HAJEE KARUTHA ROWTHER HOWDIA COLLEGE

(An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai.)
Re-Accredited with A++ Grade by NAAC (3rd Cycle)
Uthamapalayam - 625 533.

DEPARTMENT OF MICROBIOLOGY

PART IV - MICROBIOLOGY

SYLLABUS

Choice Based Credit System – CBCS

(As per TANSCHE)

With

Outcome Based Education (OBE)

(Academic Year 2023 -2026)

Semester - I

Course Category	Course Code	Course Title	Hrs	CIAE	TEE	Max Marks	Credits
Part – IV	23UMBSE11	Social and Preventive Medicine (NME)	2	25	75	100	2
	23UMBFN11	Introduction to Microbial World	2	25	75	100	2

Semester - II

Course Category	Course Code	Course Title	Hrs	CIAE	TEE	Max Marks	Credits
Part – IV	23UMBSE21	Nutrition & Health Hygiene (NME)	2	25	75	100	2
	23UMBSE22	Sericulture	2	25	75	100	2

Semester - III

Course Category	Course Code	Course Title	Hrs	CIAE	TEE	Max Marks	Credits
Part – IV	23UMBSE31	Organic Farming & Bio Fertiliser Technology	1	25	75	100	1
	23UMBSE32	Aquaculture	2	25	75	100	2
Part - V	23UGEVS41	Environmental Studies	1	-	-	-	

Semester - IV

Course Category	Course Code	Course Title	Hrs	CIAE	TEE	Max Marks	Credits
Part – IV	23UMBSE41	Vaccine Technology	2	25	75	100	2
	23UMBSE42	Apiculture	2	25	75	100	2
Part - V	23UGEVS41	Environmental Studies	1	25	75	100	2

Semester - V

Course Category	Course Code	Course Title	Hrs	CIAE	TEE	Max Marks	Credits
Part – IV	23UGVED51	Value Education	2	25	75	100	2
	23UMBIS51	Internship/ Industrial Training	-	-	-	-	2

Semester - VI

Course Category	Course Code	Course Title	Hrs	CIAE	TEE	Max Marks	Credits
Part – IV	23UMBSE61	Microbial Quality Control	2	25	75	100	2

Course Code	Course Title	Category	Credits	Hours	Marks		
					CIAE	TEE	Total
23UMBSE11	SOCIAL AND PREVENTIVE MEDICINE (NME)	NME	2	2	25	75	100

Learning Objectives		
L1	Describe the concepts of health and disease and their social determinants	
L2	Summarize the health management system	
L3	Know about the various health care services	
L4	Outline the goals of preventive medicine	
L5	Gain knowledge about alternate medicine	
UNIT	**Contents**	**No. of Hours**
I	**Introduction to social medicine:** History of social medicine-concepts of health and disease-social Determinants of health and disease-Health and quality of life-Health information system-measures of population health-health policies.	6
II	**Health management:** Applicationsofbehavioralsciencesandpsychologyinhealthmanagement-nutritional programs for health management-water and sanitation in human health-national programs for communicable and non-communicable diseases- environmental and occupational hazards and their control.	6
III	**Health care and services:** Health care of the community-information, education, communication and training in health-maternal & child health-school health services-Geriatrics-care and welfare of the aged- Mental health-health services through general practitioners.	6
IV	**Preventive medicine:** Introduction-role of preventive medicine-levels of prevention-Risk assessment in communities and vulnerable population–surveillance, monitoring and reporting of disease out breaks-forecasting and control measures in community setting–early Detection methods.	6
V	**Prevention through alternate medicine:** Unani, Ayurveda, Homeopathy, Naturopathy systems in Epidemic and pandemic out breaks. International health regulations. Infectious disease outbreak case studies and precautionary response During SARS and MERS corona virus, Ebola and novel SARS-COV2outbreaks.	6
	Total	**30**

Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Identify the health information system	K1,K2,K3,K4
2	Associate various factors with health management system	K1,K2,K3,K4,K5,K6

3	Choose the appropriate health care services	K1,K2,K3,K4,K5,K6
4	Appraise the role of preventive medicine in community setting	K1,K2,K3,K4,K5,K6
5	Recommend the usage of alternate medicine during out breaks	K1,K2,K3,K4,K5
Textbooks		
1	Park.K(2021).Text book of preventive and social medicine, 26thedition. Banarsidas Bhanot publishers.	
2	Mahajan&Gupta(2013).Text book of preventive and social medicine, 4thedition. Jaypee brothers medical publishers.	
3	Chun- SuYuan, EricJ.Bieber, BrentBauer(2006).Text book of Complementary and Alternative Medicine. Second Edition. Routledge publishers.	
4	VivekJain (2020).Review of Preventive and Social Medicine: Including Biostatics.12th edition, Jaypee Brothers Medical Publishers.	
5	Lal Adarsh Pankaj Sunder(2011).Text book of Community Medicine: Preventive and Social Medicine, CBS publisher	
Reference Books		
1.	Howard Waitzkin, Alina Pérez,Matt Anderson(2021).Social Medicine and the coming Transformation. First Edition. Routledge publishers.	
2.	GN Prabhakara(2010).Short Text book of Preventive and Social Medicine. Second Edition. Jaypee publishers.	
3.	Jerry M.Suls,KarinaW.Davidson,RobertM.Kaplan(2010).Hand book of Health Psychology and Behavioral Medicine. Guilford Press.	
4.	Marie Eloïse Muller, Marie Muller, Marthie Bezuidenhout, Karien Jooste(2006).Health Care Service Management. Juta and Company Ltd.	
5.	Geoffrey Rose(2008).Rose's Strategy of Preventive Medicine: The Complete. OUP Oxford.	
Web Resources		
1.	https://www.omicsonline.org/scholarly/social--preventive-medicine-journals-articles-ppts-list.php	
2.	https://www.teacheron.com/online-md_preventive_and_social_medicine-tutors	
3.	https://www.futurelearn.com	
4.	https://www.healthcare-management-degree.net	
5.	https://www.conestogac.on.health-care-administration-and-service-management	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	2	1	3	3
CO 2	3	3	2	2	3
CO 3	3	2	1	2	3
CO 4	3	2	3	3	3
CO 5	3	2	3	1	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	3
CO2	3	2	1	2	3
CO3	3	2	2	2	3
CO4	2	2	1	3	2
CO5	3	2	2	2	1

