation of CO_2 – Calvin cycle – C3, C4 pathway. Chemolithotrophy – Sulphur – iron – hydrogen – nitrogen – oxidations, methanogenesis – luminescence.

(14 L)

Unit III : Respiratory metabolism – Embden MayerHoff pathway – Enter Doudroff pathway – Glyoxalate pathway – Kreb's cycle – Oxidative and substrate level phosphorylation – reverse TCA cycle – gluconeogenesis – Pasteur effect ; fermentation of carbohydrates – homo and heterolactic fermentations.

(14 L)

Unit IV : Assimilation of nitrogen – dinitrogen – nitrate nitrogen – ammonia – synthesis of major amino acids – polyamines ; synthesis of polysaccharides – peptidoglycan – biopolymers as call components – cell division – endospore – structure – properties – germination.

(12 L)

Unit V : Microbial development, sporulation and morphogenesis, hyphae Vs yeast forms and their significance. Multicellular organization of selected microbes, Dormancy.

(10 L)

(**Total: 60L)**

Practical

1. Extraction of chlorophyll from plant leaves.
2. Reduction process of sugar metabolism by Nelson & Somogi method (Reducing sugar).
3. Screening for biopolymer production by bacteria.
4. Factors influencing bacterial growth.

5. Biochemical tests
6. Carbohydrate fermentation.

MSU/2018-19/CMST-M.Sc., Microbiology/Semester-I/Major Practical-1

Practical Covering the fist & second core papers (MMBL11)

Biochemistry: I, II, III, IV & V Units

Cell and Molecular Biology : I, II, III, IV & V Units

MSU/2018-19/CMST-M.Sc., Microbiology/Semester-I/Major Practical-2

Practical covering the third & fourth core papers (MMBL12)

General Microbiology: I, II, III, IV & V Units

Microbial Physiology & metabolism : I, II, III, IV & V Units

References

1. Caldwell, D. R., 1995. Microbial Physiology and metabolism, Brown Publishers.
2. Moat, A. G. and Foster, J. W., 2009, 4th Edition Microbial Physiology, Wiley.
3. Stainer, R. Y., Ingharam, J. L., Whellis, M. L., Painter, P. R., 1986. General Microbiology, Mac Millan Education Ltd., London.
4. Brun, Y. V. and Shimkets, L. J., 2000. Prokaryotic Development, ASM Press.
   Advances in Microbial Physiology –Rober & Poole 2009– Academic Press Elsevier, 56th Edition.

MSU/2018-19/CMST-M.Sc., Microbiology/Semester-I/Elective/Ppr--1

Biostatistics and Computer application (MMBEA)

L T P C

3 0 0 3

Objective: The syllabus is designed to make a thorough understanding on biological sampling and data collection and to teach the interpretation and analysis of data for the development of statistical hypothesis.

Unit I : Statistical Introduction: Definition of statistics-History and growth of statistics – Statistical methods – Types of biological data – populations, samples from populations – Random sampling.

(6 L)

Unit II : Data Interval and representation: Collection, organization and tabulation of data – Diagrammatic representation of data – Types of diagrams – Graphical representation of data.

(8 L)

Unit III : Statistical measures: Measures of Central Tendency- Mean, Median and Mode – Measures of Dispersion and Variability – Range, Dispersion measured with Quartiles, Mean Deviation, Variance and Standard Deviation, Comparison of means and variances.

(9 L)

Unit IV : Statistical Hypothesis and Analysis: Proportion of data – Examples of proportion data – Statistical treatment of proportion of data – Chi Square Test and Goodness of fit – Application of Chi Square Test, Sampling and Hypothesis: One and Two sample hypothesis – Test of Significance, Analysis of Variance: One way and Two way ANOVA classification – Regression and Correlation analysis.

(12 L)

Unit V : Basic computer application: Purpose of computer, types of computer – Hardware and Software – Programming language, Commercial software – Windows, MS Word, Excel, Power point – Statistical packages – Sigma stat, SPSS-Intra and Internet – Email, Website Creation – Database in Biology – Pub Med – Sequence Analysis – Genome and Protein database genome research.

(10 L)

(Total: 45 L)

References

1. Campbell, R. C., 1989. Statistics for Biologists, 3rd Eition Cambridge University Press, New York.
2. Jerrold H.Zar. 2009. Biostatistical Analysis, 5th Edn.Pearson Publi.India
3. A.K. Sharma. 2005. 2nd Edit. Discovery publishing House, India
4. S.B. Bhise. 2011. Text book of Computer Application and Biostatistics. Trinity publishing House, India.
5. Fundamentals of statistics – S.C. Gupta, 2016 – Himalaya Publishing House.
6. Choosing and using statistics A biologist- Calvin Dytham – 2011 3rd Edition Guide – Wiley Blackwell.
7. Practical computing for biologist Haddock and Dunn, 2011.

(or)

L T P C

3 0 0 3

Aquatic Microbiology (MMBEB)

Objective: To develop an overall knowledge about the role of microbes in determining the quality of water and factors influencing the composition of microbes in the water. This paper also teaches about the treatment of water using microorganisms as a tool and recombinant microbes on water treatment.

Unit I : Microbiology of water – Biological characteristics of water, Microorganisms in sewage and seawater, saprophytism in stored water, composition of domestic waste water, COD, BOD, total organic carbon content, Transmission of water borne diseases, Indicator Microorganisms.

(10 L)

Unit II : Water and waste water disinfection – factors influencing disinfection, type of disinfectants, their mode of action, toxicology.

(6 L)

Unit III : Activated sludge process – biology of sludge, nutrient removal, pathogen removal, bulking, foaming, biofilm reactors, waste stabilization ponds. Sludge processing – screening, thickening, dewatering, conditions, stabilization, composting. Anaerobic digestion of waste water and sludge. Biological aerosols and bio-odours from waste water treatment plants and their control.

(11 L)

Unit IV : Drinking water treatment – storage, prechlorination, coagulation, water softening, filtration, activated carbon treatment, biological treatment, disinfection. Water distribution system – biofilm formation, problems caused by biofilms. Other biological problems associated with water treatment and distribution. Home devices for water treatment.

(10 L)

Unit V : Biotechnological application in waste treatment – Bioagumentation, use of enzyme, use of immobilized cells, biosensors, application of recombinant DNA technology for waste water reuse.

(8 L)

(Total: 45 L)

References

1. Waste water Microbiology, Ed. By Gabriel Bitton, Wiley – Liss Publ., 1994.
2. Microbiology Fundamental and Applications, Sixth Edn., S. S. Purohit, Agrobios Publishers, 2000.
3. Encyclopedia of Environmental water pollution, Vol. 1 – 3, Ed. By G. R. Chatwall, Anmol Publications Pvt. Ltd., New Delhi, 2003.
4. Aquatic Microbiology – Methoda , Fourth edition, Ed. By Gerhard Rheinheimer, 1986
5. Environmental Microbiology-Methods and Protocols, Second edition, Eds. Ian T Paulsen, Andrews J. Holmes, 2013

Bioinformatics (MMBEE) **L T P C**

3 0 0 3

Objective: To develop a thorough knowledge on bio information through internet referring data base for information, predication of bio molecule structure, genetical analysis using data base gene predication, identification of genus and study on genomic and proteomics.

