SEMESTER – IV			
Core X : Marine Biology			
Code: 17PBCC41	**Hrs /Week : 6**	**Hrs / Sem: 90**	**Credits : 5**

Objectives

- To make the students realize the potentiality of marine environment
- To understand the marine ecosystem threats and conservation

Unit I Marine Environment – Zonation and Biota

Sea as a biological environment. Classification of marine environment.– Plankton – classification (size, life, habitat) and adaptations. Inter-tidal, rocky, sandy and muddy shores –features of the flora, fauna and adaptations. Role of marine micro-organisms (bacteria and fungi) in nutrient cycles (nitrate, phosphate and sulphate)

Unit II Characteristics of Sea Water

Physical properties: waves, tides, currents- types, causes, and their impact on marine organisms. Illumination, temperature, pressure,. Chemical properties: nutrients, (major, minor, and trace elements), salinity, pH, density, dissolved gases (oxygen, carbon-di-oxide).

Unit III Marine Ecosystems

Estuaries, saltmarshes, mangroves. Coral reef - ecology and types, species interaction, adaptations and importance. Threats and conservation of coastal ecosystems (coral reef and mangroves)

Unit I V Marine Pollution

Sources, effects and control measures of heavy metals, radioactive, oil, and thermal pollutions. Algal blooms-sources and effects. Microbial indicators of pollution. Role of microbes in pollution abatement.

Unit V Wealth of the sea

Living resources: Fishery products- fish meal and fish oil. Natural pearls: formation, ornamental and medicinal importance. Non-living resources: mineral wealth (manganese nodules, beach placers, glauconite and garnet). Bioactive compounds from marine organisms (bacteria, fungi, macro algae and sponges).Phycocolloids: agar-agar and algin.

Books for Reference

1. Tait, R.V. and Dipper F.A (1998) Elements of marine ecology.- 4 the d. British Library Cataloguing in Publication Data.

2. Gross, G., 1993.Oceanography: A view of the Earth. Sixth edition. Prentice Hall Inc., New Jersey.
3. McCormick, J.M. and J.V.Thiruvathaakal, 1976. Elements of Oceanography.W.B. Saunders Company, Philadelphia.
4. Nybakken, J.W. 1997.Marine Biology – An Ecological Approach. Addison Weslay Longman, Inc. California, 477pp.
5. Olivia J.Fernando 1999.Sea water-Properties and dynamics, Dhanesh Publications, Ponnagam,Thanjavur
6. Russel 1970. Marine Ecology, Academic Press- London and New York
7. Nelson and Smith 1973, Oil pollution and Marine Ecology-Plenum press
8. Benjamin- Cummings, Menlo Park, California.Vijaya Ramesh, K. (2004). Environmental Microbiology.MJP Publishers Chennai.
9. Moshrafuddin Ahamed and Basumatary. S.K.(2006). Applied Microbiology. MJP Publishers Chennai
10. Daws, C.J.1981. Marine Botany John Wiley and Sons, New York.

PRACTICALS

Hrs / Week : 2

1. Determination of acidity
2. Determination of salinity
3. Determination of alkalinity
4. Determination of total hardness
5. Determination of nitrite
6. Determination of phosphate
7. Biochemical test for micro-organisms-IMViC
8. Collection and identification of marine plankton (any three phyto and zooplanktons)
9. Identification and remarks of the following

   i. Plankton net

   ii.Inter-tidal organisms

   a. Rocky shore :Sea anemone, *Chiton*

   b. Muddyshore:*Uca, Cerithidia*

   c. Sandy shore: *Arenicola, Murex*

   iii. Food fishes*: Cybium,Sardinella*

   iv Sea weeds: *Gracilaria,Sargassum*,
10. Submission: Record Note Book

SEMESTER IV			
Common core I – Marine Biology			
Code: 17PBCC41	**Hrs/week:6**	**Hrs/Semester : 90**	**Credits: 5**

Objectives

- To make the students realize the potentiality of marine environment
- To understand the marine ecosystem threats and conservation

Unit I **Marine Environment – Zonation and Biota**

Sea as a biological environment. Classification of marine environment.Plankton – classification (size, life, habitat) and adaptations. Inter-tidal, rocky, sandy and muddy shores –features of the flora, fauna and adaptations. Role of marine micro-organisms (bacteria and fungi) in nutrient cycles (nitrate, phosphate and sulphate)

Unit II **Characteristics of Sea Water**

Physical properties: waves, tides, currents- types, causes, and their impact on marine organisms. Illumination, temperature, pressure. Chemical properties: nutrients, (major, minor, and trace elements), salinity, pH, density, dissolved gases (oxygen, carbon-di-oxide).

Unit III **Marine Ecosystems**

Estuaries, salt marshes, mangroves. Coral reef - ecology and types, species interaction, adaptations and importance. Threats and conservation of coastal ecosystems (coral reef and mangroves)

Unit I V **Marine Pollution**

Sources, effects and control measures of heavy metal, radioactive, oil, and thermal pollutions. Algal blooms-sources and effects. Microbial indicators of pollution. Role of microbes in pollution abatement.

Unit V **Wealth of the sea**

Living resources: Fishery products- fish meal and fish oil. Natural pearls: formation, ornamental and medicinal importance. Non-living resources: mineral wealth (manganese nodules, beach placers, glauconite and garnet). Bioactive compounds from marine organisms (bacteria, fungi and macro algae and sponges). Phycocolloids, agar-agar and algin.

Books for Reference

1. Tait, R.V. and Dipper F.A (1998) Elements of marine ecology.-4thed. British Library Cataloguing in Publication Data.
2. Gross, G., 1993.Oceanography: A view of the Earth. Sixth edition. Prentice Hall Inc., New Jersey.
3. McCormick, J.M. and J.V.Thiruvathaakal, 1976. Elements of Oceanography. W.B. Saunders Company, Philadelphia.
4 .Nybakken, J.W. 1997. Marine Biology – An Ecological Approach. Addison Weslay Longman, Inc. California, 477pp.
5. Olivia J.Fernando 1999.Sea water-Properties and dynamics, Dhanesh Publications, Ponnagam,Thanjavur
6. Russel 1970. Marine Ecology, Academic Press- London and New York
7. Nelson and Smith 1973, Oil pollution and Marine Ecology-Plenum press
8. Benjamin- Cummings, Menlo Park, California.Vijaya Ramesh, K. (2004). Environmental Microbiology.MJP Publishers Chennai.
9. MoshrafuddinAhamed and Basumatary. S.K.(2006). Applied Microbiology. MJP Publishers Chennai
10.Daws, C.J.1981. Marine Botany John Wiley and Sons, New York.

PRACTICALS

Hrs / Week : 2

1.Determination of acidity
2 Determination of salinity
3 Determination of alkalinity
4 Determination of total hardness
5. Determination of nitrite
6. Determination of phosphate
7 .Biochemical test for micro-organisms-IMViC
8. Collection and identification of marine plankton (any three phyto and zooplanktons)
9. Identification and remarks of the following
   i. Plankton net
   ii Inter-tidal organisms
      a. Rocky shore :Sea anemone, *Chiton*
      b. Muddy shore:*Uca, Cerithidia*
      c. Sandy shore: *Arenicola, Murex*
   ii.Food fishes*: Cybium,Sardinella*
   iii Sea weeds: *Gracilaria,Sargassum*,
10. Submission: Record Note Book

Semester IV			
Core X – Plant Biotechnology			
Code: 17PBOC41	**Hrs/week:6**	**Hrs/Semester : 90**	**Credits: 5**

Objectives:

- To enumerate the role of 21st century science (biotechnology) in increasing productivity of crop plants and to enhance the production of high value metabolites.
- To develop skill to get employment in biotechnology laboratories and industries.

Unit I: Biotechnology-scope. Principles of plant tissue culture: totipotency, differentiation, dedifferentiation, redifferntiation. Establishment of plant tissue culture lab: equipment, culture vessels, pretreatment of explants. Composition of various tissue culture media and their preparation. Establishing callus: dynamics of callus growth, factors influencing organogenesis, embryogenesis and somatic embryos.

Unit II: Micropropagation: stages of micropropagation, factors affecting shoot multiplication, induction of roots. Synthetic seeds: methods of making synthetic seeds and applications. Production of virus free plants. Somoclonal variation: isolation and characterization of variants -molecular basis and induced mutations, applications and limitations. Cell suspension culture and production of secondary metabolites.

Unit III: Production of haploids (anther, pollen and ovule), detection of haploids - morphology and genetic markers, application of haploids. Protoplast isolation and culture. Protoplast fusion-techniques, selection of fused protoplasts, application. Uses of somatic hybrids and cybrids.

Unit IV Molecular farming **-** Nutritional quality and quality of seed protein. Immuno protective drugs. Gene therapy **–** types of gene therapy, methods of gene therapy, production of antibodies and vaccines, monoclonal antibodies and its application. Biosafety – definition, requirement, biosafety in relation to transgenic research. Intellectual property rights – process of patenting, applications. Farmer's Rights and plant breeder's Rights.

Unit V Biofertilizers: Mass production of *Rhizobium*, *Azospirillum* and Blue Green Algae (BGA), Vesicular Arbuscular Mycorrhizal Fungi (VAM). Single cell protein. Production of antibiotic (Penicillin), organic acid (Citric acid) and vitamin (Vitamin B_{12}). Outline of green synthesis of nanoparticles and their characterization.

Books for Reference:

1. Colin Rattledge and K. Bjon, 2001. Basic biotechnology. Cambridge University
2. Dubey, R.C. 2005. Textbook of Biotechnology. S. Chand & Co. New Delhi
3. George, E.F. and P.D. Sherrington, 1984. Plant propagation by tissue culture. Exegetic Ltd. London.
4. Gupta, P.K. 2000. Elements of Biotechnology. Rastogi publication, Meerut.
5. Kalyan Kumar De. 2004. An Introduction to Plant Tissue Culture. New Central Book Agency, Calcutta.
6. Kumar, H.D. 1993.Molecular biology and Biotechnology. Vikas publishers, New Delhi.
7. Mahesh, 2008. Paddy molecular Biotechnology, New age international, publishers. (p) Limited.
8. Mukhopadhyay S.N, prabhakar Sharma, and Rabindra Narain, 2011. A text book of DNA recombinant technology. Wisdom press. New Delhi.
9. Ramavat, K. G., 2000. Plant Biotechnology, S. Chand & Co., New Delhi
10. Reinort, J and M.M. Yeoman, 1983. Plant cell and tissue culture. Narosa publishing house Delhi.
11. Satyanarayana U. 2006. Biotechnology. Books and Allied (P) Ltd. Kolkatta.
12. Singh, B.D.2005. Biotechnology- Expanding Horizons. Kalyani Publishers, New Delhi.

Practical
Hrs /week: 2
Practical

- Isolation of *Rhizobium*
- Synthesis of nanoparticles
- UV – visible characterization of nanoparticles
- Preparation of synthetic seeds

Set up / pictures / photographs/ demonstration

- Apical meristem culture
- Cell suspension culture
- Protoplast Culture
- Anther Culture

Submission - Record Note Book

SEMESTER IV			
Core XI - Plant Ecology			
Code: 17PBOC42	**Hrs/week:6**	**Hrs/Semester : 90**	**Credits : 5**

Objectives:

- To enhance the understanding of the environment, key ecological issues, concepts and principles of environmental protection to make life on earth more sustainable and beneficial to human.

Unit I Plant and the environment:climatic factors - air, water and temperature; Edaphic factors - types based on texture and colour. Components of soil-soil air, soil water, pH, mineral matter, organic matter, soil profile - soil organisms - reclamation of soil erosions and conservation. Biotic Factors - positive and negative interactions. Structure and function of major ecosystems - terrestrial (Grass land , forest and desert) aquatic (pond).

Unit II Population structure and dynamics: Basic concepts - characteristics of population,size and density, dispersion, age structure, natality, mortality, biotic potential and life table. Population dynamics - theory of population growth , Plant population dynamics, Regulation of population growth, Evolution among population and population interaction.

Unit III Ecological succession - Definitions, Causes of succession and climax, concept, Monoclimax and poly climax theories, Kinds of succession, Hydrosere and Xerosere. Adaptation of plants- hydrophytes,xerophytes and halophytes,

Unit IV Environmental Management Plan (EMP), ecological indicators. Bioremediation - *In situ* and *ex situ* bioremediation of hydrocarbon, dyes, heavy metals and xenobiotics. Biodegradation of pesticides, biodegradable plastics, bio-augmentation. Bio-filtration - mechanism and microrganisms used. Microbial leaching, bio-mining. Ecology in national affairs- carbon trading, carbon sequestration, blue carbon, climate conference, convention and summit.

Unit V Global environment problems - climate change, global warming, UV - B, green house effect - ozone layer depletion, acid rain , nuclear accidents and holocaust. Disaster management – flood, earthquake and landslides. Eco-management, Environmental Impact Assessment (EIA). Sustainable eco-development, environmental education, Environmental protection Act (EPA)1986. Man and Biosphere (MAB)

Books for Reference :

1. Asthana and Meera Asthana, 2001. Environmental problems and solutions. S.Chand and Co. Ltd., New Delhi.
2. Balasubramanian,D; C.F.a. Bryee, K.Dharmalingam, J.Green and K. Jeyaraman, 2005. Concepts in Biotechnology. Universities Press.
3. Dash, M.C.2001.Fundamentals of ecology. Tata McGraw Hill publishing Co. Ltd., New Delhi.
4. Murugesan, A.G.and Rajakumari , 2005. Environmental Science and Biotechnology, theory and Techniques . M.J.P. Publishers, chennai.
5. Sharma, P.D1999.Elements of ecology. Rastogi Publications, Shivaji Road, Meerut.
6. Trivedi P.R, P.L Sharma and KN Sundarshan 1994. Natural environment and Constitution of India, Efficient offset printers, New Delhi.
7. Tyller Miller G., 2004. Environment Science Thompson Brooks/Cole. Singapore.
8. Varshney C.K 1989. Water pollution and management, S.P. Printers, Noida.

Practical
Hrs /week: 2

- Determination of soil pH (at least 3 types of soil)
- Determination of soil texture.
- Determination of soil moisture.
- Determination of soil bulk density.
- Determination of soil porosity.
- Determination of soil organic matter content.
- Estimation of dissolved O_2 in water samples.
- Estimation of BOD in water samples.
- Estimation of COD in water samples.
- Adaptation of plants- hydrophytes,xerophytes and halophytes,

Submission - Record Note Book

SEMESTER - IV			
CORE XV- COASTAL ECONOMICS			
Code: 17PECC43	Hrs / Week: 6	Hrs / Semester: 90	Credits : 4

Objective

To familiarize the students with the concept and application of economics to the different resource based production systems

UNIT I FISHERIES RESOURCES: **20 Hrs**

Important aquatic fauna and flora - Important capture fisheries of the world, India, Tamil Nadu Distribution- Economics of fish marketing, domestic and export -Economic utilization of fishery resources . Important Fisheries Development Schemes and Organizations

UNIT II ECONOMY OF FISHERMEN: **20 Hrs**

Fishermen populations, GDP from fisheries sector, foreign exchange earnings and employment potential of fishing industry – PESTLE analysis of the fisheries industry

UNIT III Fish and Fishery products: **15 Hrs**

Origin, Functions and Application in Developed and Developing country markets, Drivers and Governors of change on the Demand - Drivers and governors of change on the supply

UNIT IV FISH SUPPLY CHAIN: **20 Hrs**

What is the fish supply chain? - Key links in fish and fishery product supply chain Value chain - Primary activities - Support activities - Supply chain vs value chain - The emergence of the value chains in the fish produces industry

UNIT-V COASTAL DISASTER MANAGEMENT **15Hrs**

Disaster definition – Factors are significance – Study of environment, impacts induced by human activity: Types of hazards earthquakes, Volcano, Cyclones, Tsunami, Floods, Droughts and Famines, Landslides.

Text Book: Jingan V.G.: Fish and fisheries of India, Hindustan Publ. Corpn. 1991

Reference Books

Subba Rao, N. 1986 Economics of Fisheries: A case study of Andhra Pradesh. *DayaPublishing House,* 1302, *Vaid Wara, Nai Sarak, Delhi-6.*

R. L. Varshney, "International Marketing Management", Sultan Chand.

D.C. Kapoor, "Export Management', Vikas Publishing House

Handbook of Import-Export Procedures - Ministry of Commerce, Government of India, New Delhi

SEMESTER- III			
CORE – VII AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY			
Code:17PMIC31	**HRS/WEEK: 6**	**HRS/SEM: 90**	**CREDITS: 5**

OBJECTIVES

1. To inculcate the knowledge on interaction between microbes and environment.
2. To impart advanced information in Agricultural Microbiology.

UNIT I :

Based on oxygen requirement, nutrition, temperature, habitat (soil, water & air). Physio-chemical properties of soil -Rhizosphere and rhizoplane organisms. Mineralization and Immobilization. Biogeochemical cycling: Carbon, Nitrogen, Phosphorus & Sulphur.

UNIT II :

Microbial analysis of drinking water: Tests for coliforms (presumptive, confirmed and completed tests). Purification of water: Sedimentation, Filtration (slow and rapid sand filters) and Disinfection. Aeromicrobiology – Phylloplane microflora (morphological, physiological characters: nutrition, radiation, relative humidity and temperature) – Air Pollution – aerosol, droplet nuclei and infectious dust. Examination of air microflora.

UNIT III :

Nature of sewage and its composition. Physical, chemical and biological properties of sewage (BOD, COD etc). Sewage systems and types. Sewage Treatment: Single Dwelling Unit, municipal sewage treatment – primary, secondary and tertiary treatments (Trickling filters, Activated sludge process, Oxidation lagoons and Imhoff tank).

UNIT – IV

Biological Nitrogen fixation- The range of nitrogen fixing organisms- mechanism of nitrogen fixation (biochemistry of nitrogenase) - genetics of nitrogen-fixation - Rhizobium-Legume Association - N_2 fixation by non-leguminous plants.

UNIT – V

Microbial products and plant health: PGPR (plant growth promoting rhizobacteria) - significance of mycorrhizae - Role of biofertilizers and biopesticides- Biofertilizers- (*Rhizobium*, *Azospirillum*, *Azotobacter*, *Cyanobacteria*, *Phosphobacteria and Azolla*)- Inoculants, mass production and method of application and its Quality Control (BIS specification).

REFERENCE BOOKS:

1. Shiva Aithal, C. (2010). Mordern approaches in Soil,Agricultural and Environmental Microbiology. Himalaya Publishers, New Delhi.
2. Atlas,R.M., and Bartha.M. (2003). Microbial Ecology –Fundamentals and applications. Benjamin – Cummings, Mento Park, California.
3. Martin Alexander (1983).Introduction to Soil Microbiology, Wiley eastern Ltd., NewDelhi.
4. SubbaRao,N.S.(1997). Biofertilizers in Agriculture and Forestry III Ed,Oxford and IBH Publishing Co, Pvt. Ltd, NewDelhi.

5. SubbaRao,N.S.(1995). Soil Microorganisms and Plant growth. Ed,Oxford and IBH Publishing Co, Pvt. Ltd, NewDelhi
6. Wheeler, B.E. (1976). An introduction to Plant disease. ELBS and John Wiley and sons, Ltd.
7. Rangaswamy.g., and Bagyaraj.D.J. (1996). Agricultural Microbiology. Prentice-Hall of India Pvt Ltd., New Delhi.
8. Dirk, J. Elasas, V., Trevors,.T., and Wellington, E.M.H. (1997). Modern Soil Mirobiology. Marcel Dekker INC, New York, HongKong.
9. Dubey R.C. (2001).A Text Book of Biotechnology. S Chand & Co. New Delhi.
10. Gupta,S.K.(2014).Approaches and trends in plant disease management. Scientific publishers.Jodhpur,India.
11. Jammaluddin et al (2013). Microbes and sustainable plant productivity. Scientific Publishers Jodhpur,India,G.
12. Purohit, S.S.Kothari,P.R.andMathur (1993). Basic and Agricultural Biotechnology, Agrobotanical Publishers (India).Bikaner.

SEMESTER - III			
CORE –IX INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY			
Code: 17PMIC33	**HRS/WEEK: 6**	**HRS/SEM: 90**	**CREDITS: 5**

OBJECTIVES:

1. To inculcate the knowledge of Industrial and Pharmaceutical Microbiology
2. To impart the students with the knowledge of various processes involved in Pharmaceutical industry.

UNIT-I

Isolation, preservation and improvement of industrially important microorganisms; Raw materials and media design for fermentation processes; Sterilization; Development of inoculums for industrial fermentations; Types of fermentation: Batch, Continous, Dual or Multiple, Surface, Submerged, Aerobic and Anaerobic.

UNIT-II

Fermenter- Design and types, Instrumentation and control-aeration and agitation. Recovery and purification of fermentation products. Enzymes and cell immobilization, Production of recombinant proteins having therapeutic and diagnostic applications: Insulin, Interferon, Somatotropin, Single cell protein.

UNIT-III

Biology of industrial microorganisms.*Streptomyces*, Yeasts (*Saccharomyces, Hansenula)Spirulina* and *Penicillium*. Mushroom cultivation. Biosensors and Biochips. Biofuels from microbial sources.

UNIT-IV

Alcohols (Ethanol and Butanol); Beverages (Beer and Wine); Aminoacids (Glutamic acid and Lysine); Organic acids (Citric acid and acetic acid); Vaccines (Plant – *Agrobacterium tumefaciens*, Animal – Leptospirosis, Microbes - DPT).

UNIT-V

Antibiotics (Penicillin, Cephalosporin and Streptomycin); Vitamins (Riboflavin and Cyanocobalamin); Production of enzymes (Protease, Amylase and Lipase); Biopolymers (Xanthan gum and PHB); Biopreservatives (Nisin); Production of Hormones (Testosterone and Androstenedione).

REFERENCE BOOKS:

1. WulfCrueger (2000).A Text Book of IndustrialMicrobiologyII.Ed. Panima Publishing Corporation,NewDelhi.
2. Peter F.Stanbury., Whittaker, A. and Hali,S.J.(1997).Principles of Fermentation Technology,II Ed., Pergamon Press.
3. A.H.Patel, Industrial Microbiology (1996).Macmillan India Limited.
4. Reed.G.(Editor),Industrial Microbiology, CBS Publishers
5. Prescott &Dunn(1997). Industrial Microbiology.CBS publishers and Distributors.
6. Casida,L.E.(1986).Industrial Microbiology. Eastern Limited, NewYork.
7. Michael J.Waites, Neil L.Morgan, John S.Rockey and GrayHigton(2001). Industrial Microbiology An Introduction, Replika press Pvt.NewDelhi.
8. S. S. Purohit, H.N. Kakrani, A.K. Saluja, Pharmaceutical Biotechnology (2006). Student edition, Jodhpur.
9. U. Satyanarayana, Biotechnology (2013). Books and Allied (P) Ltd, Kolkata.

SEMESTER IV			
Core XII: Applied Microbiology			
Code: 17PZOC43	**Hrs/ Week :6**	**Hrs/sem : 90**	**Credits : 5**

Objectives

- To know the basic principles of food, industrial and environmental Microbiology.
- To concentrate on the economic aspects and to make use of or combat the activities of microorganisms.
- To understand the interaction of microorganisms with their environments and the practical consequences of these interactions.

Unit I **Microbial Classification**

Definition – scope, history of Microbiology - **Bergey's classification**-recent status of classification- Five kingdom concept. Distinctive features of the major groups of microorganism- bacteria, fungi and virus

Unit II **Food Microbiology**

Microbiology of food -growth of microorganisms in food - food spoilage - food poisoning - food infections – food preservation – microbiology of fermented foods - detection of food - borne pathogens.

Unit III **Industrial Microbiology**

Choosing microorganism for industrial microbiology – bioreactors - types of bioreactors - major products of industrial microbiology – antibiotics – organic acids - biopolymers – biosurfactants - bioconversion process and biofuels. Beverages – wine, beer.

Unit IV **Medical Microbiology**

Microbial diseases - Protozoan diseases; Plasmodium, Entamoeba. Fungal diseases: mycotoxicosis, aspergillosis. Bacterial diseases: meningitis and streptococcal pneumonia. Food and waterborne diseases: cholera, typhoid. STD and contact diseases: gonorrhea and syphilis. Viral diseases: influenza, hepatitis B

Unit V Environmental Microbiology

Biodegradation using microbial communities - leaching of metals,hydrocarbon degradation in water and soil. Waste as a resource - microbes in composting, sewage treatment, biofertilizers, symbiotic -asymbiotic nitrogen fixation.

Books for Reference

1. Dubey R. C.and D.K Maheswari, 2006. A Text Book of Microbiology. S. Chand & Co, New Delhi.
2. Rogar&Stainer, John l.ingrahan, Mark l. Wheelis& Page R. Painter, 1992. General Microbiology. Mac Millan India Ltd.
3. Kannan,N. 1996. Laboratory Manual in General Microbiology. Palani Paramount Publications.
4. James Cappuccino and Natalie Sherman,1999. Microbiology - A Laboratory Manual. Addison-Wesly - Hyman Inc. Tokyo.
5. Pelzer, Chan and Krieg, Microbiology 1998. 2nd edn. Tata Mc Graw Hill Publishing Company.
6. Presscott, Harley and Klein. 2005 Microbiology, WCB Mc Graw Hill Co. New York.
7. Purohit S. S.,1991. Microbiology – Fundamentals and Application. M/S SarawathiPurohit for Student edition, India

PRACTICALS

Hrs / Week : 2

1. Sterilization technique
2. Sample handling for microbial studies.
3. Preparation of culture media for microorganisms.
4. Counting of viable cells (CFU / ml) by serial dilution & spread plate or pour plate.
5. Dye reduction test in milk.
6. Gram staining
7. Capsular staining.
8. Test for antibiotic sensitivity.
9. Isolation of nitrogen fixing symbiotic bacteria from root nodule.
10. Observation of algae, fungi and blue green algae
11. Industrial visit/ Institutional visit and submission of report

SEMESTER I			
Core I	**Fundamentals of Human Resource Management**		
Code: 18PHRC11	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credits: 4**

Objective

- To enable the students to acquire basic knowledge about HRM.

Course Outcome

CO No.	Course Outcome Upon completion of this course students will be able to	PSOs Addressed	Cognitive Level
CO-1	Enumerate the objectives, scope, functions, importance and evolution of HRM and personnel Management.	**PSO 1**	**Remember**
CO-2	Understand the approach and process of job design, job analysis, job specification and job description.	**PSO 1**	**Understand**
CO-3	Understand the process of selection, placement and induction programme.	**PSO 5**	**Understand**
CO-4	Know the concept and process of performance appraisal, potential appraisal, QWL and QC.	**PSO 1**	**Remember**
CO-5	Understand the concept of Employee health, safety, welfare, job satisfaction, morale, industrial peace and harmony.	**PSO 1**	**Understand**

Unit I **Introduction to Human Resource Management:**

Introduction: Meaning – Scope – Objective – Functions - Importance of Human resource management – Personnel Management and HRM – Similarities and Dissimilarities - Evolution of HRM - Organisation of HRM - Line and staff responsibility - Role of Personnel manager and HR manager – Human resource management practices in India.