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Hours	Marks		
					CIAE	TEE	Total
23UMBFN11	INTRODUCTION TO MICROBIAL WORLD	Foundation Course	2	2	25	75	100

Learning Objectives		
L1	Learn the general characteristics of bacteria	
L2	Describe the general characteristics and morphology of fungi.	
L3	Explain the morphology and beneficial aspects of algae.	
L4	Understand the general characteristics of virus	
L5	Learn about beneficial applications of protozoa	
UNIT	**Contents**	**No. of Hours**
I	General features and economic importance of bacteria- General characteristics and morphology of bacteria, mycoplasma, and archae bacteria. Economic importance of bacteria with examples in antibiotic production (*Streptomyces*).	6
II	General features and economic importance of fungi- General characteristics and morphology of fungi, Economic importance of fungi with examples in biopesticide (*Beauveria*), industry (*Saccharomyces*), medicine (*Penicillium*).	6
III	General features and economic importance of algae- General characteristics and morphology of algae. Beneficial aspects of algae with examples in single cell protein (*Spirulina*), soil fertility (*Anabaena*), environment (Phytoplanktons).	6
IV	General features and economic importance of virus- General characteristics of virus. Economic importance of virus with examples in vaccine production (Rubella virus), gene therapy (Adenovirus), biopesticides (Cauliflower mosaic virus).	6
V	General features and economic importance of protozoa- General characteristics of protozoa. Beneficial applications of protozoa with examples – Biocontrol (*Haemogregarina*). Harmful aspects – diseases (, *Giardia*).	6
	Total	**30**

Course Outcomes		Knowledge Level
CO	**On completion of this course, students will**	
1	Study the general features and economic importance of bacteria	K1,K2,K3,K4
2	Gain Knowledge of general features and economic importance of fungi	K1,K2,K3,K4,K5,K6
3	Understand the general features and economic importance of algae	K1,K2,K3,K4,K5,K6
4	Study the general features and economic importance of virus	K1,K2,K3,K4,K5,K6

5	Understand the general features and economic importance of protozoa	K1,K2,K3,K4,K5
Textbooks		
1.	Pelczar. M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7thEdition., McGraw –Hill, New York.	
2.	Dubey, R.C. and Maheswari, D.K. (2005). A Text book of Microbiology. S.Chand &Company Ltd, New Delhi.	
3.	Subba Rao, N.S. (1995). Soil microorganisms and plant growth, Oxford and IBH publishing Co. Pvt. Ltd. New Delhi.	
4.	Stanier, R.Y., Doudoroff, M., and Adelberg, E. A. (1957). The Microbial World. ACS publication. US.	
5.	Boyd, R.F. (1998). General Microbiology, 2nd Edition., Times Mirror, Mosby College Publishing, St Louis.	
Reference Books		
1.	Hurst, C.J., Crawford, R.L., Garland, J.L., Lipson, D.A. and Mills, A.L. (2002). Manual of Environmental Microbiology, 2nd Edition. A. SM Press, New Delhi.	
2.	Atlas, R.A. (1995). Principles of Microbiology. Mosby Publications, USA.	
3.	Madigan, M.T. and Martinko, J.M. (2014). Brock Biology of Microorganisms. 14th Edition. Prentice Hall International Inc., USA	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	2	1	3	2	2
CO 2	1	2	3	2	1	3
CO 3	3	3	2	2	3	2
CO 4	2	2	1	2	3	2
CO 5	2	2	3	1	2	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	2	2
CO2	2	3	2	2	1
CO3	3	2	3	3	2
CO4	2	1	3	2	1
CO5	3	1	2	3	1

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Hours	Marks		
					CIAE	TEE	Total
23UMBSE21	NUTRITION & HEALTH HYGIENE (NME)	NME	2	2	25	75	100