Unit I : Introduction to Bioinformatics : Definition and History of Bioinformatics, Internet and Bioinformatics, Information Networks, EMBnet-, Intranet and Internet Packages, Basics, WWW, HTML, URLs Browsers, Applications of Bioinformatics, DNA sequence Databases, Protein Sequence Databases.

(8 L)

Unit II : Proteins : Principles of protein structure; anatomy of proteins – Hierarchial organization of protein structure – Primary, secondary, super-secondary, tertiary and quaternary structure, protein sequence motif and Domain Databases, Ramachandran Map, Prediction of protein structure, Secondary structure prediction methods, Prediction of 3D structures, Homology modelling, Visualization of protein structures using Rasmol, SPDBV Viewer.

(10 L)

Unit III : Basic concepts of sequence similarity, pair-wise sequence alignments, Needleman & Wuncsh, Smith & Waterman algorithms, Scoring matrices, PAM and BLOSUM Matrices, BLAST and FASTA algorithm, Multiple sequence alignments (MSA), Importance of MSA, Clustal W and Phylip Definition and description of phylogenetic trees and various types of trees, Methods and programs for Phylogenetic tree construction.

(10 L)

Unit IV : Prediction of Genes, Gene prediction in prokaryotes and eukaryotes, promoters, splice sites, regulatory regions, Comparative genomics, functional genomics, DNA microarray, Basic concepts on identification of disease genes, OMIM database, Pharmacogenomics, Identification of SNPs, SNPs databases (DbSNP), Metabolic pathways, databases such as KEGG, EMP.

(9 L)

Unit V : Introduction to proteomics, Steps in Proteomics Research, Two-Dimensional Gel Electrophoresis, Mass Spectrometry, MALDI, ESI, Protein identification and characterization strategies, 2D Gel maps, Applications of proteomics, Proteomics in Disease Diagnosis, Protein arrays – basic principles, Drug Designing, Drug Designing approaches, Chemoinformatics.

(8 L)

(Total:45)

References

1. Attwood, T. K. and D. J. Parry-Smith, Introduction to Bioinformatics, Pearson Education Ltd., New Delhi, 2004.
2. Arthur, M. Lesk, Introduction to Bionformatics, Oxford University Press, New Delhi, 2003.
3. Higgins, D. and W. Taylor, Bioinformatics – Sequences, Structure and Databanks, Oxford University Press, New Delhi, 2000.
4. A. Baxevanis and B. F. Quellette, Bioinformatics : A practical guide to the Analysis of Genes and proteins, Wiley-Interscience, Hoboken, NJ, 1998.
5. S. R. Swindell, R. R. Miller and G. S. A. Myers, Internet for the Molecular Biologist, Horizon Scientific Press, Wymondham, UK, 1996.
6. Bioinformatics : Sequence and Genome Analysis by Mount, David, New York, Cold Spring Harbour Laboratory Press, 2004.
7. Current Protocols in Bioinformatics by Baxevanis, A. D., Davison, D. B., Page, R. D. M. and Petsko, G. A., New York, John Wiley & Sons Inc., 2004.
8. Introduction to Protein Structure by Branden, Carl & Tooze, John, Garland Publishing, 1991.
9. Molecular Modelling : Principles and Applications by Andrew Leach, Prentice Hall, 2001.
10. An introduction to Chemoinformatics by Andrew R. Leach and Valerie J. Gillet, Kluwer Academic Publishers, 2003.
11. Biological Sequence Analysis : Probabilistic models of proteins and nucleic acids by Durbin R., Eddy, S., Krogh, A. and Mitchison, G. Cambridge University Press, 1998.

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http://www.genome.jp/kegg/

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(or)

Fish Processing and Quality Assessment Technology (MMBEF)

L T P C

3 0 0 3

Objective: To develop a thorough knowledge on methods of fish processing, preparation of value added product from cheap fish product and spoilage of fish during storage and make the student suitable to work in any of the fish processing industry.

Unit I : Biochemistry of fish in relation to processing : Proximate chemical composition – inter relationships of constituents – post-mortem changes – quality indices (Total Volatile Nitrogen, Trimethyl amine and amino nitrogen, hypoxanthine, peroxide value, volatile acid number, Thiobarbituric acid value) – biochemistry of fish spoilage.

(8 L)

Unit II : Fundamentals of Bacteriology in Fish Processing Technology and fish handling methods: Bacteriology of fish, water – occurrence of bacteria on fish, its load, its type – microbial spoilage of fish and methods of preservation – microbial hazards in fish and fishery products. Handling of fish in on-board & onshores: Handling of fish – sorting – evisceration and removal of gills, ice and icing method, fish holds, containers, cleaning and disinfection – personal hygiene and HACCP.

(9 L)

Unit III : Freezing and canning methods of preservation of finfish and shell fish : Methods of freezing – types of Freezers – Freezing in liquid refrigerants, changes during freezing and storage of fish, Physical changes during freezing. Glazing of frozen fish and frozen products, IQF methods and IQF products. Canning methods: Introduction – outline of canning operation methods – Spoilage in canned foods – Application of canning in individual fishery products – Problems encountered in canned products – Canning machineries and their applications.

(10 L)

Unit IV : Curing and smoking methods of finfish and shellfish: Introduction – salting – halophilic – halotolerant and halophobic bacteria – Quality of salts and their effects on the products – salting and drying methods – different types of driers – curing methods – package of cured products (Spoilage in cured products, spoilage in salted fish, quality standards for cured products). Nature and chemical composition of smoke- bacterial properties of smoked fish – hard smoking –smoke process – cold smoking methods – Electrostatic methods – smoking fluids – Marinating. (9 L)

Unit V : By products and value added products from fish: Fish meal – manufacturing process – fish silage – oil production (body oils and liver oils) and their industrial utilization – fish mass, fins and leather – shrimp waste (Chitin, chitosan and glucosamine), a diversified food

products (FPC:Fish protein concentrate) – fish soup powder – fish chowder – fish balls – fish curry - Beche-de-mer – fish hydrolysate – preparation of enzymes (fish enzymes) – Fish pickle preparation – bacteriological peptone – fish stick – fish fingers – fish batters – Ready to eat products – Extruded products such as surimi based products and fermented fish products.