Unit II **Job Analysis and Design**

Job design: Definition – approaches - job design options

Job analysis: Definition – process - benefits of job analysis

Job Specification: Definition - Process.

Job Description: Definition - Content of Job Description.

Unit III **Selection, Placement and Induction Process:**

Selection: Definition – Meaning - Selection Process.

Placement: Definition – Meaning- Placement Process.

Induction: Definition – Meaning – Objectives - Benefits of Induction Programme - Contents of Induction Programme - Contents of Induction Programme - Phases of Induction Programme.

Unit IV **Performance Management, Quality of Work Life and Quality Circle:**

Performance management: Concept and process - performance appraisal, - potential appraisal.

Quality of Work Life (QWL): Meaning – origin - development and constituents of QWL - techniques for improving QWL.

Quality circles: Concept – structure - Roles and responsibility of various elements - Role of management quality circle in India.

Unit V **Employer health, Safety, Welfare, Job Satisfaction, Morale, Industrial Peace and Harmony:**

Employee health, Safety and Welfare Provisions under factories act.

Job Satisfaction: Definition - Determinants of Job Satisfaction - Measuring Job Satisfaction - Improving Job Satisfaction

Morale: Definition - Factors affecting morale - How to boost morale.

Industrial Peace and harmony: Definition – Significance - Maintaining good human and Industrial Relation.

Text Book:

S.S. Khanka - Human Resource Management - S. Chand & Company Ltd. New Delhi

Books for Reference:

1. K. Aswathappa - Human Resource Management - - Tata McGraw – Hill Publishing Company Ltd., 7 West Patel Nagar, New Delhi - 110008
2. Stephen Robbins and Decenzo – Human resource management- Prentice Hall of India Private Ltd. New Delhi – 110001.

SEMESTER I			
Core II	**Human Resource Planning and Development**		
Code: 18PHRC12	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credits: 4**

Objective:

- To give an in-depth knowledge on HR Planning and Development.

Course Outcome

CO No.	Course Outcome On completion of this course students will be able to	PSOs Addressed	CL
CO-1	Understand the objectives, importance and techniques of human resource planning.	**PSO 1**	**Understand**
CO-2	Know the concepts of job evaluation and job performance.	**PSO 1**	**Remember**
CO-3	Recall the process, system and strategies of HRD. Understand the features and process of career planning.	**PSO 1**	**Remember**
CO-4	Understand the concept of employee health and safety.	**PSO 1**	**Remember & Understand**
CO-5	Analyse the stages of conflict and management of conflict. Describe the need, strategy for planned change and organization development.	**PSO 1**	**Analyse & Remember**

Unit I **Introduction to Human Resource Planning**

Definition – Objectives – Characteristics - Significance – Need and Importance – Factors affecting HRP - Process of Human Resource Planning - Requirements for Effective HRP – Benefits of HRP – Barriers to HR Planning. HR Supply and Demand Forecasting: Techniques

Unit II **Job Evaluation and Performance Evaluation**

Job Evaluation: Concepts-Objectives –-Procedure – Methods – Advantage Limitations.

Performance Evaluation: Objectives – Uses – Determining the criteria for Performance evaluation- Process of Performance Evaluation – Selection of the Evaluator for conducting Performance Evaluation – Performance Evaluation Methods – The 360- degree Feedback Method- Management by Objectives.

Unit III **Human Resource Development**

The process and system of HRD – Career Planning – Features of career Planning – Objectives of Career Planning – Process of Career Planning _ Evaluation of Available Career Opportunities – Implementation and Review – Merits and Limitations of Career Planning- Competency mapping - HRD for workers - HRD strategies and experiences.

Unit IV **Employee Health and Safety:**

Meaning of health – Importance of Health – Occupational Hazards and Diseases – Protection against Hazards – Statutory Provisions concerning Health – Types of Accidents – Causes of Accidents – Accident Prevention and Management - Objectives of Providing Industrial Safety – Steps in Employee Safety Programme – Need for Employee Safety -Significance of Industrial Safety- Safety Measures – Statutory Provisions for Industrial safety in India.

Unit V **Human Resource Audit, Ethical Issues in HRM and International Human Resou**

Management:

Meaning – Features – Objectives – Scope – Steps in HR audit – Approaches to HR Auditing – Essential conditions for an Effective HR audit –
International Human Resource Management:

Types of International Business – Perspective of International HRM – Practices in International HRM.

Ethical Issues: Types of Ethics – Ethics and HRM – Approaches to Ethical issues in Organisation- Factors influencing Ethical Behaviour at Work

Text Book:

1. Pravin Durai, Human Resource Management, Pearson Publications, New Delhi
2. S.S. Khanka - Human Resource Management - S. Chand & Company Ltd. New Delhi

Books for Reference:

1. Aswathappa. K - Human Resource Management - Tata McGraw Hill Publishing Company Ltd., 7 West Patel Nagar, New Delhi - 110008.
2. David A. Decenzo Stephen P. Robbins - Personnel / Human Resource Management – Prentice Hall of India Private Ltd. New Delhi – 110001.

SEMESTER I			
Core IV	**Industrial Relations**		
Code: 18PHRC14	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credits: 4**

Objective:

To impart a thorough knowledge of Industrial Relations.

Course Outcome

CO No.	Course Outcome On completion of this course students will be able to	PSOs Addressed	Cognitive Level
CO-1	Describe the fundamentals , characteristics and objectives of Industrial Relations and ILO	**PSO 2 & PSO 1**	**Remember**
CO-2	Explain the concepts, functions, structures and problems of trade union.	**PSO 2 & PSO 1**	**Understand**
CO-3	Enumerate the importance, process, types and process of collective bargaining and negotiation.	**PSO 2**	**Understand**
CO-4	Describe the concept, forms and levels of WPM and analyse the reasons for failure of WPM	**PSO 2**	**Remember &Analyse**
CO-5	State the objectives and aspects of discipline. Analyse grievance handling procedures and settlement machinery.	**PSO 2**	**Remember & Analyse**

Unit I **Industrial Relation**

Meaning – Concept - Importance of Industrial Relations - Scope and Aspects of Industrial Relations - Components of IR - Factors affecting IR - Approaches to Industrial Relation.

India and International Labour Organization- Objectives of ILO – Structure of ILO – Functions of ILC – Impact of ILO on Indian Labour.

Unit II **Trade unions in India:**

Concept – Features - Function of Trade unions in India – Types of Trade Unions – Structure of Trade Union in India – Trade union movement in India - Trade union Act 1926 – Problems of Trade Unions.

Collective bargaining:

Meaning- Features – Importance – Principles - Types -Process - Forms of Collective Bargaining – Content and coverage of Collective Bargaining Agreement – Collective Bargaining Agreement at different Levels – Recent Trends in Collective Bargaining.

Negotiation: Types of negotiation- Process of Negotiation during Bargaining - Negotiation skills.

Unit IV **Workers Participation in Management:**

Concept - Objectives of WPM – Forms of Participation – Levels of Participation – Forms of Workers Participation in India – Reasons for failure of WPM in India.

Unit V **Discipline, Grievance Handling and Settlement Machinery:**

Discipline – Objectives - Types -Causes of Indiscipline, Maintenance of Discipline.

Grievance Handling - Meaning,-Causes –Model Grievance Procedure - Grievance Redressal machinery

Settlement Machinery: Conciliation, Arbitration and Adjudication.

Industrial Disputes act 1947.

Text Book

Mamoria, Mamoria and Gankar: Dynamics of Industrial Relations, Himalaya Publishing House **Book for Reference:**

1. Ed Rose – Employment relations, Financial Times Prentice Hall
2. Arun Monappa – Industrial Relation, Tata McGraw Hill, New Delhi

SEMESTER I			
Core I Plant Diversity I (Phycology, Mycology, Lichenology and Bryology)			
19PBOC11	**Hrs/week: 6**	**Hrs/Semester : 90**	**Credit :4**

Vision:

- To have a comprehensive idea on cryptogams.

Mission:

- To understand the taxonomy, characteristics and uniqueness of primitive plants.
- To have a broad knowledge on economic importance and ecological significance of lower plants

Course Outcome

CO. NO	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	appreciate the uniqueness and distinguish between diverse groups of primitive plants using their characteristic features	1, 2	An
CO-2	discuss the different life cycle patterns of lower plants	1, 2	Cr
CO-3	know the basic skills and techniques in micropreparation of diversified cryptogams	6	Ap
CO-4	apply the practical knowledge to identify a various cryptogams	1, 6	Ap
CO-5	understand that the cryptogams are unique in plant kingdom	1, 2	Un
CO-6	describe the economic and ecological significance of lichens	1, 2	Ap
CO-7	know the origin and phylogenetic evolution of Bryophyte	1, 2	Re
CO-8	know the scientific contribution done by eminent scientists in the field of cryptogams	1, 2	Un

SEMESTER I			
Core I Plant Diversity I (Phycology, Mycology, Lichenology and Bryology)			
19PBOC11	**Hrs/week: 6**	**Hrs/Semester : 90**	**Credit :4**

Unit I

Algae: Classification of algae by F.E.Fritsh (1954). Contribution of Indian Phycologists: M.O.P. Iyyangar and T.V. Desikachary. General characteristics. Ultrastructure of Prokaryotic and Eukaryotic algal cells and their components: cell wall, protoplasm, flagella, eye spots, chloroplast, pyrenoid, nucleus and reserve foods. Algal cytology and genetics. Economic importance of algae.

Unit II

Habitat, range of thallus structure, vegetative, asexual, sexual reproduction and life cycle patterns of Cyanophyceae, Chlorophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae. Fossil algae of above classes.

Unit III

Fungi: Classification of Fungi by Alexopoulos and Mims (1979). General characteristics. Diversity of somatic, reproductive and fruiting structures in different groups of fungi: Myxomycetes, Zygomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes. Heterothallism and Parasexuality in fungi. Economic importance of Fungi.

Unit IV

Lichens: A general account of lichens - Structure, nutrition; reproduction, classification, occurrence and Inter-relationship of Phycobionts and Mycobionts, Ecological and economic importance of lichens.

Unit V

Bryophyta: Classfication of Bryophytes by Rothmaler (1951). Origin of Bryophytes. General characteristics. Morphological, anatomical structure, vegetative, sexual reproduction and alternation of generation of Marchantiales, Jungermaniales, Anthocerotales, Sphagnales and Polytrichales. Spore dispersal mechanism in bryophytes. Economic importance of Bryophytes.

Algae

Books for Reference:

1. Bilgrami, K.S. and L.B. Sinha, 2004. *A Text Book of Algae*. CBS Publication and distributors, New Delhi.
2. Fritsch, F.E. 1972. *The structure and reproduction of algae.Vol.I & II.* Cambridge University Press.
3. Kamat, N.D 1982. *Topics in Algae*.SaikripaPrakasam, Aurangabad.
4. Robert Edward Lee,2008.*Phycology*.Cambridge University Press
5. South, G.R. and Whittick, 1987. *Introduction to phycology,* Blank well Scientific Publications, London.

Fungi

Books for Reference:

1. Alexopoulos and Mim's, 1983. *Introductory Mycology,* Wiley Eastern Ltd. Hyderbad.
2. Johri R.M., Sneh Lata & Kavita Tyagi 2010. *Text Book of Fungi*. Dominant Publishers & Distributors Pvt.Ltd.
3. Smith, G.M. 1988. *Cryptogamic Botany Vol.I* Mc-Graw Hill Book Company, New York.

Bryophyta

Books for Reference:

1. Cavers, F. 1964. *Inter relationship of the Bryophyta.* Dawsons of pall mall. London.
2. Peter George 2010.*Hand Book of Bryophyta*. Rajat Publications .New Delhi.
3. Rashid, A. 1999. *An introduction to Bryophyta*.Vikas Publishing House Pvt. Ltd.
4. Watson, E.V. 1971. *Structure and life of Bryophytes*. Hutchinson University Library, London.

Lichen

Books for Reference:

1. Ahmadjian, V. and Mason E. Hale, M.E. 1973. *The Lichens.* Academic Press, New York

Practical

Hrs/Week - 2

- **Algae:** *Nostoc, Oscillatoria, Ulva*, *Padina*, *Turbinaria*, *Hypnea, Gracilaria*,.

Collection, identification and preservation of fresh water and Marine algae**.**
Preparation of algal herbaria

- **Fungi:***Xylaria*, *Polyporus*, *Agaricus*.

Observation and study of fungi under natural habitat.

- **Bryophyta :***Plagiochasma*, *Anthoceros*, *Sphagnum*, *Polytrichum*.
- **Lichens:** *Usnea*, *Parmelia*
- Field visit to any one of the ecosystems rich in algae

Submission

- Record Note Book
- Bottle specimens/herbarium specimens (any five)

Books for Reference:

1. Ashok M. Bendre and Ashok Kumar. 2009. *A Text Book of Practical Botany –Volume 1*. Rastogi Publications, Meerut, India
2. Srivastava H. N, 1987. *Practical Botany Volume I,* Pradeep Publications, Jalandhar

SEMESTER I			
Core II Plant Diversity II (Pteridophytes, Gymnosperms and Paleobotany)			
19PBOC12	**Hrs/week: 6**	**Hrs/Semester : 90**	**Credit :4**

Vision:

- To have a comprehensive idea on vascular cryptogams and phanerogams.

Mission:

- To understand the taxonomy, characteristics and uniqueness of higher plants.
- To understand the characteristics of fossil vascular plants and their geological age of origin.

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	appreciate the uniqueness and distinguish between diverse groups of Pteridophytes and Gymnosperms using their characteristic features	1, 2	An
CO-2	discuss different life cycle patterns in different groups	1, 2	Cr
CO-3	know the basic skills and techniques in micropreparation and formulate methods to identify different groups	1, 6	Ap
CO-4	know the evolutionary significance of Pteridophyte	1, 2	Un
CO-5	infer pteridophytes are pioneer in the evolution of seed habit	1, 2	Re
CO-6	compare and contrast the origin and evolution of steles, foliage, seeded and seedless plants.	1, 2	An
CO-7	compare and contrast the seeded and seedless plants.	1, 2	Ev
CO-8	review critically the biology , ecology of fossils and methods of fossilization.	1, 7	Un

SEMESTER I			
Core II Plant Diversity II (Pteridophytes, Gymnosperms and Paleobotany)			
19PBOC12	**Hrs/week: 6**	**Hrs/Semester : 90**	**Credit :4**

Unit I

Pteriodophyta: Classification of Pteridophytes by Smith (1955). Origin and evolution of Pteridophytes. General characteristics. Telome concept. Stelar evolution in pteridophytes. Heterospory and seed habit. Theories and modifications of alternation of generations Economic importance of Pteridophytes.

Unit II

Morphological, anatomical structure, asexual and sexual reproduction of Psilotales (Phylogenetic position of Psilotales), Lycopodiales, Selaginellales, Isoetales and Equisetales, Ophioglossles and Filicales. Life cycle pattern in homosporous and heterosporous pteridophytes.

Unit III

Gymnosperms: Classification of Gymnosperms by K.R.Sporne (1965). General characteristics. Morphological, anatomical structure and reproduction of Cycadaceae, Ginkgoaceae, Cupressaceae, Podocarpaceae, Araucariaceae

Unit IV

Morphological, anatomical structure and reproduction of Ephedraceae, Welwitschiaceae and Gnetaceae. Affinities of Gymnosperms with Angiosperms and Pteridophytes. Economic importance of Gymnosperms.

Unit V

Paleobotany: Geological time scale – fossilization and Fossil types: Compressions, incrustation, casts, molds, petrifactions, coal balls and compactions. General characters of fossil Pteridophytes: *Horneophyton, Sphenophyllum and Calamites.* Fossil Gymnosperms: *Williamsonia and Cordaites.*

Pteridophyta:

Books for Reference:

1. Bower, F.D. 1988. *Primitive land plants. Vol.I & 2*. Arihant Publishers Jaipur.
2. Pandi, S.N., P.S. Trivedi, S.P. Misra, 2006. *A text Book of Botany Vol. II.* Vikas Publishing House Pvt. Ltd.
3. Parihar, N.S. 1967. *An introduction to Embryophyta, Pteridophyta.* Central Book Depot Publications in Botany, Allahabad.
4. Rashid, A. 1985. *An introduction to Pteridophyta*, Vani Educational Books.
5. Sundara Rajan S. 2009. *Introduction to Pteridophyta.* New Age International Publishers. New Delhi

Gymnosperms:

Books for Reference:

1. Chamberlain, C.J. 1986. *Gymnosperms.Structure and evolution.* CBS Publishers & Distributors, Delhi.
2. Johri R.M., SnehLata and Kavita Tyagi. 2010. *Text Book of Gymnosperms*. Wisdom Press, New Delhi.
3. Sporne, K.R.1974. *The Morphology of Gymnosperms*. B.I. Publications Pvt. Ltd., New Delhi.

Practical :

Hrs/Week – 2

- **Pteridophytes :** *Selaginella, Isoetes, Equisetum, Adiantum, Pteris.*
- **Gymnosperms :** *Cycas, Araucaria, Cupressus, Podocarpus, Gnetum,*
- **Fossils:** *Sphenophyllum, Calamites* (Pteridophytes) *Williamsonia* and *Cordaites* (Gymnosperms)

Submission - Record Note Book

Books for Reference:

1. Ashok M. Bendre and Ashok Kumar. 2009. *A Text Book of Practical Botany –Volume 1.* Rastogi Publications, Meerut, India
2. Srivastava H. N, 1987. *Practical Botany Volume I,* Pradeep Publications, Jalandhar

Semester – II			
Elective II A	**Energy and Environmental Chemistry**		
Code : 19PCHE21	**Hrs / Week : 4**	**Hrs / Sem : 60**	**Credits : 4**

Vision:

To protect and improve the environment as a valuable asset against hazardous chemicals and energy resources.

Mission:

- To learn the various types of sonochemical reactions.
- To summarise renewable and non renewable energy resources.
- To gain knowledge about Environment and its problem solving techniques.

Course outcome:

CO No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO - 1	compare heterogeneous liquid- liquid and heterogeneous solid- liquid reactions	2	An
CO - 2	distinguish between renewable and non- renewable energy resources.	5,6	An
CO - 3	explain the construction, working and applications of primary and secondary batteries.	4,8	Ap
CO - 4	classify and compare the fuels based on their appearance such as solid, liquid and gas.	7	Cr
CO - 5	demonstrate the Orsat process for flue gas analysis.	8	Ap
CO - 6	identify a catalyst used in fine chemical synthesis.	4,6	Un
CO - 7	sketch the natural cycles of environment such as the hydrological, oxygen and nitrogen cycles.	6	Cr
CO - 8	differentiate chemical and photochemical reactions occurs in atmosphere.	1,5	An

Semester – II			
Elective II A	**Energy and Environmental Chemistry**		
Code : 19PCHE21	**Hrs / Week : 4**	**Hrs / Sem : 60**	**Credits : 4**

Unit I Sonochemistry

Introduction Instrumentation (Whistle reactor, Ultrasonic cleaning bath, Direct Immersion Sonic horn, The Cup horn) Types of Sonochemical reactions - Homogeneous reaction(Strecker, Solvolysis and Hydrolysis) - Heterogeneous liquid-liquid reactions (Hydrolysis, Solvolysis, Saponification and Esterification), Heteogeneous solid-liquid reactions, Induced Organic reactions (Bouveault reactions, Cannizzaro reaction, Strecker Synthesis, Reformatsky reaction, Barbier reaction of carbonyl compounds, Dickmann reaction)

Unit II Energy resources

Introduction - classification of energy resources - Renewable - Solar energy (Solar cells, Solar batteries, Solar heat collector and Solar water heater), Wind energy (Wind mills and Wind farms), Ocean energy (Tidal energy, Ocean thermal energy and geothermal energy) and Bio mass energy (Bio fuel and Hydrogen fuel).

Non Renewable - Batteries- Construction, Working and Applications: Primary battery - Leclanche Cell, Alkaline battery, Lithium ion; Secondary battery - NICAD, Lead Acid , Nickel metal hydride cell - Fuel cell - Use of alternate energy sources – Energy Conversion process: Anaerobic digestion and bio gas.

Unit III Fuels and combustion

Introduction - Classification of fuels - Calorific values - Solid fuel - Classification of coal by rank - Metallurgical coke and its manufacture (Otto Hoffmans method) - Liquid fuel - Petroleum - synthetic petrol and its manufacture (Bergius process) - Knocking - Octane number and Cetane number. Gaseous fuel - Liquid Petroleum gas, Natural gas, Compressed natural gas - Ignition temperature - Explosive range - Analysis of flue gas (Orsat process).

Unit IV Recent developments in catalysis

Introduction - Reactions over Solid - Acid catalyst (Alkylation, Cracking & Hydrocracking, Isomerisation), Catalyst in Fine Chemical synthesis (Halogenation, Amination, Condensation, selective Oxidation reactions), Photocatalyst - Introduction - Semiconductor as photocatalyst - Water splitting by Semiconductor Particle - Photocatalysis in the removal of Organic and Inorganic pollutants - Photocatalytic reduction of Dinitrogen, Photocatalysis of Organic reactions.

Unit V Environmental chemistry

Environmental Segments - The natural cycles of environment: the hydrological, oxygen and nitrogen cycles - Chemical and Photochemical reactions in atmosphere: SO_2, O_2 and O_3

chemistry, nitrogen oxides and organic compounds - Greenhouse effect - Ozone hole - El Nino phenomenon.

Microorganisms - the catalysts of aquatic chemical reactions - Acid-base and ion exchange reactions in soil - Nitrogen pathways and NPK in soil - Waste classification and disposal - Solid waste management.

Text Books:

1. Ahluwalia V.K & Varma R.S, Alternate Energy Process in Chemical Synthesis,1st Edition,Narosa Publishing House, Delhi, 2008.
2. Jain P.C and Monika Jain, Engineering Chemistry, 15th edition, Dhanpat Rai Publishingcompany Pvt. Ltd, New Delhi, 2011.

Books for Reference:

1. B.Viswanathan, S.Sivasanker, A.V.Ramaswamy, Catalysis-Principles and Applications,Fourth edition, Narosa Publishing House, Delhi, 2011.
2. Harish Kumar Chopra, Anupama Parmar, A textbook of Engineering Chemistry, NarosaPublishing House, 1st edition, New Delhi, 2008.
3. Dr.A.Ravikrishnan, Environmental Science & Engineering, Sri Krishna High tech Publishing Company Pvt. Ltd, Eleventh edition, 2015.
4. A.K.DE, Environmental Chemistry, New age international publishers, 6th edition, 2006.

Semester – I			
Elective I Environmental Economics			
19PECE 11	**Hrs/Week: 6**	**Hrs/ Semester: 60**	**Credits: 3**

Vision:

Apply knowledge of environmental economics, including analytical tools and methods, to identify policy solutions that can correct environmental problems.

Mission:

Demonstrate understanding of the economic cause of environmental problems, environmental valuation techniques, environmental policy instruments and their economic consequences, and environmental policy decision making tools.

Course Outcome:

CO. No	Upon Completion of this course, students will be able to	PSO addressed	Cognitive Level
CO-1	apply microeconomic theory to the study of environmental issues.	6	Ap
CO-2	identify and critically evaluate alternative environmental policy instruments.	4	Un
CO-3	develop written and verbal skills in communicating an environmental economic perspective.	5	An
CO-4	enhance the student's ability to conduct professional economic research and to develop and present professional proposals, papers, and presentations	4	Ap
CO-5	increase the student’s ability to analyze environmental policies through a deeper understanding of economic behavior and incentives	8	Re
CO-6	analyze the environmental policy practices in the real world using economics methods and tools.	4	An
CO-7	demonstrate the ability to model environmental policy issues using fundamental environmental and economics skills.	6	Ap
CO-8	engage in self-directed research and learning about environmental economics.	4	An

Semester – I			
Elective I Environmental Economics			
19PECE 11	**Hrs/Week: 6**	**Hrs/ Semester: 60**	**Credits: 3**

Unit I - Economic Growth and Environment **15 Hrs**

Economic Growth and Environment: conflicting or complementing – Limits to growth model - Environmental Kuznets Curve. Environment – Economics inter-linkages using Material Balance Approach –Pollution as an externality and its impact - Environmental quality as Public good

Unit II - Environmental Pollution and Global issues **10 Hrs**

Air pollution – Water pollution – Pollution by solid wastes; Global warming and Climate change – Ozone depletion – Bio-diversity Loss – Trade and Environment

Unit III - Sustainable development **10 Hrs**

Definition of sustainable development – components of sustainable development – Theoretical approaches to sustainable development: Neo - Classical Approach – Ecological Approach – Safe Minimum Standards Approach

Unit IV- Environmental Ethics and policy **15 Hrs**

Approaches to environmental ethics – Shallow Vs Deep Ecology – Environmental Movement – Environmental movement in India: Environmental Challenges to India with respect to Air Pollution, Water Pollution, Waste Management and Bio – Diversity Loss – Environmental Policy in India

Unit V - Corporate environmental Management **10 Hrs**

Corporate Responsibility for Environmental Problems - sustainable industrialization as a production paradigm - Principles of sustainable industrialization -Industrial Ecology – Life cycle Approach -C2C -Eco labelling – Business Charter Sustainable Development

Text Book:

Karpagam.M. *Environmental Economics*. London:Sterling Publishers, 2010.

Books for Reference

1. Karpagam M and R Geetha.*Green Management – Theory and Practice*.New Delllhi: Ane Book House, 2010.
2. Tan Hodge. *Environmental Economics*. Chennai: Macmillan Press,1995.

Semester – I			
Elective II		Energy Economics	
19PECE12	**Hrs/Week: 4**	**Hrs/ Semester: 60**	**Credits: 3**

Vision:

This course is tailored for the student desiring an understanding of the relationship between the energy sector and the wider economy. Studying methods of investment evaluation in energy sector, methods for energy production cost calculation and energy pricing methodology.

Mission:

` The course examines the role of energy in economic activity, economic methods of assessing energy technologies, projects, and policies, and debates concerning alternative future energy scenarios

Course Outcome:

CO. No	Upon Completion of this course, students will be able to	PSO addressed	Cognitive Level
CO-1	understand the role of energy in economic activity.	2	Un
CO-2	have a knowledge of methods to assess alternative energy projects technologies, and policies	3	Ap
CO-3	apply this knowledge to the analysis of specific energy issues in India	5	Ap
CO-4	know what key factors and principles need to be considered in evaluating alternative energy policy options.	6	An
CO-5	understand of economic and ability to apply economic and financial evaluation of energy projects.	7	Un
CO-6	learning the basics of cost calculation for electricity and heat production from CHP and power plants	6	Ap
CO-7	provide students with a thorough grounding in the key concepts of energy economics.	5	Re
CO-8	illustrate how these concepts and standard economic tools can be used to analyse energy-related policy issues	7	Un

Semester – I			
Elective II Energy Economics			
19PECE12	**Hrs/Week: 4**	**Hrs/ Semester: 60**	**Credits: 3**

Unit I - Energy Concepts and Sub-Sectors **15 Hrs**

Concepts - Definitions - Sources and Categories of Energy - Energy Balance Tables - Energy Data Sources - Energy System - Energy - Economy Linkages - Green Energy - Forms of Energy - Electricity, Coal, Oil and Renewable Sources.