Learning Objectives		
L1	Learn about nutrition and their importance	
L2	Make student understand the nutritional facts for a better life.	
L3	Learn information to optimize our diet	
L4	Impart knowledge on different health care programs taken up by India	
L5	Learn knowledge on different health indicators and types of hygiene methods	
UNIT	**Contents**	**No. of Hours**
I	Nutrition – definition, importance, Good nutrition, and mal nutrition; Balanced Diet: Basics of Meal Planning. Carbohydrates, Lipids, Proteins and Vitamins–functions, dietary sources, effects of deficiency. Macro and micro minerals– functions, effects of deficiency; food sources of Calcium, Potassium, and Sodium; food sources of Iron, Iodine, and Zinc. Importance of water– functions, sources, requirements and effects of deficiency	6
II	Nutrition for Life Cycle: Balanced diet-Normal, Pregnant, lactating women, Infancy, young children Adolescents, Adults, and the Elderly; Diet Chart; Nutritive value of Indian foods.	6
III	Improper diets: Definition, Identification, Signs and Symptoms-malnutrition, under-nutrition, over-nutrition, Protein Energy Malnutrition, obesity; Nutritional Disease and Disorder-hypertension, diabetes, anemia, osteo malacia, cardiovascular disease.	6
IV	Health - Determinants of health, Key Health Indicators, Environment health & Public health; Health-Education: Principles and Strategies. Health Policy & Health Organizations: Health Indicators and National Health Policy of Govt. of India; Functioning of various nutrition and health organizations in India.	6
V	Hygiene–Definition; Personal, Community, Medical and Culinary hygiene; WASH (Water, Sanitation and Hygiene) programme. Rural Community Health: Village health sanitation & Nutritional committee. Community &Personal Hygiene: Environmental Sanitation and Sanitation in Public places.	6
	Total	**30**

Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Learn the importance of nutrition for a healthy life	K1,K2,K3,K4
2	Study the nutrition for lifecycle	K1,K2,K3,K4,K5,K6
3	Know the health care programmes of India	K1,K2,K3,K4,K5,K6
4	Learn the importance of community and personal health	K1,K2,K3,K4,K5,K6

	& Hygiene measures	
5	Create awareness on community health and hygiene	K1,K2,K3,K4,K5
Textbooks		
1.	Bamji, M.S., K.Krishnaswamy &G.N.V. Brahmam (2009)Text book of Human Nutrition (3rd edition) Oxford and IBH Publishing Co.Pvt. Ltd., New Delhi	
2.	Swaminathan (1995) Food & Nutrition (VolI, Second Edition) The Bangalore Printing & Publishing Co Ltd.,,Bangalore	
3.	SK. Haldar (2022). Occupational Health and Hygiene in Industry.CBS Publishers.	
4.	Acharya,SankarKr,RamaDas,MinatiSen(2021).Health Hygiene and Nutrition Perception and Practices.Satish Serial Publishing House	
5.	Dass (2021).Public Health and Hygiene, Notion Press	
Reference Books		
1.	VijayaKhader(2000) Food, nutrition & health, Kalyan Publishers, New Delhi	
2.	Srilakshmi,B.,(2010)Food Science,(5thEdition)New Age International Ltd., New Delhi	
3.	Arvind Kumar Goel(2005).A College Text book of Health & Hygiene, ABD Publishers	
4.	Sharma D.(2015).Text book on Food Science and Human Nutrition. Daya Publishing House.	
5.	Revilla M.K.F.,Titchenal A. and Draper J.(2020).Human Nutrition. University of Hawaii,Mānoa.	
Web Resources		
1.	National Rural Health Scheme: https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=969&lid=49	
2.	National Urban Health Scheme: https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=970&lid=137	
3.	Village health sanitation & Nutritional committee https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=149&lid=225	
4.	Health Impact Assessment-https://www.who.int/hia/about/faq/en/	
5.	Healthy Living https://www.nhp.gov.in/healthylivingViewall	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	2	3	2	2	3
CO 2	3	2	1	2	3
CO 3	3	1	2	3	3
CO 4	2	2	3	1	3
CO 5	2	1	3	2	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	3
CO2	2	2	2	2	3
CO3	2	2	2	2	3
CO4	3	1	3	2	3
CO5	3	2	3	2	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Hours	Marks		
					CIAE	TEE	Total
23UMBSE22	SERICULTURE	SEC	2	2	25	75	100

Learning Objectives		
L1	Acquire knowledge on the concepts of origin, growth and study of Seri culture as science and Scientific approach of mulberry plant.	
L2	Describe the morphology and physiology of silkworm.	
L3	Discuss effective management of silkworm diseases.	
L4	Demonstrate field skills in mulberry cultivation and silk worm rearing with an emphasis on technological aspects.	
L5	Demonstrate entrepreneurship abilities, innovative thinking, planning, and setting up small- Scale enterprises.	
UNIT	**Contents**	**No. of Hours**
I	General introduction to Seri culture, its distribution in India. Botanical distribution and taxonomical characters of mulberry varieties and species. Biology of Mulberry plant and Mulberry crop cultivation and protection.	6
II	Silkworm- biology-morphology of silkworm. Life cycle of silkworm – egg, larva, pupa, and moth.	6
III	**Silkworm pathology:** Introduction to Parasitism, Commensalism, Symbiosis and Parasite relationship - Mulberry Silkworm Diseases: Introduction, types, Pebrine, Grasserie, Muscardine, Flacherie, Symptoms and Pathogens, Mode of Infection, Prevention and Control - Non – mulberry silkworm diseases: Pebrine, Bacterial and viral diseases. Brief Account of Pests and Predators of Silkworms, Nature of damage and control measures.	6
IV	Rearing of silkworm. Cocoon assessmentand processing technologies. Value added products of mulberry and silkworms.	6
V	Entrepreneurship and rural development in sericulture: Planning for EDP, Project formulation, Marketing, Insectary facilities and equipments: Location, building specification, air conditioning and environmental control, furnishings and equipment, sanitation and equipment, subsidiary facilities.	6
	Total	**30**