(9 L)

(Total: 45 L)

References

1. Flrnownlee, K. A., Industrial Experimentation – Chemical Publishing Co., New York.,1989
2. Karamer, K., Fundamentals of quality control for the twigg a food industry. The AVI Publishing Co. Inc., West Port – Connecticut, 1970
3. F. Shahidi and J. R. Botta, Sea Food Chemistry, Processing technology and quality – Black Academic and Professional, London,2008
4. Quality control in fish processing – CIFT Manual, Cochin, 1979.
5. Winton, D.L. and K. B. Winton, Fish and fish products, Allied Scientific Publ., New Delhi.1999
6. Joe M. Regenstein and Carrie M. Regenstein, Introduction of Fish Technology, Van Nostrand Reinhold Publ., New York. 1991
7. George A. Rounsefell, Fishery Science its methods and application, Allied Scientific Publ., New Delhi. 1986
8. Seafood Recipes. MPEDA Publications, Cochin, 1993.
9. Fish processing, Quality control and Marketing, MPEDA Publication, Cochin, 1993.
10. Pau, L. F. and R. Olafesson, F ish quality control by Computer vision, Marcel Dekker Inc., New York.1991

MSU/2018-19/CMST-M.Sc., Microbiology/Semester-II/Core/Ppr-5

Bacteriology and Virology (MMBC21)

L T P C

4 0 0 4

Objective: To give a thorough knowledge on basic and advance aspects of Bacteria and virus. such as morphology, ultra structure, components of bacterial cell, classification and nomenclature of both Bacteria and virus and culture of virus.

Unit I : Morphology and ultra structure of bacteria – morphological types – cell walls of archaebacteria – Gram negative – Gram positive, Eubacteria – Eukaryotes, L forms – Cell walls Synthesis, antigenic properties – capsule – types, composition and function, cell membranes – structure – composition, properties. Structure and function of flagella – cilia – pili – gas vesicles – chromosomes.

(12 L)

Unit II : Classification of microorganisms – Introduction – Haeckel's three kingdom concept – Whitaker's five kingdom concept – three domain concept of Carl Woese, Basis of microbial classification – Classification and salient features of bacteria according to the Bergey's Manual of Determinative Bacteriology, Cyanobacteria, Prochlorons and Cyanelles.

(12 L)

Unit III : Classification and nomenclature of plants and animal viruses effects of viruses on plants ; appearance of plants ; histology ; physiology, biology of plants ; common virus diseases of plants ; paddy, cotton, tomato and sugarcane ; viruses of bacteria, algae, fungi, life style ; type species of plant viruses like TMV, Cauliflower, Mosaic viruses and viruses X ; transmission of plant viruses with vectors (insects, nematodes, fungi) and without vectors, seed and pollens, epidemiology, life cycle, pathogenicity, diagnosis, prevention and treatment of RNA viruses, Picorna, ortho myxo, Paramyxo, Toga and other arthropod viruses, Rhabdo, Rota, HIV and other oncogenic viruses ; DNA viruses ; Pox virus, Herps, Adeno, SV40 ; Hepatitis viruses.

(14 L)

Unit IV : Bacteriophage structural organization ; life cycle ; one step growth curve ; transcription ; DNA Replication ; phbase, phage production ; burst size ; lysogenic cycle ; bacteriophage typing ; application in bacterial genetics ; details on M13, Mu, T3, T4 and Lambda P1.

(10 L)

Unit V : Cultivation of viruses in embryonated eggs, experimental animals and cell cultures, primary and secondary cultures, suspension cell cultures and monolayer cell culture ; cell strains, cell lines and transgenic systems of viruses – physical and chemical methods (protein, nucleic acid, radioactive, electron microscopy) – infectivity assay (Plaque method, end point method) – infectivity assay of viruses.

(12 L)

(Total:60 L)

Practical

1. Isolation of bacteriophage (coli phage) from seawater sample.
2. Cultivation of virus in chick embryo.
3. Isolation of TMV virus from injected tobacco leaf.
4. Isolation of CMV virus from infected cauliflower.

References

1. Morg, C. and Timbury, M. C., 1994. Medical Virology – 10th Edn., Churchil Livingston, London.
2. Dimmock, N. J. and Primrose, S. B., 1994. Introduction of Modern Virology. 4th Edn., Blackwell Scientific Publications, Oxford.
3. Corat, H. F., Kimball, P. C. and Levy, J. A., 1994. Virology, 3rd Edn., Blackwell Scientific Publications, Oxford.
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6. Lennetter, E. H., 1984. Diagnostic procedures for viral and Rickettsial diseases. American Public Health Association, NY.
7. Williams Hayes, 1985. The genetic of bacteria and their viruses. Blackwell Scientific Publishers, London.
8. A practical guide to clinical virology – 2nd edition – 2002, Haahcim, Pattison & whitley-wiley
9. Virology principles & Applications – 2nd Edition John Carter, 2013. Wiley & saunders
10. Text of Bacteriology – Vinodsingh 2010
11. Bergey's Mannual of Systemic bacteriology

MSU/2018-19/CMST-M.Sc., Microbiology/Semester-II/Core/Ppr-6

Mycology and Phycology (MMBC22) **L T P C**

4 0 0 4

Objective: To make a thorough knowledge on fungi and algae and to know their classification, life cycle, isolation, commercial production of algae and industrial requirement of algae.

Unit I : Historical introduction to Mycology, structure and cell differentiation Division of myxomycota, Acrasiomycetes, Hydromyxomycetes, Myxomycetes, Plasmo-diophoromycetes. Chytridiomycetes, Hypochytridiomycetes, Oomycetes, Zygomycotina – Zygomycetes, . Tricomycetes. Evolutionary tendencies in lower fungi.

(12 L)

Unit II : Ascomycotina – Hemiascomycetes, Plectomycetes, Pyrenomycetes, Discomycetes, Laboulbenomycetes, Loculoascomycetes, Basidiomycotina, Teliomycetes, Hymenomycetes. Deuteromycotina – Hypomycetes, Coelomycetes, Blastomycetes.

(11 L)

Unit III : Heterothalism, sex hormones in fungi ; physiological specialization phylogeny of fungi;Lichens-Classification of Lichens,Habit and habitat and Economic importance. Mycorrhizaectomycorrhia, endomycorrhiza, vesicular arbuscular mycorrhiza. Fungi as insect symbiont. Fungal diseases – systemic and subcutaneous, mycoses, candidiasis, pneumocystis, blastomycoses, deterophytosis.

(14 L)

Unit IV : Isolation of microalgae, commercially important phytoplankton, commercial production of microalgae, photobioreactor, harvesting technology, phytoplankton in aquaculture industry, oil industry and carotenoid industry.

(12 L)

Unit V : Distribution of algae, classification of algae, algal nutrition, algal structure and reproduction. Chlorophyceae, Pheophyceae, Rhodophyceae, Diatoms, Euglenoids, algal ecology and algal biotechnology.

(11 L)

(Total:60 L)

Practical

1. Isolation and identification of microalgae from seawater.
2. Enumeration of algal cells by Haemocytometer method.
3. Isolation of marine fungi from marine environment.
4. Mushroom cultivation technique.
5. Identification of fungal spore by staining.
6. Identification of fungal diseases in selected plants and animals (Etiology).
7. Harvest of microalgal cells by different methods.