Unit II - Energy Supply Analysis **15 Hrs**

Energy Supply Analysis: Availability and Supply of Different Sources of Energy – Supply Constraints - Role of Renewable Sources of Energy - Institutional Framework for Energy Supply in India - Alternative Energy Sources – Energy Imports - Trends and Issues.

Unit III – Energy Demand Analysis **10 Hrs**

Energy Demand Analysis: Determinants of Energy Demand - Price and Income Elasticity - Demand Estimation under Administered Price Regimes - Demand and Supply Gap - Energy Shortage and Crisis - Need for Energy Demand Management - Renewable Energy Options.

Unit IV- Energy Pricing **10 Hrs**

Methods and Principles of Energy Pricing - Economic Efficiency and Equity Considerations - Pricing under Supply Constrained Framework - Energy Markets - Regulation - Issues and Challenges.

Unit V - Energy Efficiency and Conservation **10 Hrs**

Principles and Methods - Energy Supply Side and Demand Side Management and Efficiency - Institutional Machinery and Community Engagement - Estimation of Benefits - Energy Audit - Policy Alternatives

Text Book:

Kneese. A. V. and Sweeny. J. L. *Handbook of Natural Resource and Energy Economics*, North Holland: 2003.

Books for Reference:

1.Munasinghe. M & Meier. P.(2005), *Energy Policy Analysis and Modeling*. U.K.Cambridge: University Press,2005.
2. Paul Stevens. *The Economics of Energy*. UK:Edward Elgar publications,2006.
3. Sankar.U. *Public Sector Pricing: Theory and Applications*. New Delhi:Indian Economic Association Trust for Research and Development, 2004.

Semester- II			
Elective I– Economics of Tourism			
Code: 19PECE21	**Hours / Week :4**	**Hrs / Semester: 60**	**Credits :3**

Vision:

To reflects the importance of tourism to the Seychelles economy and the social wellbeing of its population

Mission:

To delivers a value-for-money and unique visitor experience, through innovation, strategic partnerships and coordination, providing information and communication and capacity development.

Course Outcome:

CO. No	Upon Completion of this course, students will be able to	PSO addressed	Cognitive Level
CO-1	critique tourism practices for their implications locally and globally.	7	Un
CO-2	contextualize tourism within broader cultural, environmental, political and economic dimensions of society.	3	Ev
CO-3	interpret and evaluate tourism as a phenomenon and as a business system.	3	Ev
CO-4	explain the diverse nature of tourism, including culture and place, global/local perspectives, and experience design and provision.	1	Ap
CO-5	identify and assess relationships and networks relative to building tourism capacity.	3, 2	An
CO-6	apply principles of sustainability to the practice of tourism in the local and global context.	4	Ap
CO-7	practice empathy and respect for diversity and multicultural perspectives.	6	Ev
CO-8	evaluate and apply various research methods commonly used in the context of tourism.	8	Ev

Semester- II			
Elective I Economics of Tourism			
Code: 19PECE21	**Hours / Week :4**	**Hrs / Semester: 60**	**Credits :3**

Unit I - Introduction **10 hrs**

Tourism as an Industry –Definition - Types, Functions, Volume and Components of Tourism - Development of Tourism - Factors responsible for the growth and development of Tourism over the Years

Unit II - Significance of Tourism **15 hrs**

Concepts of Tourism product – Characteristics of tourism product – Demand and supply characteristics – Factors affecting demand for tourism - Socio-economic importance of Tourism - Travel agency - Travel agents - Tourism guides – Travel Documents - Passport and other formalities

Unit III- Growth of Tourism **15 hrs**

Causes for the growth of Tourism - Economic and Social factors - Transport, Accommodation and Locality - Eco- Tourism – Tour Packages and Type of Package – National and International – Tour itinerary

Unit IV- Tourism Development **10 hrs**

Development of Tourism in India - Role of Private sector and Public sector - Five Year Plans and Tourism -New policy on Tourism Management Strategy- Tourism Policy analysis

Unit V - Tourism Promotion **10hrs**

Functions of Advertising Agencies - support activities – Public relations - Tamil Nadu Tourism- Importance of Tourism Centre - Chennai, Ooty, Kodaikanal, Kanyakumari, Tanjore, Madurai, Rameswaram, Kanjeepuram and Kollihills.

Text Book:

Sipra Mukhopadhay. *Tourism Economics*. New Delhi: Ann Books India, 2009.

Books for Reference:

1. Bishwanath Ghosh. *Tourism and travel management*. New Delhi:Vikas Publications House Pvt. Ltd, 2005.
2. Pran Nath Seth. *Successful Tourism Vol 1*.New Delhi: Sterling Publishers Pvt. Ltd, 1998.
3. P.J. Sangar.*Tourism Management*.New Delhi: Anmol Publications Pvt. Ltd,1990.
4. A.K. Bhatia. *International Tourism Management*. NewDelhi:Sterling Publishers Pvt. Ltd, 1980.

Semester – II			
Elective III B	Historical Tourism – Theory and Practice		
Sub Code : 19PHIE21	Hrs / Week : 4	Hrs / Sem : 60	Credits : 3

Vision: Highlights the historical sites and its significance.

Mission: Promotes the cultural heritage.

Course Outcome:

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	understand art and architecture in India.	1,2	Un, Re
CO-2	promote historical spot study.	1,2	Un, Re
CO-3	learn the architectural styles of various periods.	1,2	Un, Re
CO-4	analyse the Indo-Persian architecture.	4	An
CO-5	conducting research in historical sites.	5	Ev
CO-6	know the ways and means to conserve rich heritage.	1,2	Un, Re
CO-7	become aware of modalities of conducting historical tourism.	1,2	Un, Re
CO-8	enhance the historical skills.	1,2	Un, Re

Semester – II			
Elective III B Historical Tourism – Theory and Practice			
Sub Code : 19PHIE21	Hrs / Week : 4	Hrs / Sem : 60	Credits : 3

Unit I - Heritage - Art and Architecture in India – an Overview – field work – visit to historical sites and museums.

Unit II - Understanding Built Heritage - Stupa Architecture -Temple Architecture -Indo – Persian Architecture – Fort, Palace, Mosques

Unit III - Colonial architecture - present day architecture

Unit IV - Field Work - visit to site and conducting research.

Unit V - Modalities of conducting tourism.

Books for Reference:

1. Agarwal V.S. Indian Art. Prithvi Prakasahan, Varanasi. 1972.
2. Bhowmik S.K. Heritage Management: Care Understanding and Appreciation of Cultural Heritage. Jaipur. 2004.
3. Edith Tomory. A History of Fine Arts in India and the West. Orient Longman, 1982.
4. James Harle, The Art and Architecture of the Indian Subcontinent, Hormonds Worth, Penguin, 1988.
5. Manohar Bharadwaj, Cultural and Traditional History of India, Cyber Tech Publications, 2008.

Semester – II			
Elective IV A	Archives Keeping		
Sub Code : 19PHIE22	Hrs / Week : 4	Hrs / Sem : 60	Credits : 3

Vision: To develop the skills of data collection.

Mission: To update the recent trends in collection of data.

Course Outcome:

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	update the primary sources of History.	1,2	Un, Re
CO-2	understand the latest micro filming data collections.	1,2	Un, Re
CO-3	know the structure and functions of Archives.	1,2	Un, Re
CO-4	appreciate the work of organisation.	1,2	Un, Re
CO-5	understand the significance of record maintenance.	1,2	Un, Re
CO-6	estimate the History of Archives.	5	Ev
CO-7	learn the pool of resources of history.	1,2	Un, Re
CO-8	know the mending of records.	4	An

Semester – II			
Elective IV A	Archives Keeping		
Sub Code : 19PHIE22	Hrs / Week : 4	Hrs / Sem : 60	Credits : 3

Unit I - Meaning of the term Archives – Origin – Early History – Greece and Rome – Medieval Archives – History of Archives Keeping in France, England, USA and India. – Creation of Archives – Selection of Materials – Collection of Records – Arrangements of records.

Unit II - Organisation of Archives – Meaning of the term – History of Organisation – Principles of Organisation – Organisation of Archives in England, France and India. – Administration of Archives – Technical Administration – General Administration

Unit III - Preservation of Archives – Protection from different insects and creatures – Repairing the damaged records – Re-strengthening of the old materials. – Functions of Archives – Preservation – arrangements of records – Government – impact Archival training – Creation of Archival awareness – Publications.

Unit IV - Uses of Archives – Historical Value – Research Purpose – Reconstruction of the Past – Authenticity in History – Administrative Values – Intellectual Values – Rules Regulating Access to the Archives – India – Europe – Common Rules and Regulations.

Unit V - Private Archives and their Values – Kinds of Private Archives – Tamil Nadu Archives – Formation and Development – Saraswathi Mahal Library – Nehru Museum and Library – Parry and Company – Connemara Library – Macqueen – Dodwell – Tallboys Wheeler – B.S. Baliga – S. Singarajan.

Text Book:

1. Raj Sundar M. A Manual of Archival Systems and the World of Archives. Chennai. 1999.

Books of Reference:

1. Baliga B.S. Madras Record Office. Indian Archives Vol. IV. New Delhi. 1952.
2. Cook Michael. Archives Administration: A Manual for Intermediate and Smaller Organisations and for Local Government. Kent, 1977.
3. Schellenberg, T.R. Model Archives Principles and Techniques. Chicago. 1956.

SEMESTER I			
Core – II Microbial Diversity And Classification			
Code : 19PMIC12	**Hrs/ Week: 5**	**Hrs/ Sem: 75**	**Credits: 4**

Vision:

To understand about the evolution of organisms on earth and variability among living organisms.

Mission:

To study about the microbial population and its habitat and about microbial communities which are excellent models for understanding biological interactions and evolutionary history.

Course Outcome:

C O No	Upon completion of this course, students will be able to	PSO addressed	CL
CO -1	understand the ubiquitous nature of microbes.	1	Un
CO -2	explain the basic concept of microbial diversity and classification.	3	Re
CO -3	discuss the knowledge about the various diversification in microorganism	4	Cr
CO -4	explain the knowledge of reproduction in microbes	5	Un
CO- 5	describe genetic characters of microbes.	5	Un
CO -6	understand the general classification of microbes	4	Un
CO -7	explain the characters of protozoa	4	Un
CO -8	understand the characters of arthropod vectors	3	Un

SEMESTER I			
Core – II Microbial Diversity and Classification			
Code : 19PMIC12	**Hrs/ Week: 5**	**Hrs/ Sem: 75**	**Credits: 4**

Unit I: Biodiversity and Classification

Classification of microorganisms – Introduction – Haeckel's three kingdom concept – Whittaker' five kingdom concept – Three domain concept of Carl Woese basis of microbial classification, Salient features of bacteria according to Bergey's manual of determinative bacteriology. Identification of Microorganisms –phenotypic classification, phylogenetic classification, genotypic classification, taxonomic ranks – Techniques for determining microbial taxonomy & phylogeny: Classical & molecular characteristics - Genetic relationship - DNA homology -16S r RNA sequencing .

Unit II: Bacteria

General characters, Classification, nomenclature and properties. Structure and characteristics: Gram positive cocci– *Staphylococci, Streptococci*. Gram negative cocci– *Gonococci*. Gram positive non spore forming bacilli: aerobic – *Corynebacteria* and anaerobic- *Actinomyces*. Gram positive spore forming bacilli: aerobic- *Bacillus anthracis* and anaerobic *Clostridia.*

Unit III: Fungi and Algae

General characters, Morphology, taxonomy and classification, structure and cell differentiation of *Aspergillus sp, Candida sp, Agaricus sp*. Mycorrhiza – Ectomycorrhizae, Endomycorrhizae, Vesicular Arbuscular Mycorrhizae. Algae: Distribution, general characters, thallus and its structure, classification, nutrition and reproduction – Characters of selected groups – Blue green algae,Euglenophyta, Chrysophyta, Phaeophyta and Rhodophyta – Economic importance of algal biotechnology.

Unit IV: Virus

Classification, nomenclature and properties. Structure and characteristics of Plant virus (CaMV ,TMV) Animal virus (Adeno virus, HIV, Rhabdo virus) Insect virus (NPV,CPV) Brief outline on virion and Prions.

Unit V: Protozoa

Distinguishing characters, classification, host-parasite relationship, pathogenic mechanism, transmission, life cycle, lab diagnosis, treatment for the following: *Entamoeba sp, Leishmania sp, Giardia sp and Trichomonas sp*. Helminthes: Classification, lifecycle, pathogenesis, transmission, lab diagnosis treatment for Cestodes (*Taenia solium*) – Nematodes (*Ascaris lumbricoides*) – Arthropod vectors: Tick and mosquitoes.

Books for Reference:

1. Prescott L.M., Harley J.P., and Klein D.A 2008. *Microbiology* 7th Edition McGraw Hill, New York.
2. Madigan M.T., Martinko. J.M. Parker .J., and brock T.D. 1997. *Biology of Microorganisms*.8th Edition. Prentice Hall International Inc, London.
3. Alexopoulos, C.J.,and Mims,C.W.1979.*IntroductoryMycology*,Wiley,New York.
4. Stainer R.Y., In graham J.L., wheelis M.L., and Painter P.R. 1986. *General Microbiology*, Macmillan Education Lt., London.
5. Starr, M.P., Stolp, H., Truper, H.C.Balows, A., and Schlegel, H.C. 1991. *The Prokaryotes.A Hand Book of Habitats, Isolation and Identification of Bacteria.* Springer Verleg.
6. Tortora, Funke, and Case Addison (2001). *Microbiology - An Introduction* – 7th Edition Wesley Longman Inc
7. JohnL.Ingraham and Catherine A. Ingrahani 2000, *Introduction to Microbiology*. Books/Cole Thompson Learning, UK.
8. Talaro. K.P. and A.Talaro.1999. *Foundations in Microbiology*.WCP McGraw-Hill, New York.
9. Jagadish Chandar (1996). *A Text Book of Medical Mycology*. Inter Print. New Delhi.
10. Powar C.B and Daginawala H.F 2005. *General Microbiology, Volume I & II, 8th Edition,* Himalaya Publishing House, Mumbai.
11. Dubey. R.C., and Maheswari, S. 2000. *A Text Book of Microbiology* – Chand & Co, New Delhi.
12. Pelczar Jr. M.J., Chan E.C.S., and Kreig N.R. 1993.*Microbiology* – McGraw Hill, Inc., New York.
13. Salle, A.J. 1996. *Fundamental Principles of Bacteriology*. 7th edition. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
14. Holt, J.S. Kreig, N.R., Sneath, P.H.A. and Williams, S.T. 1994. *Bergey's Manual of Determinative Bacteriology.* 9th edition – Williams & Wilkins, Balimore.

SEMESTER – II			
Core VIII -Marine Microbiology			
Code :19PMIC24	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits:4**

Vision:

To provide the learners with the best learning experience in Marine Microbiology by providing standard education and enabling the students to become entrepreneurs and socially responsible.

Mission:

To develop young students with active and creative minds in the field of microbiology. To motivate learners to contribute to sustainable development of nation through environmental protection and social responsibility

Course Outcome:

CO No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	describe the basic knowledge on marine ecosystem.	1	Re
CO -2	acquire the knowledge about diversity of marine ecosystem	1,2	Kn
CO-3	can analyses the aware of bio fouling and prevention.	2,3,4	Ev
CO-4	interpret the knowledge on marine microorganisms.	1,2	Ap
CO-5	determines the microbial indicator organisms.	1	Kn
CO-6	explain the concept of marine pollution	2,3,4	Co
CO-7	grasp the knowledge about bioactive compounds.	2,3,4	An
CO-8	know the wealth of the sea	2	Kn

SEMESTER – II			
Core VIII -Marine Microbiology			
Code :19PMIC24	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 4**

Unit I : Marine Environment – Zonation and Biota

Classification of marine environment. – Plankton– classification (size, life, habitat) and adaptations. Physical properties: waves, tides, currents- types, causes, and their impact on marine organisms. light, temperature, pressure. Chemical properties: nutrients, (major, minor, and trace elements), salinity, pH, density, dissolved gases (oxygen, carbon-di-oxide).

Unit II: Marine Diversity

Ecology of coastal, shallow and deep sea microorganism - importance and their significance. Diversity of microorganism - Nutrient cycles- Role of microorganisms in carbon, nitrogen, phosphorous and sulphur cycles in the sea under different environments including mangroves.

Unit III: Marine Ecosystems

Estuaries, salt marshes, mangroves. Coral reef -– ecology and types, species interaction, adaptations and importance. Threats and conservation of coastal ecosystems (coral reef and mangroves). Actinomycetes in the mangroves and coral environment.

Unit IV: Marine Pollution

Sources, effects and control measures of heavy metal, radioactive, oil, and thermal pollutions. Microbial indicators of pollution. Role of microbes in pollution abatement, Bio fouling. Microbial biodegradation - hydrocarbon. Bioremediation of heavy metal.

Unit V :Wealth of the sea

Living resources: Fishery products- fish meal and fish oil. Phycocolloids; agar-agar and algin. Microbial diseases diagnosis and control. Marine microorganisms as a source of biomedical resources - dinoflagellates as a source of bioactive molecules - chemistry and pharmacology of marine toxins - saxitoxin -tetradotoxin.

Books for Reference:

1. Gross, G., 1993.*Oceanography: A view of the Earth*. 6th edition. Prentice Hall Inc., NewJersey.
2. McCormick, J.M. and Thiruvathaakal J.V., 1976. *Elements of Oceanography.*W.B. Saunders Company, Philadelphia.
3. Nybakken, J.W. 1997. *Marine Biology – An Ecological Approach*. Addison Weslay Longman, Inc. California, 477pp.
4. Olivia J.Fernando 1999. *Sea water-Properties and dynamics*, Dhanesh Publications, Ponnagam, Thanjavur

5. Russel 1970. *Marine Ecology*, Academic Press- London and New York

6. Nelson and Smith 1973, *Oil pollution and Marine Ecology*-Plenum press

7. Daws, C.J.1981. *Marine Botany* John Wiley and Sons, New York.

8. Austin. B, and D.A Austin 1999. *Bacterial Fish pathogens- Diseases of Farmed and Wild Fish.* Springer Publisher.

9. Munn and Munn 1996. *Marine Microbiology: Ecology and Applications*. BIOS Scientific publisher.

10. Rheinheimer, G., 1980 *Aquatic Microbiology-an Ecological Approach*. Blackwell Scientific Publications

11. Vijaya Ramesh, K. 2004. *Environmental Microbiology*. MJP Publishers Chennai.

12. Tait, R.V and Dipper F.A 1998. *Elements of marine ecology* - 4th edition. British Library Cataloguing in Publication Data.

13. Atlas, R.M., and Bartha.M. 2003. *Microbial ecology- Fundamentals and Applications.* Benjamin- Cummings, Menlo Park, California.

14. Grant, W.D. and Long, P.L.1981. *Environmental Microbiology*. Blackie Glasgow and London.

Semester – II			
Elective II	**B. Energy and Computational Chemistry**		
Course Code : 21PCHE22	**Hrs / Week : 4**	**Hrs / Sem : 60**	**Credits : 4**

Objectives:

- To protect and improve the environment as a valuable asset against hazardous chemicals and energy resources.
- To acquire a realistic training of computational tools in career.
- To encourage the preferential use of renewable instead non-renewable energy.

Course outcomes

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	organise C++ programming for the determination of some Chemical properties.	8	An
CO 2	calculate the delocalisation energy for aromatic system.	4	Ev
CO 3	distinguish between renewable and non- renewable energy resources.	5,6	An
CO 4	explain the construction, working and applications of primary and secondary batteries.	4,8	Ap
CO 5	classify and compare the fuels based on their appearance such as solid, liquid and gas.	7	Cr
CO 6	demonstrate the Orsat process for flue gas analysis.	8	Ap
CO 7	identify a catalyst used in fine chemical synthesis.	4,6	Un
CO 8	acquire knowledge about paints, dyes and pigments and their manufacture.	5	Un

Semester – II			
Elective II	**B. Energy and Computational Chemistry**		
Course Code : 21PCHE22	**Hrs / Week : 4**	**Hrs / Sem : 60**	**Credits : 4**

Unit I Energy resources

Introduction - classification of energy resources- Renewable: Solar energy (Solar cells, Solar batteries, Solar heat collector and Solar water heater), Wind energy (Wind mills and Wind farms), Ocean energy (Tidal energy, Ocean thermal energy and geothermal energy) and Bio mass energy (bio fuel and Hydrogen fuel).

Non Renewable – Batteries- Construction, Working and Applications: Primary battery - Leclanche Cell , Alkaline battery, Lithium ion; Secondary battery - NICAD, Lead Acid , Nickel metal hydride cell - Fuel cell - Use of alternate energy sources - Energy Conversion process: Anaerobic digestion and bio gas.

Unit II Fuels and Combustion

Introduction - Classification of fuels - Calorific values - Solid fuel - Classification of coal by rank - Metallurgical coke and its manufacture (Otto Hoffmans method) - Liquid fuel - Petroleum - Synthetic petrol and its manufacture (Bergius process) - Knocking - Octane number and Cetane number. Gaseous fuel - Liquid Petroleum gas, Natural gas, Compressed natural gas - Ignition temperature - Explosive range - Analysis of flue gas (Orsat process).

Unit III Recent developments in catalysis

Introduction - Reactions over Solid - Acid catalyst (Alkylation, Cracking & Hydrocracking, Isomerisation) - Catalyst in Fine Chemical synthesis (Halogenation, Amination, Condensation, selective oxidation reactions) - Photocatalyst - Semiconductor as photocatalyst - Water splitting by Semiconductor Particle - Photocatalysis in the removal of Organic and Inorganic pollutants - Photocatalytic reduction of Dinitrogen - Photocatalysis of Organic reactions.

Unit IV Computational Chemistry

Introduction - Character set in C++ - Tokens - Keywords, identifiers and constants, variables, operators (Input/Output) - Cascading - Selection of statements - IF, IF …..ELSE, SWITCH, WHILE, DO…..WHILE, FOR, BREAK, CONTINUE and GOTO - Functions - Arrays - Classes - Pointers - Inheritance.

C++ programming for the determination of electronegativity of an atom - Lattice energy using Born - Lande equation - Normality, Molarity and Molality of solutions - Solubility of sparingly soluble

salts - Molecular weights of organic compounds - Calculation of delocalisation energy values for aromatic systems.

Unit V Drawing Tools for Chemistry

Chemdraw: Introduction – Features and functionalities - search mode - Exploring the user interface and tool bars - Importing and exporting from chemdraw - Construction of following structures using Chemdraw: Carbohydrates, Amino acids, Lipids, Nucleic acids.

Chem sketch: Introduction - Screen parts and their functions - Features - Chemsketch versus Chemdraw - 2D, 3D optimisation - Application.

Text Books

1. Ramesh Kumari. *Computers and their Applications to Chemistry.* New Delhi: Narosa Publishing House. Second Edition 2005.
2. Jain P.C, Monika Jain. *Engineering Chemistry*. New Delhi, Dhanpat Rai Publishing company Pvt. Ltd. 15th Edition 2011.

Books for Reference

1. Raman K.V. *Computers in Chemistry.* New Delhi: Tata McGraw-Hill Publishing Company Limited. 8th Edition 2005.
2. Viswanathan B, Sivasanker S, Ramaswamy A.V. *Catalysis: Principles and Applications*. Delhi: Narosa Publishing House. 4th Edition 2011.
3. Harish Kumar Chopra, Anupama Parmar. *A textbook of Engineering Chemistry*. New Delhi: Narosa Publishing House. 1st Edition 2008.
4. Gopalan R, Venkappayya D, Sulochana Nagarajan. *Engineering Chemistry II*. New Delhi: Vikas Publications. 2011.
5. Srinivasa V, Uma Mageswari S.D, Meena M. *Engineering Chemistry*. Scitech Publications. 2002.
6. https:// www.acdlabs.com/resources/freeware/chemsketch/
7. Bethany Halford. *Reflections on ChemDraw*. 2014.

3. Shukla, M.C. Grewal T.S. and Gupta S.C. *Advanced Accounts*. New Delhi: S.Chand, 19th edition 2020.
4. Wilson M.*Advanced Accountancy Volume II*. Chennai: SCITECH Publication (India) Pvt.Ltd., 15th edition 2019.

SEMESTER –III			
Core XII	**Human Resource Management**		
Course Code: 21PCOC32	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credits : 4**

Objectives:

- To give a theoretical exposure to the students with regard to various aspects of Human Resource Management.
- To instill in students the various techniques followed in Recruitment, Selection, Induction and Performance Appraisal.
- To familiarize the students with various concepts of WPM, Wage and salary administration, safety and welfare measures, Grievance handling procedure, machinery for settlement of disputes and computer applications in HRM.

Course Outcomes:

CO No.	Upon completion of this course, students will be able to	PSO addressed	Cognitive Level
CO – 1	understand the significance of Human Resource Management.	1,3	Un
CO – 2	understand the process of recruitment, selection, placement and induction.	1,2,3	Un
CO – 3	know the various training methods, executive development programme.	1,7	Ev
CO – 4	understand the various Participative management techniques.	1,7	Ev
CO-5	understand the various compensation plans, reward system and quality of work life.	2,3, 8	Ap
CO – 6	understand the safety and welfare measures.	1,4,8	Ap
CO – 7	understand the procedure for performance appraisal.	1,4,8	Ap
CO – 8	understand and apply grievance handling procedures and machinery for settlement of disputes.	1,4,8	Ap

SEMESTER –III			
Core XII	**Human Resource Management**		
Course Code: 21PCOC32	**Hrs/Week: 6**	**Hrs/Sem: 90**	**Credits : 4**

Unit I Introduction (18 hrs)

Evolution of Human Resource Management – Importance of the Human Resource Management - Objectives of Human Resource Management - Scope of HRM - HRM Models- Role of human resource manager -Skills and qualities of HR manager –Human resource policies

Unit II Man Power Planning and Selection (18 hrs)

Importance of Human Resource Planning – Forecasting human resource requirement-Man power planning techniques - Recruitment and Selection - Sources of recruitment-Selection process - Screening tests – Interviews - Placement - Induction – Orientation– Socialisation.

Unit III Training and Development (18 hrs)

Objectives of training – Training needs - Training methods – Benefits – Executive development programmes – Common practices – Organisation development – Self development– Knowledge management.

Unit IV Sustaining Employee Interest (18 hrs)

Motivation – theories and application – Rewards – Job analysis- Job satisfaction - Job design -Empowerment of employees – Workers participation in management - Quality of work life - Career management - Career planning- Development cycle - Need assessment – Employee Compensation plans - Employee Benefits - Safety and Welfare.

Unit V Performance Evaluation and Control Process (18 hrs)

Job evaluation - Performance Appraisal: process, methods of performance appraisal-feedback– industry practices - Control process: Importance, Methods – Requirement of effective control systems – HR Audit- HR Accounting-HRIS-Grievance: causes, handling procedure-Types of industrial disputes-Machinery for settlement of disputes- Computer applications in HRM.