Course Outcomes		Knowledge Level
CO	**On completion of this course, students will**	
1	Discuss the overall aspects of Sericulture and the biology and varieties of mulberry plant. Creates awareness among students about the economic importance and suitability of Seri culture in Indian conditions.	K1,K2,K3,K4
2	Familiarize with the lifecycle of silkworm.	K1,K2,K3,K4,K5 ,K6

3	Explain common diseases of silk worm encountered during rearing, sources of infection, disease symptoms, pre-disposing factors and their management practices.	K1,K2,K3,K4,K5 ,K6
4	Attain thorough knowledge about the cultivation of mulberry, maintenance of the farm, seed technology, silkworm rearing, post cocoon techniques like stifling, reeling, and utilization of by- products.	K1,K2,K3,K4,K5 ,K6
5	Plan the facilities required for establishment of insectary. Competent to transfer the knowledge and technical skills to the Seri-farmers. Analyze the importance of sericulture in entrepreneurship development and emerge as potential entrepreneur.	K1,K2,K3,K4,K5
Textbooks		
1	Ganga,G. and Sulochana Chetty(2010). Introduction to Sericulture,, J., Oxford and IBH Pub. Co.Pvt.Ltd.,NewDelhi.	
2	Dr.R.K.Rajan & Dr.M.T.Himantharaj (2005). Silkworm Rearing Technology, Central Silk Board, Bangalore.	
3	Dandin S B, Jayant Jayaswal and Giridhar K (2010). Handbook of Sericulture technologies, Central Silk Board, Bangalore.	
4	M.C.Devaiah, K.C.Narayanaswamy and V.G.Maribashetty(2010).Advances in Mulberry Sericulture, CVG Publications, Bangalore	
5	T.V.SatheandJadhav.A.D.(2021). Sericulture and Pest Management, Daya Publishing House.	
Reference Books		
1.	S.Morohoshi(2001).Development Physiology of Silkworms 2nd**E**dition, Oxford & IBH Publishing Co.Pvt.Ltd. NewDelhi	
2.	Hamamura,Y (2001). Silk worm rearing on Artificial Diet. Oxford & IBH publishing Co.,Pvt.Ltd. New Delhi.	
3.	M.Johnson, M.Kesary(2019).Sericulture,5th.Edition.Saras Publications.	
4.	Manisha Bhattacharyya(2019).Economics of Seri culture, Rajesh Publications.	
5.	Muzafar Ahmad Bhat, Suraksha Chanotra, ZafarIqbal Buhroo, Abdul Azizand Mohd. Azam (2020).A Textbook on Entrepreneurship Development Programme in Sericulture, IP Innovative Publication	
Web Resources		
1.	https://egyankosh.ac.in›bitstream	
2.	https://archive.org›details›SericultureHandbook	
3.	https://www.academic.oup.com	
4.	https://www.sericulture.karnataka.gov.in	
5.	https://www.silks.csb.gov.in	

Mapping with Programme Outcomes

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	3	1	3	3
CO 2	2	2	3	2	3	2
CO 3	3	2	1	3	3	2
CO 4	2	1	3	2	2	1
CO 5	3	2	2	2	3	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	2	3
CO2	2	1	3	2	2
CO3	2	1	3	2	2
CO4	3	3	3	3	2
CO5	3	3	2	1	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Hours	Marks		
					CIAE	TEE	Total
23UMBSE31	ORGANIC FARMING & BIOFERTILISER TECHNOLOGY	SEC	1	1	25	75	100

Learning Objectives		
L1	Impart knowledge about the significance of organic farming and strategies to increase the yield to conserve environment.	
L2	To encourage organic farming in urban areas.	
L3	Comprehensive knowledge about bacterial bio fertilizers, its advantages and future perspective.	
L4	Structure and characteristic features of Cyanobacterial and fungal bio fertilizer	
L5	Develop the knowledge and skill to produce, analyze the quality of packaging, storage and assess the shelf life and bio efficacy of bio fertilizers.	
UNIT	**Contents**	**No. of Hours**
I	**Principle of organic farming:** principles of health, fairness, ecological balance, and care. Environmental benefits of organic farming: sustainability - reduces non-renewable energy by decreasing agrochemical need. Biodiversity-crop rotation, inter-cropping. Ecological services – biological control, soil formation and nutrient cycling.	6
II	**Organic farming for urban space;** Create a Sustainable Organic Garden (Backyard - Square Foot Gardening, Small Space Gardening, Mini Farming) Composting, Vermicomposting	6
III	**Biofertilizers:** Introduction, advantages and future perspective. Structure and characteristic features of bacterial biofertilizers - *Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium* and *Frankia*	6
IV	Structure and characteristic features of Cyanobacterial bio fertilizers- *Anabaena, Nostoc;* Structure and characteristic features offungal biofertilizers- AM mycorrhiza	6
V	Production of *Rhizobium, Azotobacter, Anabena* ; Biofertilizers - Storage, shelf life, quality control and marketing	6
	Total	**30**

Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Become an Entrepreneur with wide knowledge about farming and sustainable resources.	K1,K2,K3,K4
2	Implement organic farming in urban areas with knowledge on compost.	K1,K2,K3,K4,K5,K6
3	Gain knowledge about the bacterial biofertilizers and its advantages	K1,K2,K3,K4,K5,K6
4	Understand the significance about Cyanobacterial and fungal biofertilizers	K1,K2,K3,K4,K5,K6
5	Understand and implement the use of bio fertilizers.	K1,K2,K3,K4,K5

Textbooks	
1.	A.K. Sharma (2006). Hand book of Organic Farming
2.	A.C.Gaur (2017). Hand book of Organic Farming and Biofertilizers
3.	N.S. Subbarao (2017). Bio-fertilizers in Agriculture and Forestry (4th Edition) Med tech publisher
4.	SubbaRao, N. S. (2002). Soil Microbiology. Soil Microorganisms and Plant Growth. (4th Edition), Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
5.	Dubey, R. C. (2008). A Textbook of Biotechnology. S. Chand & Co., New Delhi.
Reference Books	
1.	Masanobu Fukuoka, Frances Moore Lappe Wendell Berry (2009). The One-Straw Revolution: An Introduction to Natural Farming, 1st edition, YRB Classics.
2.	SujitChakrabarty(2018). Organic Home Gardening Made Easy, 1st Edition,
3.	Singh and Purohit (2008). Biofertilizer technology. Agrobios, India.
4.	Bansal M (2019). Basics of Organic Farming CBS Publisher.
5.	Hurst, C.J., Crawford R.L., Garland J.L., Lipson D.A., Mills A.L. and Stetzenbach L.D. (2007). Manual of Environmental Microbiology. (3rd Edition). American Society for Microbiology.
Web Resources	
1.	https://agritech.tnau.ac.in/org_farm/orgfarm_introduction.html
2.	https://www.fao.org/organicag/oa-faq/oa-faq6/en/
3.	https://www.india.gov.in/topics/agriculture/organic-farming
4.	https://agriculture.nagaland.gov.in/bio-fertilizer/
5.	https://vlab.amrita.edu/index.php?sub=3&brch=272

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3	3	2	3	2	3	3	3	3	3
CO 2	3	3	3	3	3	2	2	2	3	3
CO 3	3	2	2	3	3	3	3	3	2	3
CO 4	3	3	3	2	3	2	3	3	2	3
CO 5	3	3	3	2	3	3	3	3	3	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	2
CO2	3	3	3	3	3
CO3	3	2	2	3	3
CO4	3	3	3	2	3
CO5	3	3	3	2	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Hours	Marks		
					CIAE	TEE	Total
23UMBSE32	AQUACULTURE	SEC	2	2	25	75	100

Learning Objectives		
L1	Provide a deeper knowledge in aquaculture systems and methods.	
L2	Explain the significance and functions of design, types and construction of aquaculture ponds.	
L3	Demonstrate the biological characteristics of various aquaculture species.	
L4	Discuss the methods involved in post stocking management.	
L5	Illustrate major cultivatable species for aquaculture.	
UNIT	**Contents**	**No. of Hours**
I	Aquaculture Systems and Methods - Scope and definition. Traditional, extensive, semi - intensive and intensive culture. Monoculture, polyculture, composite culture, mixed culture, mono-sex culture, cage culture, pen culture, raft culture, race way culture.	6
II	Aquaculture Engineering - Design and construction of pond, lay-out and design of aquaculture farm, construction, water intake system, drainage system - aeration and aerators. Ponds - Types of ponds.	6
III	Selection of Species - Biological characteristics of aquaculture species; economic and market considerations; seed resources, collection and transportation. Pre-Stocking Management-Sun drying, ploughing / tilling, desilting, liming and fertilization, eradication of weed fishes. Stocking - Acclimatization of seed and release - species combinations - stocking density and ratio.	6
IV	Post Stocking Management - Water and soil quality parameters required for optimum production, control of aquatic weeds and aquatic insects, algal blooms and microorganisms. Food conversion ratio (FCR). Growth - Measurement of growth, length - weight relationship.	6
V	Major cultivable species for aquaculture – Culture of Indian Major Carps. Culture of Giant fresh water prawn, *Macro brachiumrosenbergii* - seed collection formation sources. Hatchery management. Culture of tiger shrimp, *Penaeusmonodon* and *Litopenaeus Vannamei.* Culture of pearl oysters. Culture of sea weeds. Methods of Crab culture. Culture of ornamental fishes. Culture of Molluscs.	6
	Total	**30**

Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Analyze the significance and importance of aquaculture	K1,K2,K3,K4
2	Illustrate the types and construction of aquaculture ponds	K1,K2,K3,K4,K5,K6
3	Analyze the biological characteristics of species and choose the best species for aquaculture.	K1,K2,K3,K4,K5,K6
4	Follow methods involved for optimal growth of	K1,K2,K3,K4,K5,K6