References

1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). Introductory Mycology. 4th edition. John and Sons, Inc.
2. Alexopoulos, C. J. and C. W. Mims, 1979. Introduction to Mycology, 3rd Edn., Wiley Eastern Ltd., New Delhi.
3. Gopal Bhattacharya, 2013.Text Book of Mycology. Publisher: Neha Publishers & Distributors
4. Kumar HD. (1990). Introductory Phycology. 2nd edition. Affiliated East Western Press.
5. Mehrotra, R. S. and K. R. Anexia, 1990. An introduction to Mycology, New Age International Publishers.
6. Sreekumar S Microbiology,2015 Phycology, Mycology, Lichenology And Plant Pathology (Pb) ,pp. 789
7. Vashishta BR and Sinha AK. (2008). Fungi. S. Chand and Company Ltd. 10. Vashishta BR. (2005). Algae. 3rd edition. S. Chand and Company Limited, New Delhi.

MSU/2018-19/CMST-M.Sc., Microbiology/Semester-II/Core/Ppr-7

Immunology (MMBC23)) **L T P C**

4 0 0 4

Objective: To teach the fundamental and advance aspects of immunology and to have a thorough understanding on organs and cells involved in immune system, principle and functioning of immune systems, gene level control of immunological cell production, antigen antibody reaction and clinical aspects of immunology.

Unit I : Immunology- fundamental concepts and anatomy : Components of innate and acquired immunity; Phagocytosis; Complement and Inflammatory responses; Organs and cells of the immune system- primary and secondary lymphoid organs and tissues; Haematopoiesis- immune cells; Antigens - immunogens, haptens and super antigens..

(12 L)

Unit II : Immune components and Vaccinology: Lymphokines and cytokines; Immunoglobulins- structure, classes and biological functions; Genetic organization of immunoglobulin genes and generation of antibody diversity; Major Histocompatibility Complex - MHC genes, structure and functions; Immunization practices: Active and passive immunization; Vaccines.

(12 L)

Unit III : Immune effector responses: Humoral immune responses- B cell maturation, activation and differentiation and humoral immune response; Cell mediated immune response- T cell development and activation, mechanism of cell mediated immune response; T-cell and B-cell receptors; Antigen processing and presentation; Antigen recognition; Interaction of T-cell and B-cell; Immunological memory and Immunotolerance.

(12 L)

Unit IV : Antigen-antibody interactions: affinity, avidity, lattice theory; Immuno precipitation and agglutination techniques, immunoelectrophoresis, radio-immunoassay, ELISA, immunoblotting, immunofluorescence, flow cytometry; Monoclonal antibodies and hybridoma technology; CMI techniques- lymphoproliferation assay, Mixed lymphocyte reaction, Cell Cytotoxicity assays, Apoptosis.

(12 L)

Unit V : Clinical Immunology: Immunity to infection: Bacteria, viral and parasitic infections; Hypersensitivity- Type I-IV- detection methods; Autoimmunity- mechanism, types of autoimmune diseases; Transplantation immunology, immunological basis of graft rejection -Tissue matching and immuno suppression; Tumour immunology, cancer and the immune system; Immunodeficiency diseases.

(12 L)

(Total: 60 L)

Practical

1. Identification of lymphoid organs and cells.
2. Preparation of serum, plasma and antigens.
3. Antigen- antibody reaction – Precipitation- ODD/SRID/CID
4. Antigen- antibody reaction – Agglutination- blood grouping/active/passive agglutination
5. Cell viability/cytotoxicity assay
6. Enzyme linked immunosorbant assay –demo

References

1. Immunology 3nd Edn., Kuby, J., 1997. W. H. Freeman and Company, New York.

2. Kuby Immunology, VI edn., Goldsby R.A, Kindt T.J and Osborne B.A., 2006, W. H. Freeman and Company, New York
3. Essentials of Immunology, IV Edn, Roitt, I. M., 2000. Blackwell Science Publishers, London.
4. Fundamental Immunology, VII edn., Paul, 2012. Lippencott Williams & Wilkins, Kluwer

5.Kuby Immunology – Owen, Punt, Stanford, 7th Edition, 2015, Macmillan

6. Lippincott's illustrated Review in Immunology 2008 – Editors – Harvey & change

Kluwer Publications /Lippincottswilliam & Wilkins

MSU/2018-19/CMST-M.Sc., Microbiology/Semester-II/Core/Ppr-8

Microbial Genetics (MMBC24)) **L T P C**

4 0 0 4

Objective: To give an in depth knowledge on basic and advance aspects of microbial genetics of both eukaryotic and prokaryotic organisms.

Unit I : Basics of Microbial Genetics :Gene, Chromosome – prokaryotic & eukaryotic chromosomes, Genome, organisation in prokaryotes and eukaryotes – DNA content law of DNA constancy, & c value paradox – cot curve Mobile elements – Is elements, bacterial transposons, transposon as genetic tools.

(12 L)

Unit II **:** Bacterial Genetics: Bacterial chromosomes, E.coli choromosome structure, circular genetic map, plasmids. Gene transfer mechanisms – Genetics of Conjugation, transformation and transduction. Genetics of Quorum sensing in bacteria.

(12 L)

Unit III : Fungal Gentics: Yeast as a model organism for eukanyotic genetic research – Chromatin structure, genetic recombination and gene regulation. Meiotic & mitotie mapping, gene conversion, heterothallism & mating type Tetrad analysis & linkage detection in Neurospora.

(12 L)

Unit IV : Viral genetics: Structure, genome organisation & replication of bacteriophages – T_7, T_4 – rII locus, ϕ x 174 & M13 Phages. Genetics of Agrobacterium

(10 L)

Unit V : Archael genetics & Gene mapping in Prokaryotes**:** Chromosomes & DNA replication in Archaea. Gene transfer in Archaea. Deletion mapping, complementation, intragenic complementation, heteroduplex mapping, Foot Printing, Chromosome walking and chromosome jumping.

(14 L)

(Total:60 L)

Practical

1. Karyotyping
2. Extraction and quantification of DNA from bacterial cells.
3. Agarose gel electrophoresis.
4. Restriction mapping
5. Transformation of DNA by chemical method – $CaCl_2$ treatment
6. Isolation of mutant strains- drug resistant bacteria

References

1. Principles of Genome Analysis and Genomics – Printose & Twyman, Blackwell publishing company 2003
2. Modern microbial Genetics – Streips & Yasbin, Wiley Publications, 2002, second edition.
3. Molecular genetics of yeast – A practical approach, Johnson, Oxford University press 1994.
4. Microbial Genetics – David Freifelder. 2 edition, Jones and Bartlett Publishers, 2014.
5. Essential fungal genetics – Moore & Frazer. Springer, 2002.
6. Fungal Genetics: Principles and Practice Cees BOS, CRC Press 1996.
7. Archaea – new models for prokaryotic biology – Paul Blum. Caister Academic Press-2008.
8. Fine structure of gene
9. rII locus

MSU/2018-19/CMST/M.Sc., Microbiology/Semester-II/Major Pratical -3

Practical Covering the fifth & sixth core papers (MMBL21)

Bacteriology & Virology: I, II, III, IV & V Units

Mycology and Phycology : I, II, III, IV & V Units

MSU/2018-19/CMST-M.Sc., Microbiology/Semester-II/Major Practical-4

Practical covering the seventh & eighty core papers (MMBL22)

Immunology: I, II, III, IV & V Units

Microbial Genetics : I, II, III, IV & V Units

MSU/2018-19/CMST/M.Sc., Microbiology/Semester-II/Elective -3

Food Microbiology (LMBEC) **L T P C**

3 0 0 3

Objective: To create a full understanding about the role of microbes for food production and spoilage and also to give a clear knowledge on food borne infection and intoxication, food fermentation, industrial production of enzyme, alcohol and amino acids.