Text Book:

1. Aswathappa K. *Human Resources Management*. New Delhi: Tata McGraw Hill. Third re-print, 8th edition 2017.
2. Khanka S.S. *Human Resources Management*. New Delhi: S.Chand & Co.Ltd. 2nd edition 2019.

Books for Reference:

1. Rao V.S.P. *Human Resources Management.*New Delhi: Excel Books. 2nd edition Aug,2020
2. Tripathi P.C. *Human Resources Development.*New Delhi: Sultan Chand. 7th Reprint 2015.
3. Mamoria, C.B. and Gankar, S.V. *Human Resources Management*. Mumbai: Himalaya Publishing House. 13th edition Jan.2014

SEMESTER –II			
Elective I B	**Green Marketing**		
Course Code: 21PCOE21	**Hrs/Week: 5**	**Hrs/Sem: 75**	**Credits : 4**

Objective

- Increase the consciousness about Green Products**.**
- Make the students understand the importance of Green Marketing on consumer satisfaction anenvironmental safety.

Course Outcomes:

Co.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	discuss the concept of Green market and Green products.	1,3	Un
CO-2	assess Green Marketing and its significance.	2,4	An
CO-3	Identify the factors that affect purchase decision of consumers.	3,6	Un
CO-4	appraise the laws that promote Green Marketing.	1,8	Ev
CO-5	manage e waste.	1,8	Ap
CO-6	use Eco friendly products.	4,6	Ap
C0-7	Initiate adoption of green initiatives.	5,7	Ap
CO-8	appraise the green environment policies.	1,7	An

SEMESTER –II			
Elective I B	**Green Marketing**		
Course Code: 21PCOE21	**Hrs/Week: 5**	**Hrs/Sem: 75**	**Credits : 4**

Unit I Green Product and Green Marketing **15 Hrs**

Green Product - Green Marketing - Evolution of Green Marketing - Importance of green marketing - Benefits of Green Marketing- Adoption of Green Marketing- Green Marketing Mix – Strategies to Green Marketing

Unit-II Green Marketing Concepts **15 Hrs**

Green Spinning – Green Selling – Green Harvesting – Enviropreneur Marketing - Compliance Marketing – Green Washing – Climate Performance Leadership Index

Unit-III Green Marketing Initiatives **15 Hrs**

Green Firms – HCL's Green Management Policy – IBM's Green Solutions – IndusInd Bank's Solar Powered ATMs – ITCs Paperkraft – Maruti's Green Supply Chain – ONCGs Mokshada Green Crematorium – Reva's Electric Car – Samsung's Eco-friendly handsets- Wipro Infotech'sEco-friendly computer peripherals

Unit-IV Purchase Decision **15 Hrs**

Meaning of Purchase decision – Factors affecting Purchase decision - Steps in the decision making process - Five stages of consumer buying decision process - Models of buyer decision-making

Unit-V Environmental Consciousness **15 Hrs**

Introduction of Environment - Importance of environmentalism - Environmental movement - Benefits of green environment to the society - e-Waste exchange - Extended Producer Responsibility Plan - Guidelines for Collection and Storage of e-Waste - Guidelines for Transportation of e-Waste - Guidelines for Environmentally Sound Recycling of e-Waste

Text Book:

1. Esakki and Thangasamy.*Green Marketing and Environmental Responsibility in Modern Corporations.*Pennyslyvania:IGI Global, First Edition 2017.

Books for Reference:

1. Robert Dahlstrom, Cengage. *Green Marketing Management*, Learning, Mason13th edition 2010.
2. Jacquelyn A. Ottman. *Green Marketing: Challenges and Opportunities for the NewMarketing Age.* NTC Business Books, UK 1993.
3. Jacquelyn A. Ottman,Berrett. *The New Rules of Green Marketing*. Koehler Publishers, San Francisco 2011

Semester– I			
Core - V	**ECONOMICS OF FARM BUSINESS**		
Course Code: 21PECC15	**Hrs/Week: 6**	**Hrs/ Semester: 90**	**Credits: 4**

Objectives:

- To explain the fundamental aspects of managing a farm business
- Interpret and analyse the financial and economic performance of a farm business
- Apply appropriate economic and financial techniques to analyse new farm investments
- Select and apply appropriate methods for analyzing risk and uncertainty involved in farm business decisions

Course Outcome:

CO. No	Upon Completion of this course, students will be able to	PSO addressed	CL
CO - 1	apply economic principles to understand the conduct and performance of agricultural sector.	2	Ap
CO - 2	understand the causes of green revolution.	3	Kn
CO - 3	understand role and impact of institutional support to agricultural sector.	5	Le
CO - 4	be able to demonstrate an awareness of various agricultural market structures.	4	Kn
CO - 5	understand the role of pricing policy in agricultural sector.	8	Ev
CO - 6	be able to identify core principles of micro economics, especially related to agricultural production, cost analyses price and application of this is economics principles to selected farm management problems.	5	Kn
CO - 7	demonstrate strong conceptual knowledge of farm business	6	Re
CO - 8	develop critical thinking and problem solving skills applicable to farm business and management practices	7	Kn

Semester– I			
Core - V	**ECONOMICS OF FARM BUSINESS**		
Course Code: 21PECC15	**Hrs/Week: 6**	**Hrs/ Semester: 90**	**Credits: 4**

UNIT-I: Principles of Farm Management **20 Hrs**

Meaning and Scope of Farm Management –Importance of the Subject of Farm Management In India. Principals Involved In Farm Management Decisions: Principle of VariableProportion - Cost Principle - Principles of Factor Substitution - Law of Equimarginal Return - Opportunity Cost Principle - Principle of Combining Enterprises

UNIT- II: Farm Resources **15 Hrs**

Green Revolution - Agriculture Inputs: Fertilizers and Plant Protection, Irrigation and Farm Mechanization - Concept of Agricultural Labourer – Growth, Causes of Growth – Conditions and Problems of Agricultural Laborers and Measures Taken.

UNIT-III: Capital and Credit **15 Hrs**

Role of Capital in Agriculture - Sources of Capital - Need for Agricultural Credit - Classification of Agricultural Credit - Source of Agricultural Credit: Non-institutional and Institutional – Crop Insurance - Capital Formation In Agriculture Sector.

UNIT-IV: Marketing **20 Hrs**

Functions of Marketing - Characteristics of Agricultural Produce – Defecting In Marketing of Agricultural Produce In India – Measures Taken By Government – Regulated Markets Co-Operative Marketing – Marketed and Marketable Surplus, Marketing Costs and Margin.

UNIT-V: Price Policy and Public Distribution **20 Hrs**

Need For and Objectives of Agricultural Price Policy - Instruments of Agricultural Price Policy in India: Support, Procurement And Issue Prices - Public Distribution – Buffer Stock – Agricultural Trade and Balance of Payment With Special Reference To Agricultural Commodities.

Text Book:

S.S.Johl and Kapur. *Fundamentals of Farm Business Management*- New Delhi: Kalyani Publishers, 2nd edition 2006

REFERENCES:

1. A.N.Sharma and V.K.Sharma. *Elements of Farm Management*. New Delhi: Prentice-Hall ofIndia Pvt. Ltd, 3rd edition 2000.
2. Sadhu and Singh. *Fundamentals of Agriculture Economics*.Bombay: Himalaya PublishingHouse,1999
3. Earl.O.Heady. *Economics of Agricultural Production & resources.*New Delhi:Prentice Hall, 2008
4. Rudder Datt and K P M Sundaram. *Indian Economy*.New Delhi: S.Chand & Company Ltd, 3rdedition 2011

Semester- II			
Core - IX	**DEMOGRAPHY**		
Course Code: 21PECC24	**Hrs/Week: 5**	**Hrs/ Semester: 75**	**Credits: 4**

Objectives:

- To enable the students to make the best use of relevant demographic statistics in development analysis
- To provide students with a background for further delving into the subject.
- To help students get a better understanding of the current demographic profile of India.
- To enable the students with different sources of population data in India.
- To familiarized with different techniques of data analysis.

CO. No	Upon Completion of this course, students will be able to	PSO addressed	CL
CO -1	compare the advantages and disadvantages of the different sources of demographic data	7	Le
CO - 2	present appropriate techniques to ensure comparability of the measures across population.	2	Kn
CO - 3	describe the basic demographic indicators and elaborate on their computation and interpretation	1	Kn
CO - 4	discuss the key assumptions underlying techniques and tools.	6	Le
CO - 5	describe the relations and calculate indicators in a stationary population.	8	Kn
CO - 6	estimate the rate of change in population.	5	Un
CO - 7	define and differentiate the demographic concepts.	7	Ap
CO - 8	recognize and analyse typical demographic patterns arising from the data.	3	Kn

Semester- II			
Core - IX	**DEMOGRAPHY**		
Course Code: 21PECC24	**Hrs/Week: 5**	**Hrs/ Semester: 75**	**Credits: 4**

UNIT-I: Introduction **15 Hrs**

Meaning and Scope of Demography - Components of Population Growth and their Interdependence - Measures of Population Change - Growth, Structure and Distribution-Sources of Population Data

UNIT-II: Historical and Regional Trends **15 Hrs**

Population Trends in the Modern Era - Trends in Population (from 1965 onwards) – Population Explosion as a recent Phenomenon in the Perspective of Human History - Estimates of Sizes and Rate of Growth of Population in the Recent Years - Shifting Proportions of Human Population and Density in Different Regions.

UNIT-III: Sex and Age Structure **15 Hrs**

Patterns of Sex and Age Structure in More Developed and Less Developed Countries - Determinants of Sex and Age Structure - Age Structure - Economic and Social Implications of Sex and Age Structure- Demographic Dividend.

UNIT-IV: Techniques of Demographic Analysis **15 Hrs**

Crude Birth and Death Rates, Age Specific Birth and Death Rates - Standardized Birth andDeath Rates - Study of Fertility: Total Fertility Rate, Gross Reproduction Rate, and Net Reproduction Rate - Study of Marital Status - Life Table- Reproductive and Child Health in India – Temporal and Spatial Variations in Sex Ratios.

UNIT-V: Population Projections and Population Policies **15 Hrs**

Techniques of Population Projection - Concept of Stationary, Stable and Quasi –Stationary Population - Ageing of Population - Changes in Family Structure and Old Age Security. Definition and History of Policies affecting fertility in Developing and Less Developed Countries

Text Book:

Agarwal U.D.*Population Projections and Their Accuracy* - New Delhi: J.P.Publishers,2000

Books for Reference:

1. Bhende A and Kanitkar T. *Principles of Population Studies*. Mumbai. Himalaya Pub.,House, 1989
2. Bogue D.J. *Principles of Demography*.New York : John Wiley3rd edition 1999
3. Hans Raj, *Fundamentals of Demography*. Delhi:Surjeet Publications, 2nd edition2000.

Semester – III			
Core - XIII	**RURAL DEVELOPMENT**		
Course Code: 21PECC33	**Hrs / Week: 5**	**Hrs / Semester: 75**	**Credits : 4**

Objectives:

- To get employment in the department of rural development and Panchyatraj of both State and Central.
- The objective of this course is to provide a detailed treatment of issues pertaining to rural development to those intending to specialize in this area.
- To familiarize students with the theory of rural development issues those are relevant to Indian countryside and enable them to understand and analyze the problems of rural development.

CO. No	Upon Completion of this course, students will Be able to	PSO addressed	CL
CO - 1	help in prediction, formulating suitable policies, simplify mass of figures, facilitate comparison ofdata ,learn software programmes to analyze the statistical techniques.	7	Le
CO - 2	understand different categories of rural development policies and programmes and itsimpact on rural poverty and unemployment.	2	Un
CO - 3	inculcate about the scope, importance and sources of micro finance, SHGS and womenempowerment.	8	Un
CO - 4	know the importance, structure, significance, resources of Indian rural economy.	3	Ap
CO - 5	learn basic mathematics to analyze and understand economic problem to estimate Marginal value, rate of change, maxima and minima value, profit maximization and cost minimization, consumer and producer surplus, etc..	7	Kn
CO - 6	know different theories of international trade and finance and its impact on Indianeconomy.	6	Le
CO - 7	understand the problem of rural sector, backwardness, income inequalities, regional imbalances, gender disparities and remedial measures.	5	Kn
CO - 8	understand the economic behaviour of consumers and producers at micro and macro level.	6	Re

Semester – III			
Core - XII	**RURAL DEVELOPMENT**		
Course Code: 21PECC33	**Hrs / Week: 5**	**Hrs / Semester: 75**	**Credits : 4**

UNIT-I: Rural Development **15 Hrs**

Meaning, Definition, Scope and Concept of Rural Development, Components of Rural Development, Pre-Independence Rural Development Programmes

UNIT-II: Approaches and Policies for Rural Development **15 Hrs**

Approaches for Rural Development: Broad Front Approach, Sectoral Approach-Policies for Rural Development: National Forest Policy-National Water Policy and National Agricultural Policy.

UNIT-III: Rural Development Programmes15 Hrs

Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)-Pradhan Mantri Gram SadakYojana (PMGSY) - Bharat Nirman – Swachh Bharat, P.M Jandhan Yojana- National Rural Health Mission (NRHM).

UNIT-IV: Area Development Programmes: **15 Hrs**

Drought Prone Area Programme (DPAP)-Desert Development Programme (DDP)-Tribal and Hill Area Development Programme (THADP) - Integrated Wastelands Development Programme (IWDP)

UNIT-V: Rural Development and Welfare Schemes in Tamil Nadu: **15 Hrs**

SC&ST Sub-Plan - Social Security Scheme - Old Age Pensions-Widow Pensions-Disabled Pensions-Maternity Aid to Pregnant Women

TEXT BOOKS:

Katar Singh. *Rural Development principles, policies and Management*. NewDelhi:Sage publications, 2nd edition 1999

Reference Books:

1. M.J. Moseley. *Rural Development: Principles and Practice.* New Delhi: SagePublications 6th edition 2013
2. K. Sahu. *Rural Development in India*. New Delhi: Anmol Publications, 4th edition 2003
3. Todaro M.P. *Economic Development in III World.* New Delhi: Orient Long Man,3rdedition 1985
4. R. Chambers. Rural development. New Delhi: Putting the Last First, Longman,2ndedition 1983
5. Arora R.C *Integrated Rural Development in India*. New Delhi: S.Chand Publications,1stedition 1980.

Semester – IV			
Core - XVII	**ENVIRONMENTAL ECONOMICS**		
Course Code: 21PECC 42	**Hrs/Week: 6**	**Hrs/ Semester: 90**	**Credits: 4**

Objectives:

- To understand the role of economics in environmental issues and in the formation of environmental policy.
- To express an informed view on the role, contribution, and limitations of economic tools in providing policy guidance on environmental issues.
- To provide the students with a thorough knowledge and understanding of the foundations of environment economics.

Course Outcome:

CO. No	Upon Completion of this course, students will be Able to	PSO addressed	CL
CO - 1	apply microeconomic theory to the study of environmental issues.	2	Ap
CO - 2	identify and critically evaluate alternative environmental policy instruments.	3	Kn
CO - 3	develop written and verbal skills in communicating an environmental economic perspective.	5	Le
CO - 4	enhance the student's ability to conduct professional economic research and to develop and present professional proposals, papers, and presentations	4	Le
CO - 5	increase the student's ability to analyze environmental policies through a deeper understanding of economic behavior and incentives	8	Un
CO - 6	analyze the environmental policy practices in the real world using economics methods and tools.	5	Kn
CO - 7	demonstrate the ability to model environmental policy issues using fundamental environmental and economics skills.	6	Un
CO - 8	engage in self-directed research and learning about environmental economics.	7	Kn

Semester – IV			
Core -XVII	**ENVIRONMENTAL ECONOMICS**		
Course Code: 21PECC42	**Hrs/Week: 6**	**Hrs/ Semester: 90**	**Credits: 4**

.

UNIT-I: Introduction **20Hrs**

Meaning of Environment - Environmental Economics - Nature & Scope - significance - fundamentals of Environmental Economics - Importance of Environmental Economics-Functions and Objectives-Role of economic environment-Environmental economics issues

UNIT-II: Theory of Environmental Economics **15Hrs**

Basic theory of Environmental Economics - Environmental quality as a public good - forms of environmental quality-– Environmental issues- Natural Resource of Environmental Economics -Conservation of Natural Resources.

UNIT-III: Environmental Education **15Hrs**

Environmental Education -Environmental awareness - Education through Environmental movements - Environmental Education and Training Program-Environmental education grants – Environmental Internships and fellowships-Environmental education awards

UNIT-IV: Environmental Pollution **20Hrs**

Environmental Pollution –Types of Pollution (Air, Water, *Land*, Noise, Indoor and Nuclear) - Forest and Environmental quality - urbanization and its impact on environment - population and environmental quality - pollution control and Environmental protection- Environmental Problems.

UNIT-V: Economics of Solid Waste Management **20Hrs**

Define Solid Waste Management – Types and impacts- - Solid Waste Disposal and Management- Methods of Solid Waste Disposal and Management- Methods of Solid Waste Management- Categories of Waste- recycling and reuse of solid waste management.

Text book:

S. Sankaran. *Environmental Economics.* Chennai: Margham Publications, 2nd edition 2013

Reference Books :

1. M. Karpagam.*Environmental Economics.* New Delhi : Sung Publication Pvt.Ltd,2nd edition2011
2. T. Eugene.*Environmental Economics.*New Delhi:Virinda Publication Pvt. Ltd, 2010
3. Dorfman, Robert and Nancy Dorfman.*Economics of Environment*. Bombay:W.W.NortoCompany 2nd edition 2000

Semester- III			
Core Elective - II	**HUMAN RESOURCE MANAGEMENT**		
Course Code: 21PECE 31	**Hrs/Week: 4**	**Hrs/ Semester: 60**	**Credits: 4**

Objectives:

- To make student familiar with the principles of Management at business organizations.
- To know administration's functions which lead companies and organizations to success, by focusing on practice in the local environment.

CO. No	Upon Completion of this course, students will be able to	PSO addressed	CL
CO - 1	explain the importance of human resources and their effective management in organizations	7	Re
CO - 2	demonstrate a basic understanding of different tools used in forecasting and planning human resource needs	2	Kn
CO - 3	analyze the key issues related to administering the human elements such as motivation, compensation, appraisal, career planning, diversity, ethics, and training	8	Ap
CO - 4	research the advantages and disadvantages of induction processes for new incumbents in a role	3	Re
CO - 5	develop, analyze and apply advanced training strategies and specifications for the delivery of training programs	4	Kn
CO - 6	describe appropriate implementation, monitoring and assessment procedures of training	6	Le
CO - 7	describe the fundamental concepts and rules of law that apply to business activities, the employment function, and labour	5	Kn
CO - 8	describe trends in the labour force composition and how they affect human resource management	1	Un

Semester- III			
Core Elective -II	**HUMAN RESOURCE MANAGEMENT**		
Course Code: 21PECE 31	**Hrs/Week: 4**	**Hrs/ Semester: 60**	**Credits: 4**

UNIT-I: Nature and Scope **10Hrs**

Human Resource Management: Meaning and scope, functions and objectives - HRMModel - Human Resources planning - Job design and Job analysis.

UNIT-II: Recruitment and Selection **15Hrs**

Recruitment: Definition - Recruitment process and screening - Definition of Selection and role -Selection process - New Methods of Selection – Absenteeism and labour turnover: Determinantsand types – Motivation.

UNIT- III: Training and Development **10Hrs**

Nature and Importance of Training and Development - Impediments - Effective TrainingPerformance Appraisal and Organizational Strategy

UNIT-IV: Employee Remuneration **10Hrs**

Theories of Remuneration - Ideal Remuneration - Factors influencing remuneration - types ofincentives schemes

UNIT-V: Benefits, Safety and Welfare **15Hrs**

Types of Benefits and Services -Principles of Fringes -Empowerment - Quality of Work Life -Welfare Measures - Need for Safety and health -Business ethics - Human Resource Audit

Text Book:

R.D. Agarwal .*Dynamics of Personnel Management in India*. New Delhi:SkylarkPublication. 13th edition 1994

Reference Books:

1. Swathappa.*Human Resources and Personal Management*.New Delhi:Tata McGraw HillPublishing Co.Ltd. 4th edition 2003
2. John Storey. *Human Resource Management*.New Delhi: Rutledge Publications,2nd edition 1995
3. Terry, L. Leap, Michael D. Crino.*Personnel / Human Resource Management*. Chennai:Macmillan Publications, 3rd edition 2012
4. C.S. Venkataratnam and B.K. Srivastav.*Personal Management & Human Resources.*
    a. New Delhi:Tata McGraw Hill Publishing & Co.2nd edition 1991.

SEMESTER – I			
Core V	**Eco Literature**		
Course Code: 21PENC15	**Hrs/week : 6**	**Hrs/Sem : 90**	**Credits : 4**

Objectives:

To provide students with the fundamental aspects of Eco Literature.

To create ecological perspective and eco-consciousness among students.

Course Outcome:

CO. No.	Upon completion of this course, studentswill be able to	PSO addressed	Cognitive Level
CO-1	understand the recent trends and theories in Eco Literature.	2,3	Un
CO-2	acquire an in-depth knowledge of the relationship between literature and the physical environment.	1,4	Un
CO-3	relate life and environment through literature.	1	Ap
CO-4	appreciate the literary value of Eco Literature.	2,3	Ap
CO-5	analyse Literature in its universal context of the environment.	4,6	An
CO-6	analyse and evaluate any work of art in eco-conscious perspective.	8,9	Ev
CO-7	explore the themes of Eco Literature.	1	An
CO-8	apply the current theories and analyse their impact on literature.	3	An

SEMESTER – I			
Core V	**Eco Literature**		
Course Code: 21PENC15	**Hrs/week : 6**	**Hrs/Sem : 90**	**Credits : 4**

Unit I Introduction to Ecological Studies

Cheryl Glotfelty (b 1958) : Introduction- *The Ecocriticism Reader*

Greg Garrard (b 1953) : *Ecocriticism* (Positions)

Unit II Poetry

Saint Francis of Assissi (1I81-1226) : Canticle of the Sun
W.B. Yeats (1865-1939) : Lake Isle of Innisfree
Sri Aurobindo (1872-1950) : To a Hero Worshipper
Khalil Gibran (1883-1931) : Song of the Rain

Unit III Drama

Henrik Ibsen : *An enemy of the people*

Samuel Beckett (1906-1989) : *End Game*

Unit IV Fiction & Short Stories

Ernest Hemingway (1899-1961) : *The Old Man and the Sea*
Sinclair Ross (1908-1996) : The Lamp at Noon
Jean Ryan (b 1955) : Survival Skills

Unit V Films

James Cameroon : Avatar

Ron Clements & John Musker : Moana

Text Books:

1. Beckett, Samuel. *End Game.* UK: Faber & Faber Publishers*,* 2009.
2. Hemingway, Ernest. *The Old Man and The Sea.* US: Scribner Book Company, 1952.
3. Synge, J. M. *The Aran Islands*. Illinois: Northwestern University Press, 1999.
4. *Avatar* Dir.by Cameroon, James. Twentieth Century Fox, 2009.
5. *Moana* Dir.by Clements.R and John Musker,.Walt Disney Studios, Motion Pictures, 2016.

Books for Reference:

1. Glotfelty, Cheryl& Fromm, Harold, eds. *The Ecocriticism Reader*. London: The University of Georgia Press, 1996.
2. Garrard, Greg. *Ecocriticism.* London: Routledge, 2004.
3. Synge, J. M. *The Aran Islands*. Illinois: Northwestern University Press, 1999.

E- Resources:

1. Adamson, Joni, et al., editors. *Keywords for Environmental Studies*. NYU Press, 2016. *JSTOR*, www.jstor.org/stable/j.ctt15zc5kw.
2. Gurko, Leo. "The Heroic Impulse in '*The Old Man and the Sea*.'" *The English Journal*, vol. 44, no. 7, 1955, pp. 377–382. *JSTOR*, www.jstor.org/stable/808247. 18 Feb. 2021.
3. Hopper, Keith. "A Sense of Place: W. B. Yeats and 'The Lake Isle of Innisfree'." *Geography*, vol. 93, no. 3, 2008, pp. 176–180. *JSTOR*, www.jstor.org/stable/40574283. 11 Jan. 2021.
4. Olk, Claudia. "'A Matter of Fundamental Sounds' — The Music of Beckett's Endgame.' *Poetica*, vol. 43, no.3/4, 2011, pp. 391–410. *JSTOR*, www.jstor.org/stable/43028518.09.Oct.2020.
5. Mambrol, Nasrullah. "Analysis of John Millington Synge's Plays" https://literariness.org/2019/05/09/analysis-of-john-millington-synges-plays/ 30567860. 12 Jan. 2020.
6. Kelsall, Malcolm. Synge in Aran. Pub. by Edinburgh University Press. Vol. 5, No.2 (Autumn 1975), pp. 250-270 *JSTOR*.https://www.jstor.org/stable/23477073

Semester – II			
Core VIII	**Women's Writing**		
Course Code: 21PENC23	**Hrs / Week : 5**	**Hrs / Sem : 75**	**Credits : 4**

Objectives:

To familiarise students with the nuances of women's writings in English.

To explore the ideologies of women writers across cultures.

Course Outcome:

CO. No.	Upon completion of this course, students will beable to	PSO addressed	Cognitive Level
CO-1	know the range of feminist perspectives on literature.	1,8	Re
CO-2	analyse women writers who wrote about womanhood and authorship, from the 16th to the 20th Century	2,7	An
CO-3	discuss the issues pertaining to social conflicts in women's writings.	4	An
CO-4	discuss the women writers who challenged gender stereotypes and questioned the patriarchal status quo.	4,6	An
CO- 5	explore the writers' philosophy, aesthetics and techniques.	4	Ev
CO-6	classify the changing role women have experienced culturally, sexually, and psychologically .	3	Ev
CO-7	explore the ideologies and nuances of women writers and their works.	1,2	Ev
CO- 8	explore the ideals of women writers across cultures.	1,6	Cr

SEMESTER – II			
Core VIII	**Women's Writing**		
Course Code: 21PENC23	**Hrs / Week: 5**	**Hrs / Sem: 75**	**Credits: 4**

Unit I - Poetry

Edith Sitwell (1887-1964)	:	A Mother to her Dead Child
Judith Wright (1915-2000)	:	Woman to Man
Gwendolyn Brooks (1917-2000)	:	A Sunset of the City
Carolyn Kizer (1925-2014)	:	Fearful Woman
Rita Dove (b 1952)	:	The Fish in the Stone

Unit II - Prose

Ruth Jhabvala (1927-2013)	:	Myself in India
Simone De Beauvoir	:	The Independent Woman (Chapter XIV)

Unit III -Short Stories

Eudora Welty (1909-2001)	:	Livvie is Back
Florence King (1936-2016)	:	Junior High

Unit IV -Drama

Lorraine Hansberry (1930-1965)	:	*A Raisin in the Sun*

Unit V -Fiction

Buchi Emecheta (1944-2017)	:	*The Joys of Motherhood*

Text Books:

1. De Beauvoir, Simone. *The Second Sex.* London. Vintage Publishers, 2011.
2. Emecheta, Buchi. *The Joys of Motherhood.* London. Alison and Busby, 1979.
3. Hansberry, Lorraine. *A Raisin in the Sun*. New York: Vintage Publications, 2004.