	aquaculture species	
5	Summarize major species suitable for aquaculture in a particular environment	K1,K2,K3,K4,K5
Textbooks		
1.	Santhanam, R. Velayutham, P. Jegatheesan, G. A (2019).Manual of Freshwater Ecology: An Aspect of Fishery Environment. Daya Publishing House, New Delhi.	
2.	Stickney, R.R. (2016). Aquaculture: An Introductory Text. 3rd Edition. Centre for Agriculture and Bioscience International Publishing.	
3.	Ackefors H., Huner J and Konikoff M. (2009). Introduction to the General Principles of Aquaculture. CRC Press.	
4.	Mushlisin Z. A. (2012). Aquaculture. In Tech.	
5.	Akpaniteaku R.C. (2018).Basic Handbook of Fisheries and Aquaculture.AkiNik Publications.	
Reference Books		
1.	Arumugam N. (2014). Aquaculture. Saras Publication.	
2.	Pillay T. V. R. and Kutty M.N. (2005). Aquaculture : Principles and Practices. 2ndEdition. Wiley India Pvt. Ltd.	
3.	Tripathi S. D., Lakra W.S. and Chadha N.K. (2018). Aquaculture in India. Narendra Publishing House.	
4.	Rath R.K.(2011). Fresh Water Aquaculture. 3rdEdition. Scientific Publishers.	
5.	Lucas J. S., Southgate P.C. and Tucker C.S. (2019). Aquaculture: Farming Aquatic Animals and Plants. Wiley Blackwell.	
Web Resources		
1.	Aquaculture: Types, Benefits and Importance (Fish Farming) - Conserve Energy Future (conserve-energy-future.com)	
2.	Fisheries Department - Tamil Nadu (tn.gov.in)	
3.	Aquaculture - Google Books	
4.	aquaculture | Definition, Industry, Farming, Benefits, Types, Facts, & Methods | Britannica	
5.	Fisheries & Aquaculture (investindia.gov.in)	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3	2	3	3	3	2	3	2	3	2
CO 2	2	3	2	3	2	2	3	2	3	1
CO 3	3	3	3	2	3	2	3	2	3	1
CO 4	2	3	2	2	2	2	3	2	3	1
CO 5	3	2	3	2	3	3	3	2	3	1

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	2	3	2	3	2
CO3	3	3	3	2	3
CO4	2	3	2	2	2
CO5	3	2	3	2	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Hours	Marks		
					CIAE	TEE	Total
23UMBSE41	VACCINE TECHNOLOGY	SEC	2	2	25	75	100

Learning Objectives		
L1	To provide knowledge on the basics of immunization and induction of immunity.	
L2	To learn the types of vaccines, its immunological effects and regulatory guidelines.	
L3	To learn the role of rDNA in vaccine technology.	
L4	To provide the knowledge on conventional to recent technology of vaccine production	
L5	To learn about ethical issues and regulations in vaccine production and clinical trials	
UNIT	**Contents**	**No. of Hours**
I	History of vaccination, Active and passive immunization; requirements for induction of immunity, Epitopes, linear and conformational epitopes, characterization and location of APC, MHC and immunogenicity,	6
II	Viral/bacterial/parasite vaccine differences, methods of vaccine preparation – Live, killed, attenuated, sub unit vaccines; Licensed vaccines, Viral Vaccine - Poliovirus vaccine-inactivated & Live, Rabies vaccines, Hepatitis A & B vaccines, Bacterial Vaccine - Anthrax vaccines, Cholera vaccines, Diphtheria toxoid, Parasitic vaccine - Malaria Vaccine.	6
III	Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein-based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines. Recent advances in Malaria, Tuberculosis, HIV.	6
IV	Fundamental research to rational vaccine design. Antigen identification and delivery, T-Cell expression cloning for identification of vaccine targets for intracellular pathogens, Rationale vaccine design based on clinical requirements: Scope of future vaccine strategies.	6
V	Vaccine additives and manufacturing residuals, Regulation and testing of vaccines, Regulation of vaccines in developing countries, Quality control and regulations in vaccine research, Animal testing, Rational design to clinical trials, Large scale production, Commercialization. Vaccine safety ethics and Legal issues.	6
	Total	**30**

Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Explain the significance of critical antigens, immunogens and adjuvants in developing effective vaccines.	K1,K2,K3,K4

2	Understand the types of vaccines.	K1,K2,K3,K4,K5, K6
3	Construct vaccine applying rDNA technology.	K1,K2,K3,K4,K5, K6
4	Formulate the strategies for developing an innovative vaccine technology with different mode of vaccine delivery.	K1,K2,K3,K4,K5, K6
5	Evaluate the regulatory issues and guidelines for the management of vaccine production.	K1,K2,K3,K4,K5
Textbooks		
1.	Ronald W. Ellis.(2001). New Vaccine Technologies. Landes Bioscience.	
2.	Cheryl Barton. (2009). Advances in Vaccine Technology and Delivery. Espicom Business Intelligence.	
3.	Male, David. Ed. (2007). Immunology. 7th Edition. Mosby Publication.	
4.	Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne. (2002). Immunology. 6th Edition, Freeman.	
5.	Brostoff J, Seaddin JK, Male D, Roitt IM. (2002). Clinical Immunology. 6th Edition, Gower Medical Publishing.	
Reference Books		
1.	Stanley A. Plotkin, Walter Orenstein& Paul A. Offit.(2013). Vaccines, 6th Edition. BMA Medical Book Awards Highly Commended in Public Health. Elsevier Publication.	
2.	Coico, R. etal. (2003). Immunology: A Short Course. 5th Edition, Wiley – Liss.	
3.	Parham, Peter.(2005). The Immune System. 2nd Edition, Garland Science.	
4.	Abbas, A.K. etal. (2007). The Cellular and Molecular Immunology. 6th Edition, Sanders / Elsevier.	
5.	Weir, D.M. and Stewart, John (2000). Immunology. 8th Edition, Churchill Pvt. Ltd.	
Web Resources		
1.	https://www.slideshare.net/adammbbs/pathogenesis-3-rd-internal-updated-43458567	
2.	https://www.bio.fiocruz.br/en/images/stories/pdfs/mpti/2013/selecao/vaccine-processtechnology.pdf	
3.	https://www.dcvmn.org/IMG/pdf/ge_healthcare_dcvmn_introduction_to_pd_for_vaccine_ production_29256323aa_10mar2017.pdf	
4.	https://www.sciencedirect.com/science/article/pii/B9780128021743000059	
5.	https://www.researchgate.net/publication/313470959_Vaccine_Scaleup_and_Manufacturing	