Unit I : Food as substrate for microorganisms: Microorganisms important in food microbiology – molds, yeasts and bacteria – general characteristics – classification and importance. Principles of food preservation: Asepsis – removal of microorganisms (anaerobic conditions, high temperature, low temperature & drying). Factors influencing microbial growth in food: extrinsic and intrinsic factors- chemical preservatives and food additives-Canning, processing for heat treatment-D and F values.

(10 L)

Unit II : Contamination and spoilage: Contamination, preservation and spoilage of Cereals & its products, sugar and its products, vegetables & fruits and their products, meat and its products. Milk and its products, Fish and seafood's and their products; Poultry and its products–spoilage of canned foods-Detection of spoilage and characterization.

(8 L)

Unit III : Food borne infection and intoxications : Bacterial and non-bacterial with examples of infective and toxic types – Brucella, Bacillus, Clostridium, E. coli, Salmonella, Shigella, Staphylococcus, Vibrio, Yersinia, Nematodes, Protozoa, algae, fungi and viruses. Food borne outbreaks – laboratory testing procedures; prevention measures – food control agencies and their regulations, Sanitation – Employee's Health standards – waste treatment & disposal and their types.

(11 L)

Unit IV : Food fermentation: Experimental and industrial production methods of bread, cheese, vinegar and fermented dairy products . Spoilage and defects of fermented dairy products – Oriental fermented food products- their quality standards and control.

(8 L)

Unit V : Food produced by microbes: Fermented foods, microbial cells as food (Single cell protein), mushroom cultivation. Bioconversions – production of alcohol – fermented beverages (beer and wine). Industrial enzymes production (amylases, proteases, and cellulases); Amino acid production (glutamic acid and lysine).

(8 L)

(Total: 45)

References

1. Adams, M. R. and Moss, M. O., 1995. Food Microbiology. Royal Society of Chemistry Publication, Cambridge.
2. Frazier, W. C. and Westhoff, D. C., 1998. Food Microbiology. Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
3. Stanbury, P. F., Whitekar, A. and Hall, S. J., 1995. Principles of fermentation technology, 2nd Edn., Pergamon Press.
4. Banwart, G. J., 1989. Basic Food Microbiology. CBS Publishers and Distributors, Delhi.
5. Hobbs, B. C. and Roberts, D., 1993. Food poisoning and food hygiene. Edward Arnold (A division of Hodder and Stoughton), London.
6. Robinson, R. K., 1990. Dairy Microbiology. Elsevier Applied Science, London

(or)

Microbial Genomics and Proteomics (MMBED)) **L T P C**

3 0 0 3

Objective: This paper is dealt with genetic engineering and gives fundamental knowledge on genetic techniques and its uses in the various fields of microbiology.

Unit I : Molecular nature of mutation, mutagens. Gene transfer mechanisms –transformation, transduction, conjugation and transfection. Mechanisms and applications. Genetics analysis of microbes, Bacteria and yeast.

(8 L)

Unit II : Plasmid, F-factors description and their uses in genetic analysis. Colicins and col factors. Plasmids as vectors for gene cloning. Replication of selected plasmids ; compatibility. Transposons and their use in genetic analysis.

(10 L)

Unit III : Core techniques and essential enzymes used in rDNA technology, Restriction digestion, ligation. (7 L)

Unit IV : Cloning vectors – plasmids, phages and cosmids. Cloning strategies. Cloning and selection of individual genes, gene libraries; cDNA and genome libraries. Principles, methods and application of PCR, RT-PCR, Nested PCR.

(10 L)

Unit V : DNA sequencing methods; dideoxy and chemical method. Sequence analysis, Automated sequencing. Genome sequencing and physical mapping of genomes. Single cell genomics shot gun cloning. Transgenic plants, Development and use of transgenic animals.

(10 L)

(Total :45 L)

References

1. Microbial Genetics, Maloy et al., 1994. Jones and Barlet Publishers.

2. Molecular Genetics of bacteria. J. W. Dale, 1994. John Wiley and Stones.

3. .Modern Microbial Genetics, 1991. Streips and Yasbin, Niley Ltd.

4. Principles of Gene Manipulation, 1994. Old and Primrose. Blackwell Scientific Publications.

5. Molecular Cloning, Vol. 3, Sambrose and Russell, 2000, CSH Press.

6. Genome analysis. Vol. 4, 2002, CSH Press.

MSU/2018-19/CMST/M.Sc., Microbiology/Semester-II/supportive Course/Ppr -1

MARINE MICROBIAL TECHNOLOGY) L T P C

3 0 0 3

Objective: This paper explains various microbial technologies which are widely used in disease control, marine industry, micro algal production, pro-biotics and halo bacterial technology.

I Unit

Gene technology for disease control:

Vaccine: Different type of vaccines in microbial control; antiviral immunity and immunogenic proteins in aquatic important pathogens. Transgenic fish: development of transgenic fish and shrimp by gene transfer technology. RNA interference: principle and application of ds RNA, si RNA, mi RNA etc in microbial control.

(10 L)

II – Unit

Marine microbes for industry:

Isolation preservation and maintenance of industrially important microbes from marine environment – A general review of primary and secondary metabolites production – SCP Production – basic concept of industrial production of alcohol, organic solvents, antibiotics, amino acids, and Enzymes by marine microbes. (10 L)

III Unit

Microalgal production Technology:

Culture system-photobioreacter, Harvesting of Biomass, Bio fuel production- fats, oils, and hydrocarbons: carotenoid production, Microalgae for Aquaculture, Microalgae for waste water treatments and Genetic engineering of Microalgae.

(9 L)

IV –Unit

Probotics:

Definition-characteristics of probiotics: Probiotic microbes-production and characterization of probotics-mode of action of probiotics in fish nutrution larval rearing. Immune modulation and disease management.

(8 L)

V Unit

Halobactrial Technology:

Definition-classification – Ecology – structure and functions of complex *Halobacterium salinorum* – Biotechnological potentials of Halobacterium – important products and their uses – Role of halobacteria in salt purification. (8 L)

(Total:45)

References:

1.Methods in molecular Biology, Vol.265-RNA interference Editing and modification – jonatha.M.GOTT

2.Text book of Industrial Microbiology, A.H. PATEL

3.A text book of introduction to microbiology and Biotechnology

4.A text book of marine natural products 2002 – Peter Marian, J.A.C . John G.Immanuel & M. Michael Babu, M.S. University

5.Micro algal Biotechnology, Edited by Michael A. Borowitzka and Laglay J. Borowitzka University of Cambridge, press, new York U.S.A.