Books for Reference:

1. Prasad, Amar Nath. *Indian Writing in English: Past and Present.* New Delhi: Sarup & Sons, 2004.
2. Radhakrishan Pillai .G. *An Anthology of English Prose*. England: Cambridge University Press India, 2006.
3. Finke, Laurie A. *Feminist Theory, Women's Writing.* Ithaca: Cornell University Press.
4. Joannou, Maroula, ed. *The History of British Women's Writing, 1920-1945* Vol. 8. Hampshire: Palgrave Macmillan, 2013.

E- Resources:

1. Helaly, Mohamed. (2016). *Cultural collision and women victimization: A study of Buchi Emecheta's the joys of motherhood* (1979). 7. 70-80. 10.7813/jll.2016/7-1/10. 21 Jan 2021.

2. Prior, Pauline M. “The Death of a Child.” *The British Journal of Social Work*, vol. 11, no.3, 1981, pp. 315–327. *JSTOR*, www.jstor.org/stable/23698604. 12 Dec. 2020. Web Robolin, Stéphane. “Gendered Hauntings: ‘The Joys of Motherhood," Interpretive Acts, and Postcolonial Theory.” *Research in African Literatures*, vol. 35, no. 3, 2004, pp. 76 – 92. *JSTOR*, www.jstor.org/stable/3821295. 11 Nov. 2020.

Semester IV			
Core XIX	**Subaltern Literature**		
Course Code : 21PENC44	**Hrs / Week : 6**	**Hrs / Sem : 90**	**Credits : 4**

Objectives:

To familiarise students with the voices of oppression in literature

To orient and sensitize students on marginalization and the crisis of subalternity.

CO. No.	Upon Completion of this course, students will be able to	PSO addressed	Cognitive Level
CO-1	comprehend the unique features of subaltern literature	1	Un
CO-2	discuss the contemporary subaltern writers and their key concepts.	2	Un, An
CO-3	identify the conflicting issues in Dalit movement.	4	Un, An
CO-4	analyse the cultural aspects of the marginalized people	1, 4	An
CO-5	examine the economic problems and oppression of the exploited.	5	An, Ev
CO-6	investigate the issues of gender, race, and identity crisis of the outcast.	5, 4	Ap, An, Ev
CO-7	develop their ability to recognize the psychic problems of the oppressed.	5	An, Un, Cr
CO-8	create an awareness about the social and political problems of the oppressed.	4, 10	Cr

Semester IV			
Core XIX	**Subaltern Literature**		
Course Code : 21PENC44	**Hrs / Week : 6**	**Hrs / Sem : 90**	**Credits : 4**

Unit I: Poetry

Langston Hughes (1901-1967)	:	The Negro Speaks of Rivers
Henry Kendall (1926-1999)	:	The Last of His Tribe
Kath Walker (1920 – 1993)	:	Song of Hope
Maya Angelou (1929 – 2014)	:	Still I Rise
Meena Kandasamy (1984 -)	:	One-Eyed

Unit II: Prose

Ngugi WaThiango (b. 1938)	:	*Decolonising the Mind*- The Quest for Relevance
Gayatri Spivak (b.1942)	:	Can the Subaltern Speak?
Chimamanda Ngozi Adichie (1977)	:	We Should All Be Feminists

Unit III: Drama

Ama Ata Aidoo (b. 1942)	:	*The Dilemma of a Ghost*

Unit IV: Fiction

E. R. Braithwaite (1912-2016)	:	*Honorary White*
Bama (b.1958)	:	*Sangati*

Unit V: Short Story

Prem Chand (1880 -1936)	:	The Thakur's Well
Saadat Hasan Manto (1912-1955)	:	A Tale of 1947
Chinua Achebe (1930-2013)	:	The Mad Ma

Text Books:

Aidoo, Ama Ata. *The Dilemma of a Ghost and Anowa*. 2nd edition, Longman, 1965.
Bama. *Sangati*. Oxford University Press, 2009.
Braithwaite, E. R. *Honorary White.* Open Road Media, Reprint Edition, 2014.
Thiango, Ngugi wa. *Decolonising the Mind: The Politics of Language in African Literature*. East
African Educational Publishers Ltd., 1986.

Books for Reference:

Ambedkar, B.R. "Annihilation of Caste." Dr. Babasaheb Ambedkar: Writings and Speeches. Vol. 1. Education Department, Government of Maharashtra, 1979. Chapters: 4, 6, and 14.

Bharathi, Thummapudi. Ed. *Telugu Dalit Poetry Today*. Sahitya Akademi, 2016.

Chaturvedi, Vinayak, ed., *Mapping Subaltern Studies and the Postcolonial*. Np, 2000.

Dipesh Chakrabarty, A Small history of Subaltern studies:2000. Habitation of Modernity: Essays in the Wake of Subaltern Studies. Chicago p, 2002.

Spivak, Gayatri Chakraborti. "Subaltern Studies: Deconstructing Historiography."

Ed. Ranjith Guha, *Writings on South Asian History and Society*. Vol IV. OUP, 1985.

E-Resources

https://searchworks.stanfor.edu/view/853370

https://mgkvp.ac.in.Lectures

Semester – II			
Core X	**Indian Art**		
Course Code : 21PHIC25	**Hrs / Week : 5**	**Hrs / Sem : 75**	**Credits : 4**

Objectives:

- To preserve and maintain the heritage of arts.
- To appreciate the contribution of prominent artists.
- To understand the historical significance of Indian art.

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	understand the legacy of our ancestors to art	1	Un
CO-2	assess the architectural styles of different dynasties	5	Ev
CO-3	appreciate the sculptors work	2	Re
CO-4	evaluate the materials of sculpture	5	Ev
CO-5	know the nature of different paintings	1	Un
CO-6	learn the various types of dances	2	Re
CO-7	analyse the work of eminent artists	4	An
CO-8	draw inspiration from eminent artists	4	An

Semester – II			
Core X	**Indian Art**		
Course Code : 21PHIC25	**Hrs / Week :5**	**Hrs / Sem : 75**	**Credits : 4**

Unit I Architecture

Pre - historic Architecture – Indus Valley Architecture – Vedic Architecture - Buddhist Architecture – Gupta Architecture – Hoysalas – Pallavas – Cholas – Pandyas – Vijayanagar – Nayaks – Mughals

Unit II Iconography

Mauryas – Kushanas – Gandhara and Mathura Art – Hoysalas – Pallavas – Cholas – Pandyas – Vijayanagar and Nayaks

Unit III Paintings

Mural paintings – Ajantha – Bagh – Sittanavasal – Tanjavur – Miniature – Mughal – Pahari paintings

Unit IV Visual Arts

Dances: Folk Dances – Bharathanatiyam – Kuchupudi – Kathakali – Disco – Fusion Jazz

Unit V Eminent Artists

Rukmani Devi – Ravi Varma – Padma Subrahmaniam - Asha Bhonsle – Lata Mangeshkar – K. Balachander – Sivaji Ganesan – A.R. Rahman

Textbook:

1. Singhania Nitin. Indian Art and Culture. Chennai:Mc Graw Hill Education Pvt. Ltd.,2020.

Books for Reference:

1. Beach. M.C. *The New Cambridge History of India.* London: Cambridge University Press, 1992.
2. Bharadwaj Manohar. *Cultural and Traditional History of India.* New Delhi: Cyber Tech Publications, 2008.
3. Partha Mitter. *Indian Art.* Oxford History of Art Series. New Delhi: Oxford University Press, 2001.
4. Ray Niharranjan. *An Approach to Indian Art.* Calcutta: University of Calcutta, 1970.
5. Tomory Edith. *A History of Fine Arts in India and the West.* New Delhi: Orient Longman,1982.

Journals:

1. http://citeseerx.ist.psu.edu/viewdoc/summary;jsessionid=84BC561CAD034E544EFCAEBE2D452EE1?doi=10.1.1.732.988&rank=80&q=History%20of%20India&osm=&ossid=
2. http://citeseerx.ist.psu.edu/viewdoc/summary;jsessionid=84BC561CAD034E544EFCAEBE2D452EE1?doi=10.1.1.544.7209&rank=78&q=History%20of%20India&osm=&ossid=

E-Learning Resources:

1. https://knowindia.gov.in/culture-and-heritage/folk-and-tribal-art.php
2. https://www.culturalindia.net/indian-architecture/

Semester–III			
Core – XIV	**Epigraphy**		
Course Code: 21PHIC34	**Hrs/Week: 5**	**Hrs/Sem: 75**	**Credits:4**

Objectives:

- To be aware of the ancient scripts and importance of Inscriptions.
- To highlight the importance of Estampage of Inscriptions and copperplates.
- To know about the various dating methods.

Course Outcome:

CO.NO	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	identify the ancient scripts to determine history.	3	Un, Ap
CO-2	explain the skills of estampaging and learn its historical importance.	1,3	Un,Ap
CO-3	appreciate the importance of epigraphical evidence.	1,2	Un,Re
CO-4	assess the dating methods of various Eras.	4	An
CO-5	understand the sample study of selected inscriptions.	1,2	Un,Re
CO-6	highlight the significance of copper plates.	1,2	Un,Re
CO-7	understand the genealogy of various dynasties.	1,2	Un,Re
CO–8	make aware of eras in historical writings.	1,2	Un,Re

Semester–III			
Core – XIV	**Epigraphy**		
Course Code: 21PHIC34	**Hrs/Week: 5**	**Hrs/Sem: 75**	**Credits:4**

Unit – I Epigraphy

Introduction-meaning – Historical value of inscriptions–Kinds of Inscriptions– Hero Stones –Copper plates.

Unit – II Evolutions of Scripts

Paleography–Pictogram –Ideogram– Logogram–Graffiti –Scripts in Tamil Nadu: Tamil Brahmi – Vatteluthu – Grantha – Evolution of Tamil Script – Writing Materials.

Unit – III Dating Methods

Estampage - Photocopy–Meykirti–Dating Methods -Eras: Kali era –Saka era– Kollam era–Vikrama era–Hijira era–Dual Dating in the Pandya Inscriptions.

Unit – IV Eminent Epigraphists

George Buhler–J.F.Fleet–James Burgess–James Princep – H. Krishna Sastri – V.Venkayya – Robert Sewell–Eugen Hultzsch –K.V.SubramaniaIyer – T.V.Mahalingam – Iravatam Mahadevan – D.C.Sircar.

Unit – V Sample Study of Select Inscriptions

Mangulam Inscription –Poolankurichi Inscription Mandagapattu Inscription-Uttiramerur Inscription - Manur Inscription –Pallan Koil Copper Plates-Tiruvalangadu Copper Plates-Velvikkudi Copper Plates.

Text Book:

1. Venkatraman. R. and Subrahmanian N. *Tamil Epigraphy – A Survey. Vol. I*. Madurai: Ennes Publications,1980.

Books for Reference:

1. Hultzsch. E. *South Indian Inscriptions. Vol. II, Parts. I to V.* New Delhi:Archaeological Department,1983.
2. Minakshi. C. *Administration and Social Life under Pallavas.* Madras:1967.
3. Pandarathar. Sathasiva. T.V. *History of Pandyas.* Madras: 1998.
4. Sircar. D.C. *Indian Epigraphy*. New Delhi: Motilal Banarsidas Publishers Private Limited, 1996.
5. Fleet. J.F. *Indian Paleography*. Delhi: Munishiram Manoharlal Publishers, 2004.
6. Rajan. K. *Early Writing System- A Journey from Graffiti to Brahmi.* New Delhi: 2015.

Journal:

1. https://currentepigraphy.org/

E-Learning Resources:

1. https://youtu.be/MdPb00386Vk

Semester – II			
Core Elective I A	**Archives Keeping**		
Course Code : 21PHIE21	**Hrs / Week : 5**	**Hrs / Sem : 75**	**Credits : 3**

Objectives:

- To develop the skills of data collection.
- To update the recent trends in collection of data.
- To appreciate the importance of Archives in historical writing.

Course Outcome:

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	understand the latest micro filming data collections.	1	Un
CO-2	update the primary sources of History.	7	Ap
CO-3	know the structure and functions of Archives.	1	Un
CO-4	appreciate the work of organisation.	2	Re
CO-5	understand the significance of record maintenance.	1	Un
CO-6	estimate the History of Archives.	5	Ev
CO-7	examine the pool of resources of history.	4	An
CO-8	analyse the mending of records.	4	An

Semester – II			
Core Elective I A	**Archives Keeping**		
Course Code : 21PHIE21	**Hrs / Week : 5**	**Hrs / Sem : 75**	**Credits : 3**

Unit I **Archives**

Origin – Early History – Greece and Rome – Medieval Archives – Creation of Archives

Unit II **Organisation**

Administration of Archives – General Administration

Unit III **Preservation of Archives**

Functions of Archives – Creation of Archives awareness

Unit IV **Uses of Archives**

Authenticity in History – Administrative Values – Intellectual Values – Rules Regulating Access to the Archives – India – Common Rules and Regulations

Unit V **Public and Private Archives**

Kinds – Tamil Nadu Archives – Formation and Development – Saraswathi Mahal Library – Nehru Museum and Library – Parry and Company – Connemara Library – Macqueen – Dodwell

Textbook:

1. Dr. Thiyagarajan J. Archives Keeping. Madurai : Prabha Publications, 2007.

Books of Reference:

1. Baliga. B.S. *Madras Record Office. Indian Archives. Vol. IV.* New Delhi:1952.
2. Cook Michael. *Archives Administration: A Manual for Intermediate andSmaller Organisations and for Local Government.* Kent: 1977.
3. Raj Sundar. M. *A Manual of Archival Systems and the World of Archives.* Chennai: 1999.
4. Schellenberg. T.R. *Model Archives Principles and Techniques.* Chicago: Kansas StateHistorical Society,1956.

E-Learning Resources:

1. http://www.tnarchives.tn.gov.in/
2. http://nationalarchives.gov.in/
3. https://www.chennaimuseum.org/
4. http://keralastatearchives.org/

SEMESTER I			
Core II	Human Resource Management		
Code: 21PHRC12	Hrs/Week: 6	Hrs/Sem: 90	Credits: 4

Objectives:

- To provide a strong grounding in broad based fundamental Human Resource management, knowledge and skills and to prepare students for a meaningful and productive career as Human Resource professionals.

- To develop the analytical skills of the students to think critically so that they align the HRM concepts and strategies with the organisation.

Course outcome:

CO No.	Upon completion of this course students will be able to	PSOs Addressed	Cognitive Level
CO -1	summarize the concepts of Human Resource Management	1	Un
CO-2	interpret the objectives, scope, functions, importance and evolution of HRM and personnel Management.	1	Un
CO-3	examine the approach and process of job design, job analysis, job specification and job description.	1	An
CO-4	formulate the process of selection, placement.	5	An, Cr
CO-5	understand and explain and analyse the induction programme.	1	Un, An
CO-6	examine the process of performance appraisal and potential appraisal.	1	An
CO-7	understand the concept of QWL and QC.	1	Un
CO 8	evaluate job satisfaction, morale, industrial peace and harmony.	1	Ev

SEMESTER I			
Core II	Human Resource Management		
Code: 21PHRC12	Hrs/Week: 6	Hrs/Sem: 90	Credits: 4

Unit I **Introduction to Human Resource Management**

Introduction: Meaning – Scope – Objective – Functions - Importance of Human resource management – Personnel Management and HRM – Similarities and Dissimilarities - Evolution of HRM - Organisation of HRM - Line and staff responsibility - Role of Personnel manager and HR manager – Human resource management practices in India- Jobs and careers in HRM.

Unit II **Analyzing work and Designing jobs**

Job design: Definition – approaches - job design options

Job analysis: Definition – process - benefits of job analysis- potential problems. Job Specification: Definition - Process. Job Description: Definition - Content of Job Description.

Unit III **Recruiting, Selecting, Inducting and Placing New Hires**

Recruitment: Definition- Meaning- Features- Objectives - Process

Selection: Definition – Meaning - Selection Process – barriers to effective selection. Induction: Definition – Meaning – Objectives - Benefits of Induction Programme - Contents of Induction Programme- Phases of Induction Programme. Placement: Definition – Meaning- Placement Process.

Unit IV **Performance Management and Compensation Management**

Performance management: Concept and process - performance appraisal, - potential appraisal. Compensation management: Concept - Forms of Compensation - Types and Structure of Rewards – Objectives of Compensation Management- Factors influencing Compensation Management - Essential elements of a compensation system.

Unit V **e-HRM**

Nature of e-HRM - e-HR activities - e- Recruitment – e- Selection –e-Performance Management – e- Learning – e- Compensation.

Text Book:

Aswathappa.K. *Human Resource Management*. New Delhi; Tata McGraw-Hill Publishing Company Ltd, 7th Edition, 2017.

Books for Reference:

1. Stephen P.Robbins and Decenzo. *Human Resource Management*. New Delhi; Prentice Hall of India Private Ltd, 11th Edition, 2011.
2. KhankaS.S.*Human Resource Management*.NewDelhi;S. Chand & Company Ltd, 2nd Edition,2007.

SEMESTER I			
Core V	Industrial Relations		
Code: 21PHRC15	Hrs/Week: 6	Hrs/Sem: 60	Credits: 4

Objectives:

- To make the students fully competent to meet the challenges in the contemporary and emerging industrial relations which is becoming more complex due to technological interventions and globalization.
- To impart theoretical knowledge that provides a framework to understand the existing industrial relations and the relationship between various stake holders which will enable the students to resolve the challenges in industries and organisations.

Course Outcome

CO No.	On completion of this course students will be able to	PSOs Addressed	C L
CO-1	understand the interaction pattern among labour, management and the State.	2 ,1	Un
CO-2	have a basic knowledge of the Indian Industrial Relations System and it's distinctive features	2 ,1	Un
CO-3	understand the various approaches to Industrial Relations.	2,3	Un
CO-4	examine the concepts, functions, structures and evaluate the problems of trade union.	2	Ev
CO-5	understand the importance, types and process of collective bargaining and discuss the negotiation process during collective bargaining.	2,3	Re , An
CO-6	analyse and apply the concept, forms ,levels of WPM and evaluate the reasons for failure of WPM.	2,3	An, Ap
CO- 7	be efficient enough to handle the grievance measures according to the changing scenario of social and industrial environment.	2,3	Un, Ap
CO -8	state the causes for indiscipline and analyse the code of discipline in Industry.	2,3	Un , Ap

SEMESTER I			
Core V	Industrial Relations		
Code: 21PHRC15	Hrs/Week: 6	Hrs/Sem: 60	Credits: 4

Unit I **Industrial Relation**

Meaning – Introduction - Concept - Importance of Industrial Relations - Scope and Aspects of Industrial Relations - Components of Industrial Relations - Factors affecting Industrial Relations–Perspectives /Approaches to Industrial Relation.

Unit II **Trade unions**

Definition – Features - Functions of Trade unions in India – Principles to regulate Trade Union Function–Types and Structure of Trade Unions - Union Security - Trade union movement in India - Problems of Trade Union.

Unit III **Collective bargaining**

Meaning- Features – Importance – Principles - Process - Forms of Collective Bargaining – Content and coverage of Collective Bargaining Agreement – Collective Bargaining Agreement at different Levels - Process of Negotiation during Bargaining – Recent Trends in Collective Bargaining.

Unit IV **Workers Participation in Management**

Concept – Need for WPM - Objectives of WPM – Forms of Participation – Levels of Participation – Forms of Workers Participation in India – Reasons for failure of WPM in India.

Unit V **Grievance and Discipline**

Grievance: Concept – Causes – Pre-requisites of a Grievance Procedure – Procedure for settlement – Model Grievance Procedure.

Discipline: Definition- Causes of Indiscipline – Objectives of Discipline – The Red Hot Stove Rule - Disciplinary Action - Procedure for punishment – Types of Punishment – Chief features of the Code of Discipline – Objectives of the Code of Discipline- Code of Discipline in Industry.

Text Book:

1. Mamoria, Mamoria and Gankar. *Dynamics of Industrial Relations*. New Delhi;Himalaya Publishing House,13th Edition, 2015.

Book for Reference:

1. ArunMonappa. *Industrial Relation*.NewDelhi ;Tata McGraw Hill, 2nd Edition, 2012.

2.VenkataRathnam C.S and Manoranjan Dhal. *Industrial Relation*.NewDelhi;Oxford University Press, 2nd Edition,2017.

SEMESTER II			
Core VI	Human Resource Planning and Development		
Code: 21PHRC21	Hrs/Week: 6	Hrs/Sem: 90	Credits: 4

Objectives:

- To give an in-depth knowledge of the tools and techniques used by organizations in HR Planning and Development.
- To enable the students to link the human resource planning and development functions to organization's strategies to the meet current challenges.

COURSE OUTCOME:

CO No.	On completion of this course students will be able to	PSOs Addressed	CL
CO-1	understand the objectives, importance and techniques of human resource planning.	1,3	Un
CO-2	know the concepts of job evaluation and job performance.	1,5	Re
CO-3	recall the process, system and strategies of hrd. understand the features and process of career planning.	1	Re
CO-4	discuss the concept of employee empowerment	1,5	Re , Un
CO-5	know the concept managing hr in virtual organisation.	1,3	Re
CO-6	recall and interpret the objectives, scope and steps in hr audit.	1,5	An
CO-7	examine the ethical issues in organization and the factors influencing ethical behaviour at work.	1	An
CO-8	discuss the concept of international human resource management	1,3	Re, Un

SEMESTER II			
Core VI	Human Resource Planning and Development		
Code: 21PHRC21	Hrs/Week: 6	Hrs/Sem: 90	Credits: 4

Unit I **Introduction to Human Resource Planning**

Definition – Objectives – Characteristics - Significance – Need and Importance – Factors affecting HRP - Process of Human Resource Planning - Requirements for Effective HRP – Benefits of HRP – Barriers to HR Planning. HR Supply and Demand Forecasting Techniques

Unit II **Job Evaluation and Performance Evaluation**

Job Evaluation: Concepts-Objectives –-Procedure – Methods – Advantages and Limitations.

Performance Evaluation: Objectives – Uses – Determining the criteria for Performance evaluation- Process of Performance Evaluation – Selection of the Evaluator for conducting Performance Evaluation – Performance Evaluation Methods – The 360 degree Feedback Method- Management by Objectives.

Unit III **Human Resource Development**

Career Planning – Features of career Planning – Objectives of Career Planning – Process of Career Planning _Evaluation of Available Career Opportunities – Implementation and Review –Merits and Limitations of Career Planning. The process and system of HRD – HRD for workers -HRD strategies and experiences. Current trends in Human Resource Planning and Development.

Unit IV **Employee Empowerment and Competency mapping**

Employee Empowerment: Meaning – Approaches – Forms of Empowerment - Life stages of an empowered group – Barriers to Empowerment- Employee empowerment in India : An Overview. Competency mapping – Meaning- Process-Objectives- Methods- Models – Approaches- Merits and Limitations of Competency Mapping.

Unit V **Human Resource Audit, Ethical Issues in HRM and International Human Resource Management**

Meaning – Features – Objectives – Scope – Steps in HR audit – Approaches to HR Auditing – Essential conditions for an Effective HR audit

International Human Resource Management: Types of International Business – Perspective of International HRM – Practices in International HRM. Ethical Issues: Types of Ethics – Ethics and HRM – Approaches to Ethical issues in Organisation- Factors influencing Ethical Behaviour at Work

SEMESTER IV			
Core XVI	**Strategic Human Resource**		
Code: 21PHRC41	**Hrs/Week: 6**	**Hrs/Sem:90**	**Credits: 4**

Objectives:

- To make the students understand the concept and techniques of Strategic Management.
- To help the students to use key strategy concepts and to integrate and apply their learning to various business situations

Course Outcome

CO No.	Course Outcome On completion of this course students will be able to	PSOs Addressed	CL
CO-1	understand the kinds of strategies and importance of strategic management .	**3**	**Un**
CO-2	gain knowledge of strategic management process.	**3**	**Un**
CO-3	understand the strategy formation for objectives, policies and company mission.	**1,3**	**Un**
CO-4	analyse the strategy for internal and external environment.	**3**	**An**
CO-5	gain knowledge and use the business level strategy .	**3,6,7**	**Re , Ap**
CO-6	evaluate the corporate level strategy.	**3,6**	**Ev**
CO-7	describe the concept of strategy implementation.	**3**	**Re**
CO-8	understand the features of effective evaluation and control.	**3,7**	**Un**

SEMESTER IV			
Core XVI	**Strategic Human Resource**		
Code: 21PHRC41	**Hrs/Week: 6**	**Hrs/Sem:90**	**Credits: 4**

Unit I **Introduction to Strategic Management**

Strategy: Introduction- Concept of Strategy- Strategy formation process- Hierarchy of Strategy – Nature of Strategic Management- Strategic management process Conceptual framework for Strategic Management- Strategic Intent - Elements of Strategic Intent.

Unit II **Environmental analysis and Competitive Advantage**

Business Environment – Components of Business Environment – Internal Analysis – Framework - External Environment Analysis – Procedures – Levels – Techniques of External Analysis: ETOP / QUEST / SWOT / PEST Analysis – Porter's Five Forces Model.

Unit III **Strategies and Strategic Choice**

Concept of Corporate Strategy - Types of Corporate level Strategy: stability, expansion, retrenchment and combination - Business level strategy – Strategy in the Global Environment –Strategic Analysis and Choice (SAC): Process of Strategic Analysis and Strategic Choice – Factors affecting Strategic Choice – Tools of Strategic Analysis and Choice: Environmental Threat and Opportunity Profile / SWOT Analysis / McKinsey's 7S Framework / BCG Product- Portfolio Matrix / GE Nine Cell Matrix / Experience Curve / Market Life Cycle Model / Balanced Scorecard.

Unit IV **Strategy Implementation and Evaluation**

Strategic Implementation: Meaning - Definition – Nature – Process – Aspects – Barriers – Resource Allocation: Approaches – Structural Implementation: Types of Organizational Structure – Stages of Organizational Life Cycle – Strategic Evaluation and Control – Nature – Measures –Techniques - Designing Strategic Control Systems – Implementing Strategic Change: Types –Process.

Unit V **Strategic Issues**

Managing Technology and Innovation: Introduction – Nature of Technology – Managing Technology – Innovation – Strategic Issues in Managing Technology and Innovation – Non-Profit Organisations: Strategies of Non-Profit Organisations - Strategic Issues of Non-Profit Organisations – Internet Economy: Strategic guidelines for Internet Economy – New Business Models and Strategies for Internet Economy.

Text Book:

1. Azhar Kazmi, Strategic Management and Business Policy, 3rd Edition, Tata McGraw Hill, 2008.

Books for Reference:

1. John A.Parnell. Strategic Management, Theory and practice Biztantra (2012).
2. Adriau HAberberg and Alison Rieple, Strategic Management Theory & Application, OxfordUniversity Press, 2008
3. Dr.Dharma Bir Singh, Strategic Management & Business Policy, KoGent Learning Solutions Inc., Wiley, 2012.
4. John Pearce, Richard Robinson and Amitha Mittal, Strategic Management, McGraw Hill, 12th Edition, 2012.
5. Dr. Vellaiputhiyavan, Strategic Management, Thakur Publishers, Edition, 2014.