Mapping with Programme Outcomes:

CO /PO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	2	3	2	3	2	3	3	1	3	2
CO 2	3	3	3	2	3	3	2	3	2	3
CO 3	2	3	2	3	1	1	3	2	2	2
CO 4	2	2	3	2	2	2	3	3	1	2
CO 5	3	2	1	3	2	3	2	2	3	2

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	3	2
CO2	3	3	3	2	3
CO3	2	3	2	3	1
CO4	2	2	3	2	2
CO5	3	2	1	3	2

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Hours	Marks		
					CIAE	TEE	Total
23UMBSE42	APICULTURE	SEC	2	2	25	75	100

Learning Objectives		
L1	To understand the biology of honey bees.	
L2	To study on honey bee colony establishment.	
L3	To develop knowledge on honey extraction.	
L4	To understand the diseases of honey bees and their control.	
L5	To gain information on financial assistance and funding agencies for bee keeping industry.	
UNIT	**Contents**	**No. of Hours**
I	**Biology of Bees:** Honeybee – Systematic position – Species of Honey bees – Life history of Honey bee – behaviour – swarming – Pheromone.	6
II	**Social life in Bees:** Bee colony – Castes – natural colonies and their yield – Types of bee hives – Structure – location, care and management.	6
III	**Bee Rearing:** Apiary – Care and Management – Artificial bee hives – types – construction of spaceframes – Selection of sites – Handling – Maintenance – Instruments employed in Apiary – Extraction instruments.	6
IV	**Bee Economy:** Honey – Composition – uses – Bee wax and its uses – yield in national and international market – Diseases of honey bees and their control methods. Economics of bee culture.	6
V	**Entrepreneurship:** venture – Preparing proposals for financial assistance and funding agencies – Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens.	6
	Total	**30**

Course Outcomes		Knowledge Level
CO	**On completion of this course, students will**	
1	Understand the systematic position and life history of honey bee.	K1,K2,K3,K4
2	Reveal the different stages and types of bees and discuss about the care and management of apiculture.	K1,K2,K3,K4,K5,K6
3	Describe the practice of bee rearing process and analyze instruments employed in apiary.	K1,K2,K3,K4,K5,K6
4	Compare and contrast the composition of honey and bee wax and interpret the yield in National and International markets.	K1,K2,K3,K4,K5,K6
5	Clarify the proposal for financial assistance and funding agencies and reveal the modern methods employed in artificial bee hives.	K1,K2,K3,K4,K5

Textbooks

1.	Dewey M. Caron. (2013). Honey Bee Biology and Beekeeping. Revised Edition. Wicwas Press, Kalamazoo. ISBN 10: 1878075292
2.	R. A. Morse. (1993). Rearing queen honey bees. Wicwas press, NY. ISBN-10 : 1878075055
3.	Ted Hooper. (2010). Guide to Bees & Honey: The World's Best Selling Guide to Beekeeping. Northern Bee Books. Oxford. ISBN 10: 1904846513
4.	Jayashree K. V., Tharadevi C.S. and Arumugam N. (2014) Apiculture. Saras Publication
5.	Raj H. (2020).Vinesh Text Book of Apiculture. S. Vinesh and Co.
Reference Books	
1.	Dewey M. Caron. (2020). The Complete Bee Handbook: History, Recipes, Beekeeping Basics, and More,Rockridge Press. ISBN-10 : **1646119878**
2.	Joachim Petterson. (2016). Beekeeping: A Handbook on Honey, Hives & Helping the Bees, Weldon Owen.
3.	Eva Crane. (1999). The World History of Beekeeping and Honey Hunting. Routledge. India.ISBN-10 : 0415924677
4.	Pagar B. S. (2016). Textbook Of Apiculture. Sahitya Sagar.
5.	Sehgal P.K. (2018). Text Book of Sericulture, Apiculture and Entomology. Kalayani.
Web Resources	
1.	Bee Keeping Basics. Retrieved from:https://denton.agrilife.org/files/2013/08/beekeeping-basics.pdf
2.	Beekeeping as an Entrepreneurship, Retrieved from: https://lupinepublishers.com/agriculture-journal/pdf/CIACR.MS.ID.000270.pdf
3.	Raising Bumble Bees at Home: A Guide to Getting Started. Retrieved from: https://www.ars.usda.gov/ARSUserFiles/20800500/BumbleBee RearingGuide.pdf
4.	Apiculture – Biology for Everybody (homeomagnet.com)
5.	Apiculture: Introduction to Apiculture (iasri.res.in)

Mapping with Programme Outcomes:

CO /PO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11
CO 1	3	3	3	2	3	3	3	3	3	3	3
CO 2	3	3	2	3	3	2	3	2	2	1	2
CO 3	2	3	3	3	2	2	2	3	1	3	3
CO 4	2	2	2	3	2	3	3	3	2	2	1
CO 5	3	2	1	2	3	3	1	3	3	3	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	3
CO2	3	3	2	3	3
CO3	2	3	3	3	2
CO4	2	2	2	3	2
CO5	3	2	1	2	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Hours	Marks		
					CIAE	TEE	Total
23UMBSE61	MICROBIAL QUALITY CONTROL	SEC	2	2	25	75	100

Learning Objectives		
L1	To understand the use of various advanced techniques for application in the field of quality control and quality assurance.	
L2	To cultivate skills involved execution of microbiological techniques and to develop the good laboratory practices.	
L3	To ensure the food safety regulations and its standards.	
L4	To acquire knowledge on laboratory testing, Control & safety process.	
L5	To analyze microbial standards to establish the quality of food products.	
UNIT	**Contents**	**No. of Hours**
I	**Microbial quality control:** definition, history and introduction. Standard Methods involved in assessment of microbial quality control. Q.A and Q.C definitions and importance. Traditional Microbiological Quality Controlling methods: Sampling methods, TVC, APC and serial dilution techniques. Good laboratory practices, Good microbiological practices.	6
II	**Instruments associated in QC & QA:** Principle involved, working conditions, uses and precautions of Laminar Air Flow (LAF), Autoclave, Incubator, pH meter, Colony counter, Hot air oven, Centrifuges, colorimeter/ spectrophotometer, ELISA and storage devices. Methodology of Disinfection, Autoclaving & Incineration.	6
III	**Culture media used in QC and QA:** Design of specialized media for identification of pathogens. Good laboratory practices in culture media preparation: raw material, water, pH.Uses of media.Enrichment culture technique, Detection of specific microorganisms - on XLD agar, Salmonella Shigella Agar, Mannitol salt agar, EMB agar, McConkey Agar, Saboraud Agar.	6
IV	**Determining Microbes in Pharmaceutical Samples:** Sterility testing for pharmaceutical products, Bioburden, pyrogen test, inprocess and final process control, safety and sterility test.	6
V	**HACCP for Food Safety and Microbial Standards:** Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations. Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water.Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centers.	6
	Total	**30**

Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Understand the theoretical assessment of microbial quality	K1,K2,K3,K4

	methods and its good laboratory practices.	
2	Describe the microbiological aspects of quality control of food and pharmaceutical products.	K1,K2,K3,K4,K5,K6
3	Explain the identification of pathogenic microorganisms and good laboratory practices.	K1,K2,K3,K4,K5,K6
4	Acquire the knowledge of different sterility test for the pharmaceutical products.	K1,K2,K3,K4,K5,K6
5	Illustrate the safety concern management and regulations of food and pharmaceutical industry and learn the basic standard methods and procedures for the microbiological analysis of food.	K1,K2,K3,K4,K5
Textbooks		
1.	W.B.Hugo&A.D.Russell. (1998). Pharmaceutical Microbiology.6thEdition. Blackwell scientific Publications.	
2.	Kulkarni A. K. Bewoor V. A. ()Quality Control,Wiley India Pvt. Ltd,	
3.	Chandrakant Kokare (2016). Pharmaceutical Microbiology, 1st Edition, Nirali Publication.	
4.	Brown.M.R.W. (2017). Microbiological Quality Assurance A Guide Towards Relevance and Reproducibility of Inocula,1st Edition. CRC press.	
5.	Dev Raj Rakesh Sharma And V K Joshi (2011).Quality Control For Value Addition In Food Processing, New India Publishing Agency.	
Reference Books		
1.	Rosamund M. Baird, Norman A. Hodges, Stephen P. Denyer. (2000). Handbook of Microbiological Quality Control in Pharmaceuticals and Medical Devices. 1st Edition, CRC Press.	
2.	Konieczka, (2012). Quality Assurance and Quality Control in the Analytical Chemical Laboratory A Practical Approach (Hb), Routledge, Taylor and Francis group.	
3.	Singh Gajjar, Budhrani, Usman. (2021). Quality Control And Quality Assurance (M.Pharm)SVikas And Company.	
4.	David Roesti, Marcel Goverde (2019). Pharmaceutical Microbiological Quality Assurance and Control: Practical Guide for Non-Sterile Manufacturing, Wiley publication.	
5.	Amihud Kramer Bernard A. Twigg (2017). Quality Control For The Food Industry Fundamentals & Applications (Vol.1) 3rd Edition, MEDTEC publication.	
Web Resources		
1.	https://www.study.com/microbiology-quality-control-testing-definition-procedures.	
2.	https://www.sigmaaldrich.com	
3.	https://www.coursera.org	
4.	https://www.atcc.org	
5.	https://www.fao.org	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	3	2	3	3	3	3
CO 2	3	2	2	2	2	2	3	2
CO 3	3	3	2	3	3	3	3	3
CO 4	2	3	3	3	2	2	3	2
CO 5	3	3	3	2	3	3	3	2

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	2	3	2	3
CO3	2	3	3	3	3
CO4	3	2	3	2	3
CO5	3	3	3	2	3

Strong-3 Medium-2 Low-1