(Or)

MARINE PHARMACOLOGY)

Marine Pharmacology is one of the most rapidly expanding and attractive area of research for biologists, chemists and pharmasists. This syllabus is framed so as to enable the students to know the efficacy and specificity of the different classes of drugs available from marine resource. This paper will also provides information on isolation, mode of action, applications of marine drugs in human/fish disease management and also the development of novel marine drugs. The patent laws and IPR are also focused.

L T P C

3 0 0 3

Objective: This paper is framed to know the efficacy and specificity of the different classes of drugs available from marine resources. It also provides information on isolation, mode of action and application of marine drugs in human and fish disease management.

Unit.I : Terms and definitions – Pharmacokinetics – ADMET Properties, Bioavailability. Pharmacodynamics – Dose response relationship, drug receptors.

(9 L)

Unit.II: Biologically active compounds from marine flora, fauna and microbes – Antibacterial antifungal, antiviral, antiparasitic, anti-inflammatory and cytotoxic compounds, anticoagulants and marine toxins.

(9 L)

Unit.III: Biomedical potential of marine natural products – Isolation, structural elucidation and mode of action.

(8 L)

Unit IV : Fish Pharmacological and pharmacodynamic agents : antimicrobial, antiparasitic agents, anesthetics, vaccines, immunostimulants, breeding induction agents, osmoregulators, disinfectants etc.

(10 L)

Unit V : Drug safety – methods of drug administration, antibiotic hazards and biotransformation, ethical issues; IPR and patents.

(9 L)

Reference:

1. Pharmacolgy by Pazdernik, T.L, Kerecsen, L & Shah M.K.
2. Essentials of Medical Pharmacology by Tripathi, K.D.
3. Marine Natural Products – D.S. Bhakuni and D.S. Rawat, Springer
4. Applied Fish Pharmacology – John F.Burka Kluwer Acudemic Press.

MSU/2018-19/CMST/M.Sc., Microbiology/Semester-III/core/Ppr -9

Recombinant DNA Technology (MMBC31) **L T P C**

4 0 0 4

Objective: This paper explains rDNA technology, particularly gene cloning and its techniques. It also explains about various technologies used in the genetic engineering such as gel electrophoresis, polymerase chain reaction, Hybridization techniques, site directed mutagenesis, RFLP, RAPD and chromosome walking, DNA sequencing technologies.

Unit I : ***Gene cloning principles***: Enzymes and Vectors used in rDNA technology; Steps in chimera construction:- isolation of insert and vector, cutting and joining, gene transfer and selection of recombinants.

(12 L)

Unit II : ***Cloning strategies***: Construction of DNA, cDNA and metagenomic libraries; Probe construction and labelling; Cloning in *E. coli, Streptomyces*, Yeast, Baculovirus and higher organisms.

(12 L)

Unit III : ***Expression system***: prokaryotic and eukaryotic expression systems and their application in *E. coli, Streptomyces*, Yeast, Baculovirus and animal hosts.

(12 L)

Unit IV : ***Techniques in genetic engineering***: Gel electrophoresis; Polymerase Chain Reaction; Hybridization techniques; Site directed mutagenesis, RFLP, RAPD and Chromosome walking; DNA sequencing technologies.

(12 L)

Unit V : ***Gene cloning in medicine***: Production of recombinant products-proteins/drugs; Gene therapy; Transgenic and GM organisms- guidelines for rDNA and transgenic research; Safety issues and IPR.

(12 L)

(Total:60 L)

Practical

1. Safety, Reagent preparation and SOP in rDNA lab
2. Plasmid isolation and Restriction analysis
3. Analysis of recombinants- blue & white colony screening
4. PCR analysis of 16s gene
5. Analysis of protein by SDS-PAGE.
6. Demonstration – blotting techniques.

References

1. Concepts in Biotechnology, Balasubramainan, D. *et al*., 1996, University Press.
2. Molecular Cloning, Sambrock and Russell, 2000, CSH Press.
3. PCR Strategies, Innis, M. A., Gelfand, D. H. And Shinskey, J. J., 1995, Academic Press.
4. Principles of Gene manipulation, Blackwell Scientific Publications. 6th edition Primrose, Twyman and Old.
5. Gene Cloning – An Introduction, Brown, T. A., 1995, Chapman & Hall.
6. Biotechnology, Rehn, H. J. and Red, G., 2000, Wiley VCH.
7. Recombinant DNA, Watson J. D, Gilman M. W and Zoller M., 1992, Scientific American Books.
8. Analysis of genes and Genomics – Richard J. Reece John wiley & Sons, Ltd, 2014.

MSU/2018-19/CMST/M.Sc., Microbiology/Semester-III/core/Ppr -10

Bioprocess Technology (MMBC32)) **L T P C**

4 0 0 4

Objective: This paper provides knowledge on different types of microbial technologies and its uses in the area like fermentation, food industries and waste water and solid management. It also explains about immobilization techniques and its uses.

Unit I : Fermentation technology in General: Types of fermentation- surface, submerged solid state, adhesive, batch, continuous and fed batch- principle of chemostat and thermostat. Bioreactors – types, parts and their functions – optimisation conditions, aeration, agitation, foam control, process control equipments.

(12 L)

Unit II : Microbes and fermentation media: Isolation, preservation and maintenance of Industrial important microorganisms- Microbial growth kinetics and microbial death kinetics- Media for industrial fermentation: Source of nutrients, types of media; synthetic and crude media; Advantage and disadvantage- Sterilization: Air and Media sterilization, Types, Advantages and disadvantages.

(14 L)

Unit III : Downstream processing: Introduction, removal of microbial cells and solid matter, foam separation, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, Membrane process. Drying and crystallization- Effluent treatment, BOD, COD and disposal of effluents.

(12 L)

Unit IV : Immobilization technique and Chemical products**:** Whole cell immobilization and their industrial applications- Production of chemicals: Alcohol (ethanol); acids (Citric, acetic and gluconic acids), solvents (glycerol, acetone and butanol), Antibiotics (Penicillin, Streptomycin and Tetracycline); Aminoacids (Lysine and Glutamic acid); Single Cell Protein.

(12 L)

Unit V : Introduction of Food Technology**:** Elementary idea of canning and packing – Sterilization and Pasteurization of food products – Technology of Typical food and food products (bread, cheese & idli) – Basic food preservation techniques.

(10 L)

(Total: 60 L)

Practical

1. Isolation of industrially important microorganisms for microbial processes.
2. Determination of thermal death point (TDP) and thermal death time (TDT) of microorganisms for design of a sterilizer.
3. Comparative studies of ethanol production using different substrates.
4. Microbial production of citric acid using different substrates.
5. Microbial production of antibiotics (Penicillin).
6. Production and estimation of alkaline protease.
7. Use of alginate for cell immobilization.