SEMESTER IV			
Core XVII	Human Resource Information System		
Code: 21PHRC42	Hrs/Week: 6	Hrs/Sem:75	Credits: 4

Objectives:

- To inculcate to the students the importance of a robust information collection and management system with a view to understand complex human behaviour and stake holder interest which impact the organisation and its performance.
- To educate the students about the complexity of data which when analysed thoroughly will enable them to understand the driving force behind stake holder behaviour with a view to provide solutions for long term sustenance of the organisation.

Course Outcome:

CO No	Course Outcomes On completion of this course, students will be able to	PSOs Addressed	CL
CO-1	describe the role of Human resource Information Systems in business.	7	Un
CO-2	understand the concepts of HRIS and evaluate the usage of different software packages for HRIS.	7	Un, Ev
Co-3	effectively utilize database, DBMS and RDBMS to organise, store and retrieve data.	7	Un , Ap
CO-4	create database using MS – Access.	7	Un, Ap
CO-5	understand the concepts and methods of HR accounting	7	Un
CO-6	evaluate the steps in system development, and describe the process of system design and implementation.	7	Un, Ev
CO-7	discuss the types of IS threats and various kinds of security technology.	7	An
CO-8	discuss the emerging trends of HRIS and outsourcing of HR	7	An

SEMESTER IV			
Core XVII	Human Resource Information System		
Code: 21PHRC42	Hrs/Week: 6	Hrs/Sem:75	Credits: 4

Unit I **Introduction to HRIS**

HRIS – Meaning - Definition –Importance – Data and Information needs for HR Manager –Structure of HRIS – HRIS subsystems – Mechanics of Human Resource Information Systems (HRIS) - Software Packages For Human Resource Information Systems Including ERP Software Such as SAP, Oracle Financials and Ramco Marshall.

Unit II **Data Base Concepts and Application in HRIS:**

Database Concepts – Data, Information and Knowledge – DBMS Structure – Objectives of Database - Advantages and disadvantages of Database – Subsystems of DBMS – Functions of DBMS –RDBMS –Entities and attributes – tables – Queries- Forms. Data warehousing and Data Mining- Applications of DBMS using MS ACCESS – Designing an MS Access Data base

Unit III **HR Accounting**

Meaning - Definition – Concept – Objectives – Methods of HR accounting – Measuring Human Resource Strength – Skills Measurement – Matching Project requirements.

Unit IV **IS Development, Project Management, System Design and Implementation:**

System Development Life Cycle- System Development Models – Project Management: Planning tools – Project Management Framework – System Design: Definition- Conceptual design- Detailed system design- Implementation: Definition – Process.

Unit V **Security and privacy in HRIS and Future of HRIS:**

Principles of Information security – Threats- Issues of Internet Security - IS Security Technology - Social and Ethical Issues of IS - Information Security management for HRIS – Future of HRIS – Changing world of HR – Integration of HR system – Paperless office and outsourcing of HR.

Text Book:

1. Micheal J. Kavanagh ,*Human Resource Information Systems*.NewDelhi;Sage Publications India Pvt. Ltd, 2015.
2. Goyal.D.P. *Management Information System*.NewDelhi;Vikas Publishing House , 2009.

Books for Reference:

1. Davis.*Management Information System*.Chennai; McGraw Hill Education Pvt Ltd,2013.
2. Jawadekar.*Management Information System*.NewDelhi ;Tata Mc Graw Hill , 2009.
3. James.A.O'Brien.*Management Information System*.Chennai; McGraw Hill Education Pvt Ltd ,2017.

SEMESTER III			
Elective II	**Business Environment**		
Code: 21PHRE32	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 3**

Objectives:

- To enable students to understand and appreciate the influence of the forces in the external economic, political, legal, social, and technological environment on business.
- To impart theoretical knowledge that provides a framework to understand the existing external environment and help in preparing appropriate strategies for organisations to face the challenges.

Course Outcome

CO No.	**Course Outcome** On completion of this course students will be able to	**PSOs Addressed**	**C L**
CO-1	understand the Overview of Business Environment	4	Un
CO-2	gain knowledge of Business and Its Environment and the influence of the forces in the external environment.	4,6	An ,Ev
CO-3	understand the concept of Economic System.	4	Un
CO-4	understand the concept of Political Environment	4	Un ,Ap
CO-5	gain knowledge of the Economic Environment	4,6	Un , An
CO-6	understand the influence of Social Environment in business.	4,6	Un ,Ap
CO- 7	gain knowledge of the technological developments and the impact of informational technology.	4,6	Un , Ap
CO -8	explain the Economics of development and help in preparing appropriate strategies for organisations to face the challenges	4	Re, Un

SEMESTER III			
Elective II	Business Environment		Credits: 3
Code: 21PHRE32	Hrs/Week: 4	Hrs/Sem: 60	

Unit I **Overview of Business Environment**

Basic Concepts of Functioning of an Economy - National Income - Business and Its Environment – Political, Economic, Socio-cultural, Technological, Legal and Ecological environment - India's Population and Its Impact on the Economy.

Political environment: Government and Business - Role of Government in Business - GDP Trend and distribution and Business opportunities- Monetary System- Social and cultural factors and their implications for business.

Unit II **Technology Environment**

Technology Development - Technology Trade and transfer- Technology Trends in India- Role of Information Technology.

E – Commerce: Essential Components, Strategies, Business Models- Digital payment system – Risk in E payment system – Payment security.

Unit III **Economic System**

Economic System -Capitalism- Socialism - Mixed Economy -Public Policies - Business Economic -Monetary and Fiscal Policies- Foreign Trade Policy. Economic Legislation – FEMA- Intellectual Property Rights.

Unit IV **Business Economics**

Meaning and scope of business economics - Objectives of business firms - Demand analysis: Law of demand; Elasticity of demand and its measurement - Consumer behaviour: Utility analysis; Indifference curve analysis - Law of Variable Proportions: Law of Returns to Scale- Theory of cost: Short-run and long-run cost curves - Price determination under different market forms: Perfect competition; Monopolistic competition; Oligopoly- Price leadership model; Monopoly; Price discrimination - Pricing strategies: Price skimming; Price penetration; Peak load pricing – Competition Act.

Unit V **The Economics of Development**

The Economics of development - Stages and Strategies of Economic Growth - Role of the State in Economic Development-Economic Planning; New Economic Policy (1991)- India in the Global Economic System – FDI- WTO - World Bank- IMF.

Text Book:

1. Francis Cherunilam.,*Business environment: Text and Cases*. Bangaluru Himalaya Publishing House,2009.

Books for Reference:

1. Fernando. A.C. *Business Environment* . New Delhi; Pearson Education,2011.
2. Paul, Justin .*Business Environment: Text andCases*. New Delhi ;McGraw Hill Education, 2010.
3. Murthy C.S.V, E-Commerce Concepts, Models, Strategies, Mumbai, Himalaya Publishing House. Edition 2016

SEMESTER I			
Core – II Microbial Diversity and Classification			
Course Code : 21PMIC12	**Hrs/ Week: 5**	**Hrs/ Sem: 75**	**Credits: 4**

Objectives:

To understand about the evolution of organisms on earth and variability among living organisms.

To study about the microbial population and its habitat and about microbial communities which are excellent models for understanding biological interactions and evolutionary history.

Course Outcome:

C O No	Upon completion of this course, students will be able to	PSO addressed	CL
CO -1	understand the ubiquitous nature of microbes.	1	Un
CO -2	explain the basic concept of microbial diversity and classification.	3	Re
CO -3	discuss the knowledge about the various diversification in microorganism	4	Cr
CO -4	explain the knowledge of reproduction in microbes	5	Un
CO- 5	describe genetic characters of microbes.	5	Un
CO -6	understand the general classification of microbes	4	Un
CO -7	explain the characters of protozoa	4	Un
CO -8	understand the characters of arthropod vectors	3	Un

SEMESTER I			
Core – II Microbial Diversity and Classification			
Course Code : 21PMIC12	**Hrs/ Week: 5**	**Hrs/ Sem: 75**	**Credits: 4**

Unit I: Biodiversity and Classification

Classification of microorganisms – Introduction – Haeckel's three kingdom concept – Whittaker' five kingdom concept – Three domain concept of Carl Woese basis of microbial classification, Salient features of bacteria according to Bergey's manual of determinative bacteriology. Identification of Microorganisms –phenotypic classification, phylogenetic classification, genotypic classification, taxonomic ranks – Techniques for determining microbial taxonomy & phylogeny: Classical & molecular characteristics - Genetic relationship - DNA homology -16S r RNA sequencing.

Unit II: Bacteria

General characters, Classification, nomenclature and properties. Structure and characteristics: Gram positive cocci– *Staphylococci, Streptococci*. Gram negative cocci– *Gonococci*. Gram positive non spore forming bacilli: aerobic – *Corynebacteria* and anaerobic- *Actinomyces*. Gram positive spore forming bacilli: aerobic- *Bacillus anthracis* and anaerobic *Clostridia.*

Unit III: Fungi and Algae

General characters, Morphology, taxonomy and classification, structure and cell differentiation of *Aspergillus sp, Candida sp, Agaricus sp*. Mycorrhiza – Ectomycorrhizae, Endomycorrhizae, Vesicular Arbuscular Mycorrhizae. Algae: Distribution, general characters, thallus and its structure, classification, nutrition and reproduction – Characters of selected groups – Blue green algae, Euglenophyta, Chrysophyta, Phaeophyta and Rhodophyta – Economic importance of algal biotechnology.

Unit IV: Virus

Classification, nomenclature and properties. Structure and characteristics of Plant virus (CaMV ,TMV) Animal virus (Adeno virus, HIV, Rhabdo virus) Insect virus (NPV,CPV) Brief outline on virion and Prions.

Unit V: Protozoa

Distinguishing characters, classification, host-parasite relationship, pathogenic mechanism, transmission, life cycle, lab diagnosis, treatment for the following: *Entamoeba sp, Leishmania sp, Giardia sp and Trichomonas sp*. Helminthes: Classification, lifecycle, pathogenesis, transmission, lab diagnosis treatment for Cestodes (*Taenia solium*) – Nematodes (*Ascaris lumbricoides*) – Arthropod vectors: Tick and mosquitoes.

Books for Reference:

1. Prescott L.M., Harley J.P., and Klein D.A *Microbiology* New York: Mc Graw Hill, 7th Edition, 2008.
2. Madigan M.T. Martinko. J.M. Parker .J. and brock T.D. London: *Biology of Microorganisms*.. Prentice Hall International Inc, 8th Edition, 1997.
3. Alexopoulos, C.J., and Mims, C.W. New York. *IntroductoryMycology*,Wiley, 1979.
4. Stainer R.Y., In graham J.L., wheelis M.L., and Painter P.R. London: *General Microbiology*, Macmillan Education Lt., 1986.
5. Starr, M.P., Stolp, H., Truper, H.C.Balows, A., and Schlegel, H.C. *The Prokaryotes.A Hand Book of Habitats, Isolation and Identification of Bacteria.* Springer Verleg. 1991.
6. Tortora, Funke, and Case Addison *Microbiology - An Introduction* – Wesley Longman Inc 7th Edition, 2001.
7. JohnL.Ingraham and Catherine A. Ingrahani *Introduction to Microbiology*. , UK: Books/Cole Thompson Learning, 2000.
8. Talaro. K.P. and A.Talaro. *Foundations in Microbiology*. New York: WCP McGraw-Hill, 1999.
9. Jagadish Chandar. *A Text Book of Medical Mycology.* New Delhi: Inter Print. 1996
10. Powar C.B and Daginawala H.F *General Microbiology, Volume I & II,* Mumbai Himalaya Publishing House, 8th Edition, 2005.
11. Dubey. R.C. and Maheswari, S. *A Text Book of Microbiology* – New Delhi: Chand & Co, 2000.
12. Pelczar Jr. M.J., Chan E.C.S., and Kreig N.R. *Microbiology* – New York: McGraw Hill, Inc., 1993.
13. Salle, A.J. *Fundamental Principles of Bacteriology*. New Delhi.. Tata McGraw- Hill Publishing Company Ltd., 7th edition. 1996.
14. Holt, J.S. Kreig, N.R., Sneath, P.H.A. and Williams, S.T.. *Bergey's Manual of Determinative Bacteriology.*– Balimore: Williams & Wilkins, 9th edition 1994.

SEMESTER – II			
Core VIII -Marine Microbiology			
Course Code :21PMIC24	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits:4**

Objectives:

To provide the learners with the best learning experience in Marine Microbiology by providing standard education and enabling the students to become entrepreneurs and socially responsible.

To develop young students with active and creative minds in the field of microbiology. To motivate learners to contribute to sustainable development of nation through environmental protection and social responsibility

Course Outcome:

CO No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	describe the basic knowledge on marine ecosystem.	1	Re
CO -2	acquire the knowledge about diversity of marine ecosystem	1,2	Kn
CO-3	can analyses the aware of bio fouling and prevention.	2,3,4	Ev
CO-4	interpret the knowledge on marine microorganisms.	1,2	Ap
CO-5	determines the microbial indicator organisms.	1	Kn
CO-6	explain the concept of marine pollution	2,3,4	Co
CO-7	grasp the knowledge about bioactive compounds.	2,3,4	An
CO-8	know the wealth of the sea	2	Kn

SEMESTER – II			
Core VIII -Marine Microbiology			
Course Code :21PMIC24	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 4**

Unit I : Marine Environment – Zonation and Biota

Classification of marine environment. – Plankton– classification (size, life, habitat) and adaptations. Physical properties: waves, tides, currents- types, causes, and their impact on marine organisms. light, temperature, pressure. Chemical properties: nutrients, (major, minor, and trace elements), salinity, pH, density, dissolved gases (oxygen, carbon-di-oxide).

Unit II: Marine Diversity

Ecology of coastal, shallow and deep sea microorganism - importance and their significance. Diversity of microorganism - Nutrient cycles- Role of microorganisms in carbon, nitrogen, phosphorous and sulphur cycles in the sea under different environments including mangroves.

Unit III: Marine Ecosystems

Estuaries, salt marshes, mangroves. Coral reef -– ecology and types, species interaction, adaptations and importance. Threats and conservation of coastal ecosystems (coral reef and mangroves). Actinomycetes in the mangroves and coral environment.

Unit IV: Marine Pollution

Sources, effects and control measures of heavy metal, radioactive, oil, and thermal pollutions. Microbial indicators of pollution. Role of microbes in pollution abatement, Bio fouling. Microbial biodegradation - hydrocarbon. Bioremediation of heavy metal.

Unit V :Wealth of the sea

Living resources: Fishery products- fish meal and fish oil. Phycocolloids; agar-agar and algin. Microbial diseases diagnosis and control. Marine microorganisms as a source of biomedical resources - dinoflagellates as a source of bioactive molecules - chemistry and pharmacology of marine toxins - saxitoxin -tetradotoxin.

Books for Reference:

1. Gross, G.,.*Oceanography: A view of the Earth*. 6th edition. New Jersey: Prentice Hall Inc.,. 1993

2. McCormick, J.M. and Thiruvathaakal J.V., *Elements of Oceanography.* Philadelphia: W.B. Saunders Company,. 1976.

3. Nybakken, J.W.. *Marine Biology – An Ecological Approach*. California: Addison Weslay Longman, Inc., 477pp. 1997

4. Olivia J.Fernando. *Sea water-Properties and dynamics*, Thanjavur : Dhanesh Publications, Ponnagam,. 1999.

5. Russel. *Marine Ecology*, London and New York: Academic Press-. 1970.

6. Nelson and Smith, *Oil pollution and Marine Ecology*-Plenum press. 1973.

7. Daws, C.J.. *Marine Botany.* New York : John Wiley and Sons,. 1981.

8. Austin. B, and D.A Austin. *Bacterial Fish pathogens- Diseases of Farmed and Wild Fish.* Springer Publisher. 1999.

9. Munn and Munn. *Marine Microbiology: Ecology and Applications*. BIOS Scientific publisher. 1996.

10. Rheinheimer, G., *Aquatic Microbiology-an Ecological Approach*. Blackwell Scientific Publications. 1980.

SEMESTER –III			
Core- XI - Food and Dairy Microbiology			
Course Code : 21PMIC33	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 4**

Objectives:

To impart the advanced level knowledge in the subject of food microbiology

Course Outcome:

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO- 1	Recall the techniques in food microbiology.	1	An
CO- 2	Explain the about microorganisms important in food	2,5	Un
CO -3	Knowledge about the microbial contamination of food.	1,2,4	Un
CO- 4	knows about the techniques in food preservation and fermented foods	3,4,6	Re
CO -5	Knowledge about beneficial and harmful aspects of microbes in dairy products	2,4,5,6	Cr
CO -6	Communicate the recent techniques on good manufacturing.	2,4,5,6	Un
CO-7	Grasp the quality and safety assurance in food industry and the hazard analysis and critical control point	2,3	Re, Un
CO-8	Grasp microbial examinations in food	4,5	Un,Ap

SEMESTER –III			
Core- XI-Food and Dairy Microbiology			
Course Code : 21PMIC33	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 4**

Unit I : Introduction to Food Microbiology

Food as a substrate for microorganisms – Microorganisms important in food microbiology – Molds, yeasts and bacteria –General characteristics, classification and importance –Factors influencing microbial growth in food – Extrinsic and intrinsic factors (Nutrient content, pH, redox potential, relative humidity, temperature, gaseous atmosphere).

Unit II: Microbial contamination of foods

Microbial contamination of foods - spoilage of food by microbes in cereals and cereal products- fruits, vegetables and its dried products- Eggs and poultry – meat- fish – canned foods.

Unit III: Food Preservation

Principles of food preservation: Methods of food preservation – Aseptic handling, pasteurization of milk, refrigeration and freezing, dehydration, Radiation - UV, Smoking chemicals – organic acids, nitrates, nitrites, sulphur di oxide and sulphites. Food fermentation: Bread, Tempeh, Fermented dairy products (Kefir, Koumiss, Acidophilus milk).

Unit IV: Dairy Microbiology

Dairy Introduction – Sources of microorganisms in milk – Classification of microbes – Biochemical types, characteristics and pathology. Milk borne diseases – bacterial (Mastitis, Anthrax, Brucellosis, Diphtheria, Tetanus) and viral diseases (Food and mouth disease, Rinderpest, Cowpox, and Virus diarrhoea) in cattle's – Control measures.

Unit V: Microbiological examination of foods

Microbiological examination of foods – Estimation and examination of specific microorganisms, Bacteriological examination of milk – microbial standard and milk grading- MBRT and Resazurin method. Good manufacturing practice, hazard analysis critical control point (HACCP) concept. BIS Laboratoryservice.

Textbook:

1. FrazierW.C., and Westhoff D.C., *Food Microbiology.* New Delhi: Tata McGraw Hill Publishing Co. Ltd,. 4th edition, 2008

Books for Reference:

1. Adams M.R., and Moss M.O., *Food Microbiology*. Cambridge: The Royal Society of chemistry, 1995.
2. Atlas. R.M., *Microbiology–Fundamentals and Applications*, MacmillianPublishing Company. 1989.
3. Banwart G.J., *Basic Food Microbiology*. NewYork: Chapman & Hall. 1989.
4. Board R.C., *A modern Introduction to food Microbiology.* Oxford: Blackwell Scientific Publication,. 1983.
5. Robinson .R.K., *Dairy Microbiology*. London: Elsevier Applied Sciences, 1990.
6. Jay J.M. *Modern Food Microbiology*. New Delhi: CBS Publishers and Distributors, 1987.

SEMESTER – IV			
Core – XIII- Environmental Microbiology			
Course Code :21PMIC41	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credit: 4**

Objectives:

1. To provide the learners with the best learning experience in Microbiology by providing standard education and enabling the students to become entrepreneurs and socially responsible.
2. Developing young students with active and creative minds in the field of microbiology enabling the students to become entrepreneur by applying the microbial technology.
3. Motivating learners to contribute to sustainable development of nation through environmental protection and social responsibility.

Course Outcome:

CO.No	**Upon completion of this course, students will be able to**	**PSO addressed**	**CL**
CO-1	recall the ecological groups of microbes	1	Re,
CO -2	have knowledge about the interaction between microbes and organisms at other tropic level.	1,2	Un, An
CO-3	interpret the microbiology of sewage and its treatment	2,3	Co
CO-4	explain about aero microbiology and microbial ecology	2	Un, An
CO-5	acquire basic knowledge about water purification	2	Ap
CO-6	gets knowledge about biogeochemical cycles	2,4	Co
CO-7	understanding about biodegradation.	2	Sy
CO-8	develop the application of biodegradation and bioremediation.	5	Ap, Cr

SEMESTER – IV			
Core – XIII- Environmental Microbiology			
Course Code :21PMIC41	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credit: 4**

Unit I: Microbial Ecology

Interaction between abiotic and biotic factors in an ecosystem, ecological niche, limiting factor, concept of community, fluctuation and succession. Basic concept of food chain, food web and energy flow. Microbial symbiosis: commensalism, mutualism, parasitism and predation with examples.

Unit II: Biogeochemical cycles

Types of biogeochemical cycles: Water cycle, gaseous cycle (Oxygen, Carbon & Nitrogen), and sedimentary cycles (Sulphur & Phosphorus). Biogeochemical cycles of micronutrients.

Unit III: Aerobiology

Air space in different layers of atmosphere, bioaerosol, assessment of air quality - sedimentation, impaction impingement, suction, and filtration. Brief account of transmission of airborne microbes (Bacteria, Virus & Fungi). Microbiology of indoor and outdoor. Allergy: causes and tests for detection of allergy.

Unit IV: Aquatic Microbiology

The aquatic ecosystem (Pond)– factors governing micro flora and their distribution in natural water. Water pollution and its sources. Role of organic pollutants in water, concepts of C-BOD, N-BOD & COD. Treatment of waste water by aerobic and anaerobic processes (like trickling filter, activated sludge, oxidative pond, anaerobic digestion and chemical disinfection).

Unit V: Advancement in Bioremediation

Concept, principle and mechanism of bioremediation, factors affecting bioremediation, types of bioremediation. Bioremediation of metals with examples. Biodegradation and biotransformation of xenbiotics including pesticides, chlorinated and nitrated aromatic compounds, phenolic compounds and polycyclic aromatic compounds.

Books for Reference:

1. Atlas,R.M and Bartha.M. *Microbial Ecology –Fundamentals and applications.* California: *Benjamin – Cummings*, Mento Park, 2003.
2. SubbaRao, N.S. *Soil Microorganisms and Plant growth*. NewDelhi Oxford and IBH Publishing Co, Pvt. Ltd, 3rdEdition, 1995.
3. Gupta,S.K. *Approaches and trends in plant disease management*. India: Scientificpublishers.Jodhpur, 5th Edition, 2014.
4. Jammaluddin et al. . *Microbes and sustainable plant productivity* India*:* Jodhpur: Scientific Publishers,. 3rdEdition, 2013.
5. G.Purohit, S.S.Kothari,P.R.andMathur. *Basic and Agricultural Biotechnology*, India: Agrobotanical Publishers Bikaner. 1993.
6. Prescott, L.M., Harley, J.P. and Helin, D.A.. *Microbiology*, , New York. McGraw Hill, 5th Edition, 2008.
7. Schlegal, H.G.. *General Microbiology*, Cambridge: Cambridge Univeristy. 7th edition, 1995.
8. Prabhakaran, G. *Introduction to Soil and Agricultural Microbiology, New Delhi:* Himalaya Publishing House. 2004.
9. George N. Agrios.. *Plant Pathology*. Academic Press. 5th Edition. 2005
10. Raina M. Maier, Ian A. Pepper and Charles Gerba. *Environmental Microbiology*. Academic Press. 2nd edition. 2009.
11. Dubey, R.C. and Maheswari, D.K.. *A text book of Microbiology*, NewDelhi: S. Chand and Company Ltd, 2013.
12. Shiva Aithal, C. *Mordern approaches in Soil,Agricultural and Environmental Microbiology*. NewDelhi: Himalaya Publishers. 2010.
13. Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D.. *Biology Microorganisms*, NewDelhi: Prentice Hall, 12th Edition, 2000.
14. Pelczar, M.J., Schan, E.C. and Kreig, N.R. *Microbiology – An application based approach*, NewDelhi: Tata McGraw Hill Publishing Company Limited, 5th Edition, 2010.

SEMESTER – IV			
Core – XIV- Soil and Agricultural Microbiology			
Course Code :21PMIC42	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credit: 4**

Objectives:

1) To provide the learners with the best learning experience in Soil and agricultural Microbiology by providing standard education and enabling the students to become entrepreneurs and socially responsible.

2) To develop young students with active and creative minds in the field of microbiology

3) To enabling the students to become entrepreneur by applying the microbial technology.

4) To motivate learners to contribute to sustainable development of nation through environmental protection and social responsibility

Course Outcome:

CO.No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	recall the ecological groups of microbes and properties of soil	1	Re, Un
CO -2	have knowledge about the soil fertility	1,2	Un
CO-3	recall the previous basic knowledge about nitrogen fixing	1,2	Re, Co
CO-4	explain about plant microbe interaction.	2	Un
CO-5	acquire basic knowledge about important of plant microbe interaction for different layers (rhizosphere, phyllosphere)	2	Ap ,Un
CO-6	gets knowledge about recombinant microbes in agriculture.	2,4	Un, Co
CO-7	demonstrate an understanding of bio fertilizer	2	Sy
CO-8	develop the application of bio fertilizers in agricultural	5	Ap, Cr

SEMESTER – IV			
Core – XIV- Soil and Agricultural Microbiology			
Course Code :21PMIC42	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credit: 4**

Unit I : Microbes and soil fertility

Introduction and concepts of agricultural microbiology- soil microorganisms – bacteria (Cyanobacteria and Actinobacteria), algae, fungi, protozoans, nematodes and viruses Soil formation - Soil properties – Physical and chemical - Role of microbes in soil fertility. Soil fertility evaluation and improvement.

Unit II: Biogeochemical cycling and microbes

Biogeochemical cycles – Carbon, Phosphorus, Sulphur, Iron, Nitrogen - Symbiotic nitrogen fixation (*Rhizobium, Frankia*), non- symbiotic nitrogen fixation (*Azotobacter, Azospirillum*); Nitrogenase enzyme, *nif*genes and molecular mechanism of nitrogen fixation. Role of nodulin genes in nodule development and symbiosis. Genetic engineering of BNF.

Unit III: Plant-microbial interaction

Interrelationships between plants and microorganisms and their interactions with plants. Microbial associations in Spermosphere, Phytosphere, Rhizosphere (Mycorrhiza types and importance to agriculture) –phyllosphere (Anabaena-Azolla) -decomposition of organic Matter by microorganisms - cellulose, hemicellulose, lignin. Humus formation.

Unit IV: Plant Pathology

Plant pathogens: Bacterial – *Xanthomonas, Agrobacterium,*Fungal – *Cercospora, Pyricularia,* Viral – TMV, Bunchy top virus) Mechanisms of plant pathogenicity, symptoms of plant diseases, transmission of plant diseases. signaling events in pathogenesis and resistance to pathogens. Molecular basis of Plant disease control along with cultural practices, chemical and biological control.

Unit V: Bio fertilizers & **Bio pesticides**

Principles of mass production, Quality Control and Field applications - Bacterial bio fertilizer: *Rhizobium, Azotobacter- Azopirillum,*–Phosphobacteria. Algal biofertilizer - Blue green algae, Azolla.Fungal biofertilizers - Mycorrhizae – ecto and endo mycorrhiza. Biopesticides – Viral (NPV, CPV & GV), bacterial (*Bacillus thuringiensis*, *B. papillae* & *Pseudomonas* sp.), Fungal (*Beaveria* sp., *Metarrhizium* sp. & *Verticillium* sp.), Protozoan (*Mattesia* sp., *Nosema* sp., & *Lambornella* sp.)

Text books:

1. Dubey R.C. and Maheswari D.K.*A text book of Microbiology*.New Delhi:S. Chand and Company Ltd. Reprint, 2006.

2. Rangaswamy G and BagyarajD.J. *Agricultural Microbiology*. NewDelhi: Prentice-Hall of India Pvt Ltd.2nd edition, 2004.

Books for Reference:

1. Atlas R.M, and BarthaM. *Microbial Ecology –Fundamentals and applications.* California: Benjamin & Cummings, 2003.

2. Subba RaoN.S. *Soil Microorganisms and Plant growth*. New Delhi: Oxford and IBH Publishing Co, Pvt. Ltd, 3rd edition, 1995.

3. SahaT.K. *Ecology and Environmental Biology*. Kolkata: Books and Allied Pvt. Ltd., 2010.

4. Shiva Aithal, C. *Modern approaches in Soil, Agricultural and Environmental Microbiology*. New Delhi: Himalaya Publishers,.1st edition, 2010.

SEMESTER - III			
ELECTIVE -III	**B. ENERGY SOURCES**		
Code: 21PPHE32	**Hrs/Week: 6**	**Hrs/Semester:90**	**Credits: 4**

Objectives:

To facilitate the students to achieve a clear conceptual understanding of energy sources and its pros and cons

Course Outcomes:

CO No.	**Upon completion of this course, students will be able to**	**PSOs addressed**	**CL**
CO 1	outline the technologies that are used to harness the power of solar energy	1	An
CO 2	discuss the positive and negative aspects of solar energy in relation to natural and human aspects of the environment	5	Un
CO 3	Summarize the structure of biomass.	8	Ev
CO 4	Assess economic factors affecting geothermal energy production	5	Ev
CO 5	Analyse and critically evaluate emerging geothermal technologies.	8	An
CO 6	Compare chemical energy to mechanical energy.	1	An
CO 7	Write the uses of Hydrogen energy	5	Cr
CO 8	List the main characteristics (advantages/disadvantages) for fuel cells.	8	Ap

SEMESTER - III			
ELECTIVE -III	**B. ENERGY SOURCES**		
Code: 21PPHE32	**Hrs/Week: 6**	**Hrs/Semester:90**	**Credits: 4**

UNIT I: Solar Radiation

Introduction – Solar constant – Solar Radiation at the Earth's surface – Solar Radiation data– Estimation of Average Solar Radiation– Solar Radiation on Tilted surfaces - Solar Radiation Geometry– Solar Radiation measurements

UNIT II: Bio Mass

Biomass Conversion Technologies– Photosynthesis– Classification of Biogas plants– Advantages and Disadvantages of Flooting Drum plant– Advantages and Disadvantages of fixed Dome Type Plant– Selection of site for a Biogas plant -Community Biogas plants– Materials used for Biogas generation

UNIT III: Geothermal Energy

Estimates of Geothermal Power – Nature of Geothermal Fields – Geothermal Sources– Interconnection of Geothermal Fossil Systems– Advantages and Disadvantages of Geothermal Energy over other Energy forms– Applications of Geothermal Energy– Material selection for Geothermal Power Plants– Geothermal Expansion– Geothermal Well Drilling– Operational and Environmental Problems.

UNIT IV: Chemical Energy: Batteries

Introduction– Basic Battery Theory– Definitions of Fundamental Quantities– Battery Fundamental Characteristics– Different types of Battery arrangement– Classification of Batteries– Advantages of Batteries for Bulk Energy Storage.

UNIT V: Hydrogen Energy

Introduction– Electrolysis or the Electrolytic production of Hydrogen– Hydrogen Storage– Hydrogen Transportation– Hydrogen Technology Development in India (or) Safety and Management -Solar Energy Methods– Hydrogen as an alternative fuel for motor vehicles– Utilization of Hydrogen Gas

Text Books:

1. Rai G D. *Non-conventional energy sources.* Khanna Publishers. 2011.

Book forReference:

1. Sukhatme S P. *Solar Energy – Principles of Thermal Collection and Storage.* McGraw-Hill Education. 3rd Edition 2009.

2. Vaughn Nelson.*Introduction to Renewable Energy.* CRC Press. 1st Edition. 2011.

3. David Herak. *Biomass for energy applications.* MDPI. 1st Edition 2021.

SEMESTER II			
Core V : Animal Physiology			
Course Code: 21PZOC21	**Hrs/ Week: 5**	**Hrs/Sem: 75**	**Credits: 4**

Objectives:

- To provide students with an outstanding educational experience that prepares them for different careers, innovative and cutting edge research, and academia.
- To equip the students in the discipline of Physiology, by imparting knowledge and understanding of structure and function of human biological systems.
- To foster the development of professional skills through well designed curriculum; based on experiments, training and research.

Course outcomes

CO. No	**Upon completion of this course, students will be able to**	**PSOs addressed**	**CL**
CO- 1	compare digestive and circulatory system and infer regulation of blood pressure and heart beat	1, 2	Un,An
CO-2	understanding mechanisms of respiration and point out physiological adaptations to special conditions	1, 2	Un,An
CO-3	indicate the relationship between different environments and excretory organs and osmo ionic regulation	5	Ap, An
CO-4	appraise neuromuscular mechanisms and relate the physical and chemical phenomena	2 , 6	Un, Ev
CO-5	associate the endocrine glands with physiological actions and develop healthy life style	2, 4	Un,Cr
CO-6	perceive the steps involved in transmission of nerve impulses	5	Ev
CO-7	relate the structure and physiology of muscular system	7	Un
CO-8	elaborate the integration and interactions of hormones	8	Cr

Unit I **Digestive and Circulatory Systems**

Digestive system - gastrointestinal secretary functions and the glands - role of GI hormones. Structure of mammalian heart-cardiac cycle - cardiac output- control of heart beat - blood pressure and its regulation – related diseases (hypertension, hypotension, stroke).

Unit II **Respiratory System**

Human respiration**:** Anatomy and Physiology of the respiratory tract- transport of oxygen and carbondioxide-regulation of respiration-artificial respiration-physiological response to oxygen deficient stress (diving, high altitude) and exercise.

Unit III **Neuromuscular System**

Nervous system: neurons –structure and types- nerve impulse propagation – concept of synapse- transmission of electrical and chemical synapse- reflex arc-– reflex action.

Muscular system:Structural basis of contraction - sliding filament theory – mechanism and energetics of muscle contraction.

Unit IV **Excretory System**

Human kidney: nephron – mechanism of urine formation – regulation of ionic and osmoregulation in invertebrates – Protozoa, crustaceans and insects, Chordates – fishes, birds and mammals.

Unit V **Endocrinology**

Basic mechanisms of hormone action -endocrine glands in mammal –pituitary, thyroid, adrenal and islets of Langerhans - hormones and functions-hormonal disorders- role of hormones inmenstrual and estrous cycle-pregnancy – parturition – lactation - hormones and neoplastic growth.

Books for Reference

1. Hoar. *General and Comparative Physiology*. New Delhi. Prentice. Hall of India Pvt Ltd, 1975.
2. Sembulingmam K, and PremaSembulingam. *Essentials of Medical Physiology.* New Delhi: Jay Pee Brothers, 2006.

3. Kunt Schmidt-Nielsen K. *Animal Physiology, Adaptation and Environment*. Cambridge University Press. 1985.

4. Ladd Prosser C. *Comparative Animal Physiology*, Agra: Third edition. Satish Book Enterprise Book Sellers and Publishers, 1984.

5. Malcolm S. Gordon. *Animal Physiology Principles and Adaptations*. London: Third edition. Collier MacMillan International edition. Collier MacMillan Publishers. 1984.

6. Nagabhushanam, R and M.S. Kodarkar.*Textbook of Animal Physiology,* New Delhi: Oxford and IBH Publishing Co., 1978.

7. Bentley P.J. *Comparative Vertebrate Endocrinology*, Delhi: First edition Chand& Company Ltd, 1980.

8. Constance R.Martin. *Endocrine Physiology*, New York: First edition. Oxford University Press, 1985.

9. Prakash S. Lohar. *Endocrinology – Hormones and Human Health*, Chennai: MJP Publishers, 2005.

10. Sawant S.C. *A Textbook of Human Physiology* New Delhi: Wisdom Press, 2015.

PRACTICALS

Course Code: 21PZOCR3

Hrs/Week 2 **Credit : 1**

1. Estimation of haemoglobin
2. Determination of erythrocyte sedimentation rate (ESR)
3. Detection of haemin crystals of blood
4. Salt loss/ salt gain in a fish
5. Effect of temperature on oxygen consumption of fish
6. Urine analysis for sugar,albumin, urea and creatinine
7. Urine analysis for sediments
8. Assay of acid/alkaline phosphatase enzyme
9. Chart/slide/photograph

a. Endocrine glands in man - Transverse section of pituitary,thyroid,pancreas and adrenal

b. Conditional reflex

c. Pregnancy test – demonstration

Books for Reference

1. Rastogi S.C. *Experimental Physiology*, New Delhi: Wiley Eastern Limited, 1982.
2. Nigam S.C. and Omkar. *Experimental Animal Physiology and Biochemistry,* New Delhi: New Age International (P) Limited, 2006.

SEMESTER – III			
Core X	**Aquaculture Practices and Farm Management**		
Course Code: 21PZOC32	**Hrs/Week:6**	**Hrs/Semester:90**	**Credits:4**

Objectives

- To develop a comprehensive knowledge and transferable professional skills for career in aquaculture industry
- To acquaint with technical and general knowledge for competent fisheries management

Course Outcome:

CO. No.	Upon completion of this course, students will be able to	PSO's addressed	CL
CO-1	design aquaculture systems	1	Cr
CO-2	develop practical skills for management of culture ponds	3	Ap
CO-3	apply techniques involved in breeding and culture of various organisms	1,2	Ap
CO-4	demonstrate competency in live feed culture and feed formulation	2,3	Un, Ev
CO-5	evaluate and manage aquaculture diseases, health and safety issues in aquaculture ventures	1,6	Un, Ev
CO-6	discuss important factors for performing a sustainable aquaculture	1,3	Un, Ap
CO-7	compare the principles of genetic improvement of fish stock	1	Un
CO-8	analyse aquaculture economics and marketing strategies	1,3	An, Ap

SEMESTER – III			
Core X	**Aquaculture Practices and Farm Management**		
Course Code: 21PZOC32	**Hrs/ Week:6**	**Hrs/Semester:90**	**Credits:4**

Unit I **Aquaculture Basics and Management**

Scope of aquaculture, Fishery resources of India and Tamil Nadu. Selection of site, construction of fish farm, soil chemistry, construction of different types of fish ponds. Management of culture ponds - fertilization, water quality management, predators and weed management.

Unit II **Seed Production and Culture Techniques**

Carp culture : Carp: Brooders care and management seed collection from natural sources, bundh breeding, hypophysation, fish seed transport, hatching and rearing techniques. Culture of edible oyster, pearl oyster and sea weed.

Unit III **Nutrition and Health Management**

Culture of fish feed organisms: diatoms, cladocerans, rotifers, artemia. Artificial feed formulation and management. Bacterial (gillrot & Furunculosis) viral (EUS White spot disease, Erythrocytic necrosis) fungal diseases (Saprolegniasis & Branchiomycosis) Nutritional deficiency diseases, ectoparasites, endoparasites, principles of fish health management, fish vaccines.

Unit IV **Integrated Aquaculture Management**

Water pollution, its effect on fisheries and methods of its abatement. Sewage – fed fish culture - sewage treatment. Integrated fish farming - animal husbandry cum fish culture, paddy cum fish culture, fish culture in cages and pens. Culture of air breathing fishes.

Unit V **Aquaculture Biotechnology and Economics**

Genetic improvement of stock - hybridization, polyploidy, production of monosex, sterile fish, transgenic fish, gynogenesis, androgenesis. Aquaculture economics, fish marketing, involvement of government organizations in marketing. Role of CMFRI, NIOT, CIBA & NABARD.

Books for Reference

1. Dubey. S.K. and Band and Ghosh. *Fish Biotechnology*. New Delhi: Wisdom Press. 2012.
2. Amita Saxena. *Fisheries Economics*. New Delhi: Daya Publishing House. 2011.
3. Schonder. S.L. *Hypophysation in Indian Major Carps*. Agra: Sathish Book Enterprises 1980.

4. Pandian. I.D. Abhinandan Kumar and Rajbhushan Prasad. *Aquaculture and Biotechnology*. New Delhi: A.K. Publ. 2009.
5. Agnihotri. S.B. *Aquaculture Management and Technology*. New Delhi: Swastik Publication. 2013
6. Felix. S. *Marine and Aquaculture Biotechnology*. Jodhpur, India: Agrobios. 2010.
7. Santhanam. R., Ramanathan, N. and G. Jegathesan. *Coastal Aquaculture in India.* Delhi: CBS Publishers 1st edn. 1990.
8. Shagufta. *Fish Health and Diseases*. New Delhi: APH Publishing Corpoartion. 2012.
9. Yougesh Kumar and Rajeev Tyagi. *Aquaculture Fisheries Biotechnology and Genetics*. Delhi: Mangalam Publishers & Distributors. 2013.
10. Chandra Sekar. Y.S. *Fish Nutrition in Aquaculture*. Delhi: Swasthik Publishers & Distributers. 2012.
11. Rajendra Kumar Rath. *Freshwater Aquaculture*. Jodhpur: Scientific Publishers. 2011.
12. Singh. V.B. *Fish Farming.* New Delhi: ALP Books. 2010.

PRACTICALS

Course Code : 21PZOCR5

Hrs/ Week: 2 **Credit: 1**

1. Estimation of dissolved ammonia in water samples
2. Estimation of alkalinity in water samples.
3. Analysis of fresh water plankton
4. Decapsulation technique and hatching of artemia cysts
5. Feed formulation exercise – preparation of compound feed - Demonstration
6. Identification of cultivable food fishes
7. Identification of aquatic weeds, predatory fishes and insects.
8. Induced breeding in fishes
9. Study of fish parasites and diseases.
10. Visit to aquaculture farm

Books for Reference

1. Methods in Hydrobiology Manual. *Centre for Advanced Studies in Marine Biology*, Published by Annamalai University, Parangipettai, Chidambaram. 2011.

2. Felix, N., Ahilan, B. and S. Athithan. *Fish Nutrition and Feed Technology Manual.* Thoothukudi: Fisheries College and Research Institute Tamilnadu Verteinary & Animal Science University. 2004.

3. FAO Fisheries Technical Paper. No. 361; *Manual on the Production and Use of Live food for Aquaculture.* Laboratory of Aquaculture and Artemia Reference Centre, University of Ghent, Belgium. 1996.

SEMESTER IV			
Core XIII	**Marine Biotechnology**		
Course Code: 21PZOC41	**Hrs/Week: 4**	**Hrs/Sem: 60**	**Credits: 4**

Objectives

- To impart knowledge of biotechnological applications of marine organisms among the students.
- To provide an excellent education emphasizing the important processes and impacts on the marine ecosystems and ways to control them.

Course Outcome

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	recall different zones of the sea	2	Un
CO-2	understand the physical and chemical properties of seawater and its impact on ocean life	5	Un
CO-3	identify and classify marine planktons based on their characteristics	3	An
CO-4	classify the flora and fauna of estuaries, mangroves and salt marshes and their adaptations	1	An
CO-5	analyse the role of microbes in recycling of nutrients	3	An
CO-6	explain the aspects of marine pollution and its impact on marine life	5	Un
CO-7	appraise the complexity and diversity of resources in the marine environment	4	Ev
CO-8	develop skills in a range of theoretical and practical applications on bioactive substances	6	Cr

Unit I Marine Habitat

Classification of marine habitat, plankton – classification and adaptations. Intertidal rocky, sandy and muddy shores – the features of fauna and adaptations. Marine microbes (bacteria, viruses and fungi).

Unit II Marine Ecosystems

Estuaries, mangroves, coral reef – ecology and types, species interaction and adaptations. Conservation of Gulf of Mannar Biosphere Reserve. Role of microbes in the sea: recycling of nutrients – nitrate, phosphate and sulphate.

Unit III Marine Pollution

Sources, effects and control measures of heavy metal, radioactive, oil and thermal pollutions. Biotechnology in marine pollution control.

Marine bioremediation - microplastics.

Unit IV Microbial Action in the Marine Environment

Biofouling – biofoulers – micro and macro foulers – impact of biofouling in maine environment and prevention. Biodeterioration: agents and protective methods.

Corrosion – mechanism and prevention.

Unit V Wealth of the Sea

Mineral wealth – petroleum, manganese nodules, beach placers, glauconite and garnet. Bioprospecting of marine resources - bioactive compounds from marine organisms (bacteria, fungi micro, macro algae and sponges). Sea-ranching of economically important marine organisms – crustaceans and molluscs.

Books for Reference

1. Bimla Singh. *Marine Biotechnology and Aquaculture Development*. Delhi: Vista International Publishing House. 2006.
2. Girish Chopra. *Coastal and Marine Geography*. Delhi: Common Wealth Publisher. 2012.
3. Gross G. *Oceanography: A view of the Earth*. New Jersey: Sixth edition. Prentice Hall Inc. 2008.
4. Mc Cormick J.M. and J.V. Thiruvathaakal. *Elements of Oceanography*. Philadelphia: W.B. Saunders Company. 1981.
5. Nybakken J.W. *Marine Biology – An Ecological Approach*. California: Addison Weslay Longman, Inc. 1997.
6. Olivia J. Fernando. *Sea water-Properties and Dynamics*. Thanjavur: Dhanesh Publications. 1999.
7. Frank E. Firth. *The encyclopedia of marine resources*. New York: Van Nostrand Reinhold Company.1969.
8. Veena. *Understanding Marine Biology*. New Delhi: Discovery Publishing House Pvt. Ltd. 2012.
9. Atlas R.M. and Bartha. M. *Microbial ecology- Fundamentals and Applications*. California: Benjamin- Cummings. 2003.
10. Vijaya Ramesh K. *Environmental Microbiology*. Chennai: MJP Publishers. 2004.
11. Moshrafuddin Ahamed and Basumatary S.K. *Applied Microbiology*. Chennai : MJP Publishers. 2006.
12. Tait R.V. and F.A. Dipper. *Elements of Marine Ecology*. Great Britain: British Library Cataloguing in Publication Data. 4th edition 1998.

PRACTICALS

Course Code: 21PZOCR7

Hours/ Week : 2 **Credits : 2**

1. Determination of acidity

2. Estimation of salinity

3. Determination of alkalinity

4. Estimation of total dissolved solids

5. Determination of nitrite

6. Estimation of phosphate

7. Collection and identification of marine plankton (any three phyto and zooplankton)

8. Identification and comments on the following

   i. Plankton net

   ii. Inter-tidal organisms

      a. Rocky shore: Sea anemone, Chiton
      b. Muddy shore: Uca, Cerithidia
      c. Sandy shore: Arenicola, Murex

   iii. Biofouling

   iv. Corrosion

9. Analysis of buckle canal sample (TDS/ Microbial load)

10. Visit to mangroves / estuaries / marine environment

Books for Reference

1. Strickland and Parsons. J.D.H. *A Practical Handbook of Seawater Analysis*, Canada: Bulletin 167, Fisheries Research Board of Canada. Second Edition 1972.
2. Kiewood Maff, D. *ICES* T*echniques in Marine Environmental Sciences*. Denmark: International Council for the Exploration of the Sea, 1987.

SEMESTER IV			
Core XIV	**Conservation Biology**		
Course Code: 21PZOC42	**Hrs/Week: 5**	**Hrs/Sem: 75**	**Credits: 4**

Objectives

- To create environmental awareness among students.
- To inculcate knowledge about the natural resources, biodiversity their conservation and efforts towards their sustainability.
- To generate concepts of prediction, prospecting, preservation and restoration of dwindling natural resources.

Course Outcome

CO. No.	**Upon completion of this course, students will be able to**	**PSO addressed**	**CL**
CO-1	infer the problems of unsustainable development	1	Un
CO-2	justify that human survival depends on developing practices that will achieve sustainable systems	3	Ev
CO-3	explore the biological, sociological and legislative perspectives for the management of flora and fauna to conserve wildlife.	5	An
CO-4	evaluate the importance of natural resources on conservation of biodiversity	3	Ev
CO-5	analyse the conservation management of various resources	3	An
CO-6	gain knowledge on values and threats of biodiversity	2	Ap
CO-7	learn the role of various organization in conservation of biodiversity	6	Un
CO-8	apply scientific principles and modern technologies to resolve problems in disaster management	8	Ap

Unit I Environment–Sustainable Development

Environmental ethics, issues - possible solutions - from unsustainable to sustainable development; Environmental Protection Act (1986) - Forest Conservation Act (1980), Wildlife (Protection) Act of Government of India (1972).

Unit II Conservation of Forest and Water Resources

Forest resources: Use and overexploitation – deforestation - timber extraction – mining - dams and forests – tribes. Conservation of forest.

Water resources: Use and over exploitation of ground water – surface water – conflicts over water – dams – benefits and problems - conservation of water.

Unit III Conservation of Land and Energy Resources

Land resources: Land as a resource – land degradation – soil erosion and desertification – conservation of soil.

Energy resources: Growing energy needs – renewable and non-renewable energy sources – use of alternate energy source.

Role of individual in conservation of natural resources.

Unit IV Biodiversity and Conservation

Biodiversity - values of biodiversity - threats to biodiversity – hot spots – biosphere reserve. *In-situ* conservation - *ex-situ* conservation - role of organizations in conservation **-** NBPGR, BSI, ZSI, WWF, IUCN - Ramsar Convention.

Unit V Disaster Management

Climate change – global warming

Causes, impact and management of earthquakes – cyclone – wildfires – landslide – flood – drought - disaster management system (DMIS).

Books for Reference

1. Dhulasi Brindha, V. *Environmental Studies*. New Delhi : Allied Publishers Pvt. Ltd. 2004.
2. Veer Bala Rastogi and M.S. Jayaraj. *Animal Ecology and Distribution of Animals*. Delhi: Kedarnath Ramnath, Meeruti.2009.
3. Agarwal, A.C. *Environmental Biology*, Bikaner : Agro Botanical. 1999.

4. Anjaneyalu, Y.B. *Introduction to Environmental Science*, Hyderabad: SPBS. Publications. 2004.
5. Kormondy Edward J. *Concepts of Ecology.* India: Prentice Hall Pvt. Ltd. 1994.
6. Odum, E.P. *Basic Ecology.* Saunder: CBS College Publishing. 1983.
7. Anubha Kaushik and C.P. Kaushik. *Environmental Science and Engineering*. NewDelhi: New Age International (P) Publishers. 2007.
8. Ravi Krishnan, A. *Environmental Science and Engineering*. Chennai: Sri Krishna Publications. 2010.
9. Saha, T.K. *Ecology and Environmental Biology*. Kolkatta: Books and Allied (P) Ltd. 2008.

PRACTICALS

Course Code: 21PZOCR8

Hrs/ Week: 2 **Credit: 1**

1. Estimation of population density using Quadrat method
2. Population density study – Mark and Recapture method
3. Chart – Rare, Threatened, Endangered and Extinct species
4. Mapping of National Parks in India with a note on important fauna
5. Mapping of Wild Life Sanctuaries in India with a note on important fauna
6. Renewable Energy Resources – Wind Energy
7. Case Study on Man Animal Conflict
8. Red Data Book
9. Shannon Wiener Index
10. Visit to an ecologically important place – National parks, Sanctuaries.

Books for Reference

1. Gareth Williams. *Techniques and Field work in Ecology*. Bell & Hyman Ltd. London. 1987.

2. Jaya Surya, Arumugam. N, Dulsy Fatima, Meyyan, R.P., Prasannakumar, S., Mani, A., Mariakuttikan, A., Narayanan, L.M., Nallasingam, K., Kumaresan, V. and A.M. Selvaraj. *Practical Zoology Vol-3*. Saras Publication, Nagercoil. 2013.

SEMESTER IV			
Core XV	**Commercial Zoology**		
Course Code: 21PZOC43	**Hrs/ Week: 5**	**Hrs/ Sem: 75**	**Credits: 4**

Objectives

- To facilitate self-employment and entrepreneurship in Apiculture and Sericulture.
- To motivate the students to take up careers related to agro-based, rural oriented cottage industry through imparting knowledge in apiary management, mulberry cultivation and silkworm rearing.

Course Outcome

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	understand the behaviour of bees, prevent swarming and manage bee colonies	3	Un
CO-2	identify, choose suitable bees and maintain bee hive successfully	2	Ev
CO-3	inspect bee colony, identify diseases of bees, recognize their enemies and take necessary control measures	4	An, Ap
CO-4	apply their knowledge to implement the procedure to extract honey and other bee products	5	Ap
CO-5	demonstrate an understanding of mulberry cultivation, silkworm rearing and silk reeling	1	Un
CO-6	identify diseases, pests of mulberry, silkworm and adopt control measures	4	Ap, Cr
CO-7	utilize their knowledge in harvesting, marketing cocoons and reeling operations	5	Ap
CO-8	develop practical proficiency in apiculture and sericulture from the lab work as well as visit to the apiary and the sericulture unit.	6	Ap

Unit I **Beekeeping Technology**

Apiculture as a cottage industry - choice of species in apiculture- Indian bee, European bee. Beekeeping equipments - Langstroth hive and Newton's hive- appliances used in apiaries. Swarming – prevention and control. Queen rearing and introduction. Artificial feeding.

Unit II **Management of Bees & Honey Bee Products**

Diseases of bees - brood diseases, diseases of adult bees - nosema and septicemia, enemies and pests - greater wax moth, lesser wax moth, ants, wasps, mites - control measures. Extraction and uses of honey - bee wax - bee venom, pollen, propolis, royal jelly – Agmark index.

Unit III **Silkworm Rearing**

Mulberry silkworm development – silkworm rearing – rearing house – rearing appliances rearing operations. Shelf rearing – floor rearing – shoot rearing. Silkworm diseases – bacterial flacherie, muscardine, grasserie. Pest - Indian uzifly - symptoms and control measures.

Unit IV **Cocoon Mounting and Reeling**

Mounting - cocoons – harvesting and marketing of cocoon. Grading of silk and cost benefit ratio. Silk reeling – reeling operations, reeling appliances – cottage basin – filature units - by-products.

Unit V **Economics of Sericulture**

Sericulture industry – present status – prospects in India; Role of Governmental organizations and NGOs in the development of Sericulture industry – Schemes for Sericulture development – NABAARD, MSME, MUDRA.