References

1. Biochemical Engineering, Alba, S., Humphrey, A. E. and Millis, N. F. Univ. of Tokyo Press, Tokyo.1985
2. Introduction to Biochemical engineering, D.G. Rao (2nd edn.). Tata McGraw Hill education ltd., New Delhi, 2010.
3. Biochemical Engineering Fundamentals, Baily, J. E. and Ollis, D. F., Mc Graw Hill Book Co., New York, 2008
4. Bioprocess Technology, Fundamentals and Applications, P.Svenska, KTH, Royal Institute of Technology, Stockholm, 2000.
5. Bioprocess Technology, Anton Moser, Springer-Verlag, Austria, 1988

MSU/2018-19/CMST/M.Sc., Microbiology/Semester-III/core/Ppr -11

Medical Microbiology (MMBC33) **L T P C**

4 0 0 4

Objective: This paper discusses the developments in medical microbiology, study of disease causing microorganisms, its mode of action, classification, general characters and techniques used to control microorganism in laboratory.

Unit I : Historical events and developments in medical microbiology, Medically important microbes – Bacteria, fungi,algae and virus and Parasites. Normal microflora of human body, role of resistant flora in human. Nosocomal infection, common types of hospital infections and their diagnosis and control.

(12 L)

Unit II : Establishment, spreading, tissue damage and anti phagocytic factors; mechanism of bacterial adhesion, colonization and invasion of mucus membranes of respiratory, enteric and urogenital tracts. Role of aggressions, depolymerising enzymes, organotrophism, variation and virulence. (12 L)

Unit III : Classificaton of pathogenic bacteria. Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Corynebacterium, Bacillus, Clostridium, non-sporing anaerobes, organisms belonging to Enterobacteriaceae. Vibrios, Non-fermenting Gram negative Bacilli, Yersinia ; Haemophilus ; Bordetella. Brucella ; Mycobacterium, Spirochaetes, Actinomycetes ; Rickettsiae, Chlamdiae.

(12 L)

Unit IV : General properties of viruses ; Virus hot interactions ; Pox viruses ; Adenoviruses ; Picarno viruses ; Orthomyxoviruses ; Arboviruses ; Rhabdoviruses ; Hepatitis viruses ; Oncogenic viruses ; Human Immuno Deficiency Viruses (AIDS). Dermatophytes, Dimorphic fungi, Opportunistic fungal pathogens. Description and classification of pathogenic fungi and their laboratory diagnosis.

(12 L)

Unit V : Laboratory control of antimicrobial therapy; various methods of drug susceptibility testing, antibiotic assay in body fluids. Brief account on available vaccines and schedules; Passive prophylactic measures; Medically impartant parasites – disease diagnosis, control & Prevention. Protozoan disease, Nematode diseases.

(12 L)

(Total: 60 L)

Practical

1. Isolation and identification of Normal flora of skin.
2. Isolation and identification of Streptococci from teeth.
3. Serological test (WIDAL).
4. Antimicrobial sensitivity test by Kirby – Baur method.

References

1. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.
2. Baron, E. J., Perterson, L. R. and Finegold, S. M. Mosby, (1990). Bailey and Scott's Diagnostic Microbiology
3. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
4. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
5. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Centuary-Crofts publication.
6. Mackie and McCarney (1996). Medical Microbiology, Vol. I, Microbial Infection, Vol. 2, Practical Medical Microbiology, Churchill Livingstone,
7. Shanson, Write, P. S. G., (1982). Microbiology in Clinincal Practice,
8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

MSU/2018-19/CMST/M.Sc., Microbiology/Semester-III/core/Ppr -12

Bioremediation (MMBC34) **L T P C**

4 0 0 4

Objective: To enable the students to know the role of microorganisms in liquid and solid waste management and briefing the treatment strategies used in industries, sanitation and atomic power stations.

Unit I : Bioremediation : *In situ* bioremediation, intrinsic bioremediation, engineered *in situ* remediation and *ex situ* bioremediation, solid phase and slurry phase systems and factors affecting slurry phase system.

(10 L)

Unit II : Industrial wastewater sources and treatment strategies : Introduction and targets, wastewater flow fractions from industrial plant, Wastewater from sanitary and employee facilities, Wastewater from in-plant water preparation, kinds and impacts of wastewater

components, Hazardous substances, Corrosion inducing substances, Typical treatment sequence in a wastewater treatment, plant and wastewater composition and treatment strategies in the food processing industry.

(14 L)

Unit III : Bacterial metabolism in wastewater treatment systems : Decomposition of organic carbon compounds in natural and man made ecosystems, Basic biology, Mass and energy balance of aerobic biopolymer degradation, Mass and energy balance for aerobic and anaerobic glucose respiration and sewage sludge stabilization. General considerations for the choice of aerobic and anaerobic wastewater treatment systems, Anaerobic degradation of carbohydrates in wastewater, protein, neutral fats and lipids.

(14 L)

Unit IV : Activated sludge process : Historical development, Single and two stage processes, single sludge carbon, nitrogen and phosphorus removal, waste water characteristics, removal of organic carbon. Nitrification, denitrification, phosphorus removal, environmental factors, carbon and nitrogen removal process and post denitrification with external organic carbon.

(11 L)

Unit V : Bioremediation of heavy metals, Xenobiotics, Microbial degradation of xenobiotics, Microbial leaching – Microorganisms used in leaching, Chemistry of leaching, Direct, Indirect leaching, Leaching process, Examples of Bioleaching. Genetically modified microorganisms (GMO) in Bioremediation and Environmental concern.

(11 L)

(Total:60 L)

References

1. A text book of Biotechnology – R. C. Dubey, 2001.
2. Environmental Biotechnology – H. J. Jordening and J. Winter, 2005.
3. Environmental Biotechnology – Arvind Kumar, 2004.
4. Recent Advances in Bioremediation and biodegradation, Vol. I & II, Garg, K. L. and K. G. Mukherji, 1993.

MSU/2018-19/CMST/M.Sc., Microbiology/Semester-III/Major Pratical -5

Practical Covering the nineth & tenth core papers (MMBL31)

Recominant DNA Technology: I, II, III, IV & V Units

Bioprocess Technology : I, II, III, IV & V Units

MSU/2018-19/CMST-M.Sc., Microbiology/Semester-III/Major Practical-6

Practical covering the eleventh & twelfth core papers (MMBL32)

Medical Microiology: I, II, III, IV & V Units

Bioremediation:

MSU/2018-19/CMST/M.Sc., Microbiology/Semester-III/Elective/Ppr- 4

Bioethics and Bio safety (LMBEG)) **L T P C**

3 0 0 3

Objective: To teach the principles followed in RDNA technologies. Discussing different norms in lisencing, toxicity, social, novelty testing, composition of patterns, lisencing and cross lisencing.

Unit I : Bio-safety regulation and definitions, national and international guidelines, r-DNA guidelines. Experimental protocol approvals, levels of containment, environmental aspects of biotech applications, degradation of pollutants, Bacterial mining- vaccines- Biological pesticides, use of genetically modified organisms and their release in environment.