Books for Reference

1. Krishnaswami S. *Improved Method of Rearing Young Age Silkworms*. Bangalore: Central Silk Board, 1990.
2. Hisao Aruga. *Principles of Sericulture*. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd. 1990.

3. Acharya J. *Sericulture and Development*. New Delhi: Indian Publishers Distributers Kamak Nagar, 1993.
4. Pierre Jean – Prost. *Apiculture*. New Delhi: Oxford & IBH Publishing Co. Pvt. LTD, 1994.
5. Raja Instus E. *Economics of Bee Keeping Industry*. Jaipur and New Delhi: Rawat Publications, 1994.
6. Mishra R.C. *Perspectives in Indian Apiculture*. Agro Botanica, 4E 176 J.N. Vyas Nagar, Bikaner, H.S. Offset Printers, Daryagunj, New Delhi: 1997-98.
7. Arthur G. and Carter J. *Beekeeping: A Guide to the Better Understanding of Bees, their Diseases and the Chemistry of Beekeeping*. New Delhi: Biotech books, 2004.
8. Everett Franklin Phillips. *Bee Keeping*. Jodhpur: Agrobios (India), Agro House, Chopasani Road, 2010.
9. Ganga G. and Sulochana Chetty J. *An Introduction to Sericulture*. New Delhi: Oxford & IBH Publishing Co Pvt. Ltd, 2019.

PRACTICALS

Course Code: 21PZOCR8

Hrs / Week : 2 **Credit: 1**

1. Identification of bee species and castes.
2. Mounting of mouth parts and legs of worker bee.
3. Adulteration in honey
4. Beekeeping equipments - Newton's hive, hive tool, smoker, uncapping knife, pollen box, honey extractor.
5. Identification of diseases and enemies of honey bees.
6. Development of silkworm.
7. Mounting of silk gland.
8. Rearing house and appliances.
9. Silkworm diseases and pests.

10. Filling forms for entrepreneurs

11. Visit to an apiary or sericulture unit.

Books for Reference

1. Tammanna N. Sonwalker. 1993. *Hand Book of Silk Technology*. Wiley Eastern Ltd. Chennai.
2. Alka Prakash. 2001. *Laboratory Manual of Entomology*. New Age International (P) Ltd, 4835/ 24, Ansari Road, Daryaganj, New Delhi – 110002.

SEMESTER IV			
Core Elective	**A. Ornamental Fish Culture**		
Course Code: 21PZOE41	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 4**

Objectives

- To impart basic understanding for operating an ornamental fish farm and improve the quality of fisheries education, research and extension activities.

- To generate technically skilled manpower to work in ornamental fish farms, augment ornamental fisheries trade, export earnings and self employment.

Course Outcome

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	explain the construction, fabrication and accessories required for setting up an aquarium tank	1	Un
CO-2	apply the knowledge and skills in aquarium management	2	Ap
CO-3	evaluate the types and culture of live feed organisms and formulate the artificial feed	3	Ev
CO-4	demonstrate the mastery related with taxonomy and biology of ornamental fish	3	Ap
CO-5	identify the commercially important fresh water and marine ornamental fishes and their transport	8	Ap
CO-6	analyse the different breeding techniques employed for varieties of ornamental fish	2,3	An
CO-7	acquire competencies to become an entrepreneur in ornamental fish culture	3	Un
CO-8	develop entrepreneurial skills and make aware of National and International export process and income generation	2,7	Cr

Unit I Construction of Fishtanks

Design and Construction of fish tanks – setting up of tanks - accessories for aquarium - hood, light source, hand net, suction tube, scrapper tool, aerator, heater, gravels, filters and aquarium decor –aquarium plants and its importance.

Unit II Aquarium and Fish Health Management

Maintenance of water quality - temperature, water hardness, ammonia, pH, O_2, CO_2. Control of snail and algal growth. Fish diseases - protozoan, fungal, bacterial and parasitic diseases - symptoms, diagnosis, therapy and prevention.

Unit III Fish Nutrition

Different types of feed - artificial and live feed - culture of live feed organisms - infusorians - zooplankton - rotifers - copepods - cladocerans - spirulina - brine shrimp - chironomous - tubifex. Artificial feed: ingredients of feed formulation – Pearson square method of feed formulation - steps in the preparation of artificial feed – nutritional deficiency diseases.

Unit IV Biology and Breeding

Taxonomy and biology of egg layers - siamese fighting fish, gold fish, koi, rosy barb, neontetra, zebra cichlid and angel fish. Live bearers - molly, guppy, sword tail and platy. Breeding and spawning of egg layers and livebearers – parental care in ornamental fishes.

Unit V Marine ornamental Fishes and Transport

Commercially important marine ornamental fishes - butterfly fish, parrot fish, clown fish, marine angel fish. Transport of ornamental fishes – oxygen packing - use of sedatives - marketing strategies.

Books for Reference

1. Jameson. J.D. and R. Santhanam. *Manual of Ornamental Fishes and Farming Technologies* – Tuticorin: Fisheries College and Research Institute TANUVAS. 1996
2. Santhanakumar. R. and A.M. Selvaraj. *Manual of Fresh water Ornamental Fish Culture*, Tuticorin: Department of Fisheries Extension, Fisheries College and Research Institute, TANUVAS. 2007
3. Venkataramani V.K. and N. Jeyakumar. *Biodiversity and Stock Assessment of Marine Ornamental Fishes*. Tuticorin: Department of Fisheries Biology and Capture Fisheries,

Fisheries College and Research Institute, TANUVAS. 2004

4. Tharadevi, C.S. and K.V. Jayashree. *Home Aquarium*. Nagercoil: Saras Publications. 2009
5. Santhanam R., Sukumaran N. and P. Natarajan. *A Manual of Freshwater Aquculture*. NewDelhi: Oxford and IBH Publishing Co. Pvt. Ltd. 1990
6. Gupta, S.K. and P.C. Gupta. General and Applied Ichthyology. New Delhi: Chand and Company Ltd, 1st Edn. 2006
7. Dholakia, A.D. *Ornamental Fish Culture and Aquarium Management*. Delhi: Daya Publishing House, Trinagar. 2009.

SEMESTER II			
Core V	**Plant Diversity II (Pteridophytes, Gymnosperms and Paleobotany)**		
Course Code: 21PBOC21	**Hrs/week: 5**	**Hrs/Semester: 75**	**Credit: 4**

Objectives:

- To have a comprehensive idea on vascular cryptogams and phanerogams.
- To get an idea on the past history of biosphere and evolution of seed plants.
- To understand the taxonomy, characteristics and uniqueness of vascular plants.

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	appreciate the uniqueness and distinguish between diverse groups of Pteridophytes and Gymnosperms using their characteristic features	1, 2	An
CO-2	discuss different life cycle patterns in different groups	1, 2	Cr
CO-3	know the basic skills and techniques in micropreparation and formulate methods to identify different groups	1, 6	Ap
CO-4	know the evolutionary significance of Pteridophyte	1, 2	Un
CO-5	infer pteridophytes are pioneer in the evolution of seedhabit	1, 2	Re
CO-6	compare and contrast the origin and evolution of steles,foliage, seed and seedless plants.	1, 2	An
CO-7	compare and contrast the seed and seedless plants.	1, 2	Ev
CO-8	review critically the biology, ecology of fossils andmethods of fossilization.	1, 7	Un

SEMESTER II			
Core V	**Plant Diversity II (Pteridophytes, Gymnosperms and Paleobotany)**		
Course Code: 21PBOC21	**Hrs/week: 5**	**Hrs/Semester: 75**	**Credit: 4**

UNIT I: Pteriodophytes: Classification of pteridophytes (PPG) by Erics (2016 (upto order level). Origin and evolution of pteridophytes. General characteristics. Telome concept. Stelar evolution in pteridophytes. Heterospory and seed habit. Theories and modifications of alternation of generations. Life cycle pattern in homosporous and heterosporous pteridophytes. Distribution of pteridophytes in India

UNIT II: Morphological, anatomical structure, asexual and sexual reproduction of Psilotales, Lycopodiales, Selaginellales,Isoetales, Equisetales, Ophioglossles and Polypodiales. Aposory, Apogamy, Vivipary, Parthenogenesis. Economic importance of pteridophytes.

UNIT III: Gymnosperms: Classification of gymnosperms by Christenhusz *et al.* (2011) (Upto family level). General characteristics. Distribution of gymnosperms in India. Morphological, anatomical structure and reproduction of Cycadaceae, Ginkgoaceae, Welwitschiaceae,Gnetaceae and Ephedraceae,

UNIT IV: Morphological, anatomical structure and reproduction of Araucariaceae, Podocarpaceae and Cupressaceae. Affinities of gymnosperms with angiosperms and pteridophytes. Economic importance of gymnosperms.

UNIT V: **Paleobotany:** Geological time scale – fossilization and fossil types: compressions, incrustation, casts, molds, petrifactions, coal balls and compactions. General characters of fossil pteridophytes: *Horneophyton, Sphenophyllum* and *Calamites*. Fossil gymnosperms: *Williamsonia* and *Cordaites*. Indian Paleobotanists: Birbal Sahni, D.D. Pant, M. Ramanujam, Osmani.

Books for Reference:

Pteridophytes:

1. Bower, F.D. *Primitive land plants*. Vol. I & 2. Jaipur : Arihant Publishers. 1988.

2. Pandey S.N., Trivedi P.S., Misra S.P. *A text Book of Botany* Vol. II. New Delhi: Vikas Publishing House Pvt. Ltd., 2006.
3. Parihar, N.S. *An introduction to Embryophyta, Pteridophyta.* Allahabad: Central Book Depot Publications in Botany. 1967.
4. Rashid, A. *An introduction to Pteridophyta*. New Delhi: Vani Educational Books. 1985.
5. Sundara Rajan S. *Introduction to Pteridophyta*. New Delhi : New Age International Publishers. 2009.

Gymnosperms:

1. Chamberlain, C.J. *Gymnosperms.Structure and evolution*. New Delhi: CBS Publishers &Distributors, 1986
2. Johri R.M., Sneh Lata and Kavita Tyagi. *Text Book of Gymnosperms*. New Delhi : Wisdom Press. 2010.
3. Sporne, K.R. *The Morphology of Gymnosperms*. New Delhi: B.I. Publications Pvt. Ltd., 1974.

Practical: Hrs/Week – 2

Pteridophytes:

- *Selaginella* – Habit, Section: T.S. of stem, rhizophore, L.S. of cone
- *Isoetes* - Habit, Section: T.S. of leaf
  Permanent slide: L.S. of male and female cone
- *Equisetum* - Habit, Section: T.S. of internode
  Permanent slide: L.S. of cone
- *Lygodium* – Habit, Section: T.S. of rachis
  Permanent slide: T.S. of pinnule
- *Osmunda* – Habit, Section: T.S. of rachis
  Permanent slide: L.S. of cone
- *Pteris* – Habit, Section: T.S. of rachis and pinnule
- *Adiantum*- Habit, Section: T.S. of rachis and sori
- *Salvinia* – Habit, Section: T.S. of stolon
  Permanent slide: L.S. of cone

Gymnosperms:

- *Cycas* – Twig, Section: T.S. of corolloid root, rachis and leaflet
  Permanent slide: L.S. of microsporophyll, male cone (entire), female cone (entire)
- *Gnetum* – Twig, T.S. of stem and leaf
  Permananent slides: L.S. of male and female cone, wood showing anomalous secondary thickening and seed (entire).
- *Araucaria* – Twig, Section: T. S. of stem

Permanent slide: L.S. of cone

- *Podocarpus* – Twig, Section: T.S, of stem, leafPermanent slide: L.S. of cone
- *Cupressus*: Twig, Section: T. s. of stem
  Permanent slide: L.S. of male cone and female cone

Fossils:

Pteridophytes:

- *Sphenophyllum*
- *Calamites*

Gymnosperms

- *Williamsonia*
- *Cordaites*

Field study: No. of days 3 (Pteridophytes and Gymnosperms: Western Ghats)

Submission - Record Note Book

Lab manuals for Reference:

1. Ashok M. Bendre and Ashok Kumar. *A Text Book of PracticalBotany*Volume1. Meerut : Rastogi Publications. 2009.
2. Srivastava H. N, *Practical Botany* Volume I, Jalandhar : PradeepPublications, 1987.

SEMESTER II			
Core VI	**Marine Botany**		
Course Code: 21PBOC22	**Hrs/week: 5**	**Hrs/Semester: 75**	**Credits: 4**

Objectives:

- To give elaborate account on marine environment and its role in controlling the Earth'sclimate.
- To understand the different types of marine habitats and the adaptation of life there in.
- To understand the role of marine products and their socio economic and environmental significance

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	analyze how marine organism adapt to their dynamic environment	5	Un
CO-2	recall how natural events and human activities affect coastal habitats	7	Re
CO-3	critically analyze and evaluate pollution issues, their sources and the influences humans have with the dynamic marine environment	7	An
CO-4	achieve practical skills in processing, preserving and culturing marine plants	6	Ev
CO-5	evaluate the uses of marine resources and realize the role of phytoplankton and bacteria in the economy of the ocean	5	Ap
CO-6	able to signify the characteristic feature of coral reefs and their role in biodiversity conservation	1	An
CO-7	able to identify and understand the role of mangroves in coastal protection and their adaptation to its hostile environment	5	Ap
CO-8	explain the ecological relationship between organisms and their environment	2	An

SEMESTER II			
Core VI	**Marine Botany**		
Course Code: 21PBOC22	**Hrs/week:5**	**Hrs/Semester: 75**	**Credits: 4**

UNIT I: Classification of marine habitat - ecology of pelagic, benthic and sublittoral zones, deep sea, sandy muddy and rocky shore. Characteristics of marine habitat – tides and chlorinity, upwelling, plate tectonics, tsunami, green house effect, carbon pump. Ocean and regulation of climate on earth.

UNIT II: Marine biodiversity –phytoplankton - characteristics, measuring and sampling. Marine bacteria, marine fungi, seaweeds and sea grasses. Threats and conservation of seaweeds and sea grasses. Nutrient cycling: carbon, nitrogen, sulphur and phosphorus.

UNIT III: Marine products - traditional uses; human food and agriculture. Marine colloids and hydrocolloids - Agar - agar, algin, alginates, carrageenan, diatomite, marine lipids, flavanoids, and carotenoids. Marine pharmacology –identification of bioactive compounds in marine organisms – mangroves, seaweeds, and sea grasses.

UNIT IV: Culture of micro algae –laboratory culture, preservation and maintenance of culture and mass culture. Commercial cultivation of seaweeds. Marine pollution –thermal pollution, oil pollution, heavy metal pollution, radioactive pollution and industrial pollution. Algal blooms. Global climate changes: impact on specific diversity and productivity, ocean as carbon sink, effect on coral bleaching. Biological rhythms.

UNIT V: Mangroves and salt marshes: geographical distribution, habit, adaptations, and trophic interactions. Present status and stresses on the mangroves with special reference to Sunderbans. Regeneration of mangroves. Coral reefs – ecology, species interaction, economic importance and conservation.

Books for Reference:

1. Cliton Jand Dawes. *Marine Botany.* New York: A wiley – Intersciences publication John Wiley andsons, 1981.
2. Dring M J. *The Biology of Marine plants.*London: Edward Arnold, 1982.
3. Kumudranjan Naskar and Rathindranath. *Ecology and Biodiversity of Indian mangroves. Vol. I & II,* Delhi: Daya publishing House, 1999.
4. Michael P. *Ecological methods for field and laboratory investigations*, Uttar Pradesh: Tata McGraw – Hill publishing Company Limited, 1986.
5. Sinha P.C. *Marine pollution,* New Delhi: Anmol publications Pvt. Ltd., 1998.

6. Tait R.V. *Elements of Ecology*, London: Butter worths, 1978.
7. Warren. *Biology and water pollution* control, London: W.B.Saunders Company, 1971.

Practicals: Hrs/Week: 2

- Determination of acidity
- Estimation of alkalinity
- Estimation of Salinity
- Collection and identification of phytoplankton.
- Determination of total hardness
- Estimation of nitrate (Spectrophotometry)
- Estimation of Phosphate (Spectrophotometry)
- Heavy metal analysis from mangrove sediments

Specimens / photographs / charts

- Plankton net
- Seaweeds
- Sea grasses
- Mangroves
- Alginates
- Carrageenan

Books for Reference

1. Murugesan A.G and Rajakumari. *Environmental Science and Biotechnology andBiotechnology Theory and Techniques, Chennai:*MJP Publishers, 2005.

SEMESTER - IV			
Core: XIII	**Plant Physiology**		
Course Code: 21PBOC41	**Hrs/week: 6**	**Hrs/Semester : 90**	**Credits: 5**

Objectives:

- To make them understand the organized complexity of the life process in plants.
- To investigate how the physical process and chemical connection determine plant's function and to layout practical skills in conducting a physiological experiment.
- To comprehend how the environmental cues sensitize chemical signals to regulate a lot of physiological functions.

Course Outcomes:

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	understand the effect of the soil-plant-water continuum (SPWC) and assess the need of mineral nutrients and symptoms specific to nutrient deficiency.	6	Un
CO-2	discuss how root structure and functions influence the transfer of inorganic nutrients from the soil into the plants,	3	Un
CO-3	analyse the mechanism of assimilation of inorganic molecules into organic molecular components.	3	Un
CO-4	analyse light enhanced photochemical reactions that culminates in the synthesis of ATP and NADPH and fixation of carbon dioxide into organic compounds	3	Un
CO-5	describe respiration with its associated carbon metabolism and releasing of energy stored in chemical bonds in a controlled manner for cellular use	3	Re
CO-6	review systematically how plant's manage physiologically with respect to environmental stress.	7	Cr
CO-7	Remark on the hormone controlled and light mediated morphogenetic events in plants.	3	An
CO-8	design and conduct scientific experiments and analyze the data critically	6	Cr

SEMESTER - IV			
Core: XIII	**Plant Physiology**		
Course Code: 21PBOC41	**Hrs/week: 6**	**Hrs/Semester : 90**	**Credits: 4**

UNIT I: Water relations of plants - components of water potentials and their relation. Absorption of water - Mechanism of ascent of sap. Translocation - Mechanism of translocation of solutes- source sink relationship, phloem loading and unloading. Transpiration - stomatal movement, antitranspirants, guttation. Inorganic nutrient - ion uptake - passive and active uptake and transport. Role of mineral nutrients- deficiency and toxicity symptoms. Hydroponics and its significance.

UNIT II: Photosynthesis-General concepts, Principle of light absorption-action spectrum, absorption spectrum. Pigment system and quantum yield. Photosynthetic apparatus-organization of components in the thylakoid membrane, photochemical reaction- LHS, OEC, mechanism of electron transport -Z-scheme and cyclic; proton transport and chemiosmotic synthesis of ATP; regulation of photosynthetic machinery; carbon reaction-general aspects, activity of rubisco- Calvin Benson cycle, Inorganic carbon concentrating mechanism- C_4 carbon cycle, CAM, C_2 oxidative photosynthetic carbon cycle (photorespiration) significance of C_2 cycle-ecological aspects of photosynthesis. Accumulation and partitioning of photosynthates.

UNIT III: Respiration- overview, mitochondria-structural organization, glycolysis, regulation of glycolysis, PPP, Citric acid cycle, e^- transport system and chemiosmotic synthesis of ATP; alternative oxidase mechanism in plants (cyanide resistance respiration in plants); respiration and coupling of other metabolism. Assimilation of mineral nutrients in plants- N_2cycle, Nitrate assimilation. Ammonium assimilation and synthesis of aminoacids (GOGAT). Biologicalfixation of N_2. Assimilation of S and P in plants.

UNIT IV: Growth hormone- history, biosynthesis, molecular mechanism of action and physiological role of auxin-regulators of cell elongation, phototropism and gravitropism; gibberellin-regulators of plant height; cytokinin-regulators of cell division in shoots and roots, movement of nutrients, chloroplast development; abscisic acid-seed maturation, antistress signal (closes stomata in response to water stress), ethylene-fruit ripening, senescence, abscission, morphactins and brassinosteroids. Photo morphogenesis-phytochrome-mediated photo responses. Physiology of flowering. Biological clock-occurrence of circadian rhythm in plants-examples.

UNIT V: Stress physiology-concepts; types; biotic stress- role of secondary metabolites in plants defense mechanism against pathogens, insect and herbivores. Abiotic stress-types-salinity, drought, freezing, radiationand heavy metal. Biological impacts-morphological, anatomical, metabolical and physiological. Regulatory mechanism-stress sensing, signal transduction pathways, transcriptional regulation, regulatory hormones, ROS, phytochelatins, secondary messenger in plants-

cAMP, Ca-calmodulin.

Books for Reference

1. Beevers, L. *Nitrogen metabolism in plants.* London: William clowes& sons Ltd., 1976.
2. Bidwell, R.G.S. *Plant physiology*. New York: Macmillan publishing company. 1979.
3. Devlin, R.M. *Plant Physiology*. New Delhi: Narosa publishing House.1974.
4. Jain, V.K. *Fundamentals of Plant Physiology*. New Delhi: S.Chand and Co. Ltd., 2004.
5. Noggle, G.R. and Fritz, G.J. *Introductory plant physiology*. New Delhi: Prentice Hall. 2002.
6. Salisbury, F.B. and Ross. C.W. *Plant Physiology*. Thomson Wordsworth, 2007.
7. Taiz, L. and Zeiger. E. *Plant Physiology*. United States of America: Sinauer Associates. Publishers Massachusetts.1998.

Practical Hrs/ week: 2

- Hill activity - effect of light quality.
- Effect of antitranspirants in transpiration and determination of stomatalindex and frequency (Single leaf method & calcium chloride method)
- Determination of water potential(any onemethod)
- Membrane permeability studies.(using different solvents and temperature)
- Nitrate reductase activity – any one factor (light conditions /age)
- Determination of amylase activity.
- Determination of peroxidase activity
- Estimation of proline (Under normal and stressed conditions)
- Determination of chlorophyll content during aging/ under different light conditions
- Study on nutrient ion uptake.
- Determination of sugar content in fruits during ripening process.

Submission - Record Note Book

Laboratory Manual for Reference:

1. Francis H Witham, David F Blaydes and Robert N Devlin, *Experiments in Plant Physiology.* New Delhi: Vanmostr and Rain hold Company. 1970.

SEMESTER IV			
Core XIV	**Horticulture and Seed Technology**		
Course Code: 21PBOC42	**Hrs/week:4**	**Hrs/Semester: 60**	**Credits: 4**

Objectives:

- To promote, develop, disseminate horticultural and strengthen in the field of seed science & technology.
- To understand the techniques and make significant contribution to an efficient and sustainable production of crops.
- To understand the importance of seed certification and seed testing.

Course Outcomes:

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	understand the scope and potential of horticulture product in India and Tamil Nadu	4	Un
CO-2	classify the horticulture plants based on soil and climate	4	Ap
CO-3	Illustrate different systems of planting in orchard and suggest plant choices	4	Ap
CO-4	demonstrate the methods and types of pruning and explain the basics of soil science and justify the role of soil as a medium for plant growth	4, 7	Un
CO-5	explain about integrated nutrient management and demonstrate the skills of soil testing	7	An
CO-6	identify the diseases and pest of crops and their management	6	Ap
CO-7	acquire skills & handling operations of different equipment's inseed science laboratory	2	Ap
CO-8	learn the techniques of seed processing for quality up gradation and of storage for maintenance of seed quality.	1	Un

SEMESTER IV			
Core XIV	**Horticulture and Seed Technology**		
Course Code: 21PBOC42	**Hrs/week:4**	**Hrs/Semester : 60**	**Credits : 4**

UNIT I: Introduction to Horticulture – definition, special features of horticulture, divisions of horticulture, importance of horticulture. Plant growing structure – Hot beds, cold frames, green houses. Nutrition of horticulture plants, irrigation of horticulture plants.

UNIT II: Pomology: Definition, establishment of orchard: location and site, preliminary operation, planning of an orchard, laying out of the orchard, planting distance, planting season, planting method and transplantation. Training, pruning, cropping, harvesting, handling, storage and preservation of fruits.

UNIT III: Olericulture: Definition, Climate and soil requirement, spacing, water and weed management, nutrient requirement and management, training system for vegetables, harvest and yield of important vegetablecrops – tomato, brinjal, chilly, Bhendi, cluster beans, dolichous bean, onion, cucumber, bitter guard. Storage and preservation of vegetable.

UNIT IV: Seed technology: definition, importance, principles of seed production. Foundation and certified seed production of varieties and hybrids. Principles of GM crop and organic seed production. Seed storage – principles- factors affecting seed longevity during storage – Seed treatments and packaging materials - measures for pest and disease control during storage and godown sanitation. Post-harvest handling of seeds - threshing methods - drying - methods of seed drying - Seed processing - seed cleaning and grading - Processing equipment -cleaner cum grader -Upgrading equipment - specific gravity separator, colour sorter, indented cylinder separator, spiral separator, magnetic separator, needle separator - working principles - Seed quality enhancement techniques - importance - seed fortification, seed priming, seed coating, seed pelleting.

UNIT V: Seed Quality and seed testing: Seed certification - phases of certification, procedure for seed certification, field inspection, field counts, field and seed standards. Post-harvest inspection - processing,

bagging and tagging. Seed testing: seed viability and longevity, pre and post-harvest factors affecting seed viability. Seed ageing – physiology of seed deterioration liquid peroxidation seed viability. Seed vigourand its concept, vigour test method. Factors affecting seed vigour.Physiological and basis of seed vigour in relation to crop performance and yield.

Books for Reference:

1. Allard John, R.W. *Principles of plant breeding New York:* Wiley & Sons, Inc. 1960.
2. Chopra, V.L *Plant Breeding Theory and Practice*. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd., 2000
3. Choudhri D and Amal Metha *Flower crops cultivation and management.* Jaipur: Oxford Book Company, 2010.
4. Edmund Senn - Andrew – Halfacre. *Fundamentals of Horticulture*. Tata Mc. Graw Hill, 1977.
5. Hartmann & Kester, – *Plant propagation*. New Delhi: Prentice – Hall of India Pvt. Ltd., 1989.
6. Mallikarjuna Reddy and Aparna Rao *Plant propagation in horticulture*.New Delhi: Pacific book international. 2010
7. Randahawa *Floriculture in India*. Allied publishers, 1985.
8. Utpal Banerji *Horticulture.* Jaipur: Mangal Deep Publication, 2008.
9. Agarwal, R.C. Seed Technology. New Delhi: Oxford and IBH Publishing Co., 1996.

Practicals:
Hrs / Week: 2

- Knowledge of garden implements and tools - Spade, Sprayer, Water can, Pruning scissor, Tiller, Digging fork, Pickaxe, Budding and Grafting Knife,
- Preparation of nursery and seed bed.
- Propagation - stem, leaf and root cutting.
- Propagation - air layering, budding and grafting technique.
- Designing kitchen garden, Rockery, Hanging basket, terrarium
- Seed sampling and testing: Physical purity, germination, viability, etc.
- Seed and seedling vigour test.

Laboratory Manual for Reference:

1. Horticulture Science lab manual. Dr. Chiwan W. Lee. Department of Plant Science, North Dakota State University
2. A Practical Manual of Seed Science and Technology Volume-1. Dr.Satya Prakash Gupta.