(10 L)

Unit III : Bioethics: Definition- ethics- norms in India- Licensing of animal house- norms for conducting studies on human and animal subjects- Ethical clearance. ELSI

(8 L)

Unit IV : Bioethics for Cosmetics and nano materials development-Environmental safety and impact of toxicity- social and ethical issues of nanoparticles- Toxicity related to animal models

(9 L)

Unit V: Definition- conditions for patent ability: Novelty testing- composition of patent- patenting of biotechnological discoveries- commercialization- Biotech companies- Natures implications- screening and selection of genetic materials for patenting- Public attitude- Genetic counselling.

(9 L)

Unit VI : WTO-GATT & TRIPS. Different types of intellectual property rights – patents. Licensing and cross licensing. Plant Breeders right procedure for obtaining Indian patent & International patents.

(9 L)

(Total: 60)

References

1. Biotechnologies and Development, Sasson A, UNESCO Publications, 1988
2. Biotechnologies in developing countries present and future, Sasson A, UNESCO Publications, 1993
3. Laboratory biosafety manual Third edition, World Health Organization Geneva 2004
4. Cartagena Protocol on Biosafety (2006) Ministry of Environment and Forest, Government of India, New Delhi
5. Intellectual property rights on Biotechnology, Singh K, BCIL, New Delhi

(or)

Nano Science and Technology (MMBEH)) **L T P C**

3 0 0 4

Objective: This paper deals with the use of nano technology in the field of biology. It also explains the application of their technology in microscopes, nano biosensor and drug discovery and nano particle used in pollution control.

Unit I : Definition and basics about nanotechnology –– Nanoparticles, Nanomaterials, Nanocrystals, Nanowires, Nanofactories. Top down and bottom up synthesis of Nanoparticles, Properties and Applications of nanoparticles. (8 L)

Unit II : Nanoparticles and nanomaterials characterization techniques – Scanning Electron Microscopy (SEM), Energy dispersive X-ray (EDX), Transmission Electron Microscopy (TEM), Fourier transform infrared spectroscopy (FTIR), Atomic Force Microscopy (AFM), X-ray powder diffraction (XRD), Raman Spectroscopy, UV-Vis spectroscopy, Particle size analyzer. (10 L)

Unit III : Nanoparticles in sensors, Nanobiosensors – Quantum dots – Carbon nanotubes and its applications, Nanometrology, Length mesturement, Nanolithography, Forces measurement – Measurement of single molecules. Fabrication of nanochips, Microfluidics. (9 L)

Unit IV : Nanomedicine in Drug Discovery – Polymer coated Nanoparticles and Liposome coated nanoparticles in Cancer treatment – Nanomedicine in diabetic therapy -Nanocarriers for drug delivery – Nanoparticles for drug delivery to the brain.

(9 L)

Unit V : Nanoparticles in pollution control – Nanoparticles in waste water treatment. – environmental and safety impacts – Toxicity of nanoparticles – Toxicity of CNTs, Fullerens,

Dendrimers, Quantum dots, Risk of explosion – Social and ethical issues of nanotechnology – Economic impacts.

(9 L)

(Total:45)

References

1. Nanotechnology in Environment – Balakrishna Rao, M. and Krishna Reddy, K., Campus Books International, New Delhi.
2. Encyclopedia of Nanotechnology – Arora, M. P., Vol. 5, Discovery Publishing House, New Delhi.
    a. Vol. 1 – Understanding Nanotechnology.
    b. Vol.2 – Prospects of Nanotechnology.
    c. Vol.3 – Emerging Nanotechnology.
    d. Vol.4 – Nanomedicine.
    e. Vol.5 – Molecular Engineering.
3. The Handbook of Nanomedicine. Second Edition, By Kewal K. Jain. Humana Press, Springer publishers.

MSU/2018-19/CMST/M.Sc., Microbiology/Semester-III/Supportive course/Ppr- 2

APPLIED MARINE BIOTECHNOLOGY)

L T P C

3 0 0 3

Objective: To teach the technologies used to produce various marine products and their pre servation. It also teaches about the production of bioactive compounds and marine natural product. It also explains the application of Genetic Engineering in the marine science.

Unit 1 : Marine natural products: Agar agar, Alginate carageenan, Chitin, Chitosan. Marine lipids, marine flavourants, lectins, heparin, carotenoids.

(9 L)

Unit II : Marine Pharmacology: Identification of bioactive compounds containing marine organisms – Extraction of bioactive compounds. Screening, standardization of marine drugs.

(9 L)

Unit III : Industrial fisheries: Fish processing techniques, methods of fish processing Freezing, canning, smoking and value added products – quality control.

(9 L)

Unit IV : Bioremediation and biofouling: Marine pollutants – Bioremediation – CMO in bioremediation – Aquaculture effluent treatment – Biofouling organisms and their control.

(9 L)

Unit V : Aquaculture Biotechnology: Application of Genetic Engineering – Production of transgenic fish – disease diagnosis – Cryopreservation techniques – Broodstock management and larval raring – Feed technology – Prebiotics & probiotics.

(9 L)

(Total:45 L)

References:

1. Marine Natural Products – D.S. Bhakuni and D.S. Rawat
2. Pharmacology by Pazdernisc, T.L, Kereesen, L & Shah, M.K.
3. Quality Control in fish Processing – CIFT maual
4. Fish Processing, Quality control and marketing – MPEDA publication
5. Environmental Biotechnology – Arivndkumar 2004
6. Recent Advances in Bioremediation and Biodegradation Vol.I & II: Garg K.L. & K.G. Mukkerji 1993

(or)

Ornamental fish culture) **L T P C**

3 0 0 3

Objective: This paper gives detailed knowledge on Ornamental Fish culture and explains the scope, application, feeding technique, pond management and disease control. It also teaches about the commercial importance.

Unit.I : Scope, application and importance of ornamental fish culture – Ornamental fish culture economics – Construction and design of aquarium tanks.

(9 L)

Unit.II: Commercially important fresh water ornamental fishes - their biology, breeding and larval rearing techniques.

(9 L)

Unit.III: Feed and feeding strategies in ornamental fish culture – Live feed culture – Daphnia, Tubifix and Chironomid culture – Artificial feed formulation and preparation

(9 L)

Unit.IV: Water quality management in ornamental fish culture – Temperature, dissolved oxygen, pH and ammonia control – Re-circulation system.

(9 L)

Unit.V: Disease management in ornamental fish culture, Bacterial, fungal and virul diseases and their control – Package and Transportation techniques.

(9 L)

(Total: 45 L)

Reference:

1. Aquaculture by T.V.R. Pillai
2. Dictionary of Nutrition and Food technology by J.K. Bhattacharjee
3. Industrial Microbiology by L.E. Casida
4. Aquaculture Nutrition by Michael B. New.

MSU/2018-19/CMST/M.Sc., Microbiology/Semester-IV/Project

Credit: 12

Semester – IV : MMBP41 – Project work

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