REVISED SYLLABUS

Adikavi Sri Maharshi Valmiki University

DEPARTMENT OF BOTANY
KRISHNA TUNGA CAMPUS,
MANTRALAYA ROAD, YERGERA-584133
KARNATAKA-INDIA

REVISED SYLLABUS

I SEMESTER: HARD CORE THEORY-BOT: HCT-1.1
ALGAE, FUNGI, BACTERIA AND VIRUSES

Credits-04 **Theory-64 Hrs**

***Learning Objectives**: The course aims to introduce students to the fascinating microscopic world of algae, fungi, bacteria, and viruses. It focuses on understanding their structural diversity, classification, reproduction, and ecological significance. Students will explore their roles in agriculture, industry, and medicine, while also learning about plant diseases caused by microbial pathogens and their control measures.*

***Course Outcome**: Course provides extensive knowledge on both fundamental and applied aspects of microorganisms and lower cryptogams, highlighting their ecological roles, economic importance, and relevance in agriculture, industry, and medicine. Further, the course equips students with practical skills for identification of microbial groups, diagnosis of plant diseases, and their effective management.*

Unit I: Algae: Introduction and contributions of Phycology, General characters and classification of algae (Fritsch, 1945 and Van den Hoek 1995); Distribution of algal communities-freshwater, marine and terrestrial; algae from usual environments. Thallus ultrastructure organisation, reproduction and life cycle patterns of Cyanophyceae (*Microcystis, Nostoc, Oscillatoria* and *Scytonema*), Chlorophyvceae (*Chlorella, Spirogyra, Volvox,* Desmids and *Coleochatae*), Charophyceae (*Chara* and *Nitella*), Xanthophyceae (*Vaucheria* and *Botrydium*), Bacillariophyceae (Pennales and Centrales), Phaeophyceae (*Ectocarpus, Porphyra* and *Sargassum*) Rhodophyceae (*Batrachospermum* and *Polysiphonia*). Economic importance of algae. Biochemicals from algae: enzymes, vitamins, antibiotics, sterols and liposomes. **16 h**

Unit II: Fungi: General characteristics and classification, morphological, structural diversity and reproduction in Myxomycotina (*Stemonitis*), Mastigomycotina (*Saprolegnia*) Zygomycotina (*Mucor* and *Rhizopus*), Ascomycotina (Yeast, *Aspergillus* and *Peziza*), Basidiomycotina (*Puccinia, Agaricus* and *Lycoperdon*), Deuteromycotina (*Cercospora, Alternaria* and *Rhizoctonia*). Homothallism and Heterothallism, Economic importance of fungi: Agriculture- biofertilizers and biopesticides, Pharmaceuticals- antibiotics and hormones, Industrial- organic acids and mushroom cultivation, Nutrition- edible fungi. Lichens: General characteristics, classification, ecological significance, economic importance. **16 h**

Unit III: Bacteria: General characters, classification, Ultrastructure of bacterial cell, Reproduction in Bacteria: Fission, sexual reproduction (Genetic recombination) - Conjugation, Transformation and Transduction. Bergey's Manual of Systematic Bacteriology, Role of Bacteria in Agriculture and Nitrogen fixation. Bacterial diseases: Citrus canker, Black arm, boll rot and blight of Cotton, Bacterial leaf blight of paddy. Bacterial Plasmids and their characteristics. Spirochaetes, *Rickettsiae* and *Chlamydiae.* **16 h**

Unit IV: Viruses: General characters, Morphological and structural diversity, classification, nomenclature and ultrastructure of TMV and Bacteriophages, Reproduction, Infection and multiplication of Phage (Lytic cycle). Viroids and Prions. Viral diseases: TMV, YBMV and PRSV (Papaya ring spot). Mycoplasma: General Characters, Ultrastructure studies and classification. Mycoplasma diseases and management: Little leaf of *Vinca rosea*, Grassy shoot of Sugarcane. Phytoplasma- a brief account. Mycoplasma like organisms (MLOs).

16 h

Suggested Readings/References:

1. Bold and Wynee. 1985. Introduction to algae - structure and reproduction. Prentice - Hall, India.
2. Desikachary. 1959, Cyanophyta, ICAR. New Delhi.
3. Dixon. 1973. Biology of Rhodophyta. Oliver and Boyd, London.
4. Dodge JD. 1973. The Fine Structure of Algal Cells, Academic Press, INC. London.
5. Fritsch FE. 1961, Structure and reproduction in algae, Vol - I, & II Cambridge University Press, London.
6. Bruns TD, White TJ and Taylor JW. 1991. Fungal molecular systematics. Annu. Rev. Ecol. Syst, 22: 525-64.
7. Burnell JH and Trinci APJ. 1979. Fungal walls and hyphal growth, Cambridge University Press. Cambridge.
8. Chandhniwala. 1996. K.M. Infectious fungi, Anmol Publications, Pvt. Ltd.
9. Bergey, D. H (1923). Bergey's manual of determinative bacteriology: a key for the identification of organisms of the class schizomycetes. The Williams & Wilkins Company. Baltimore:
10. Contract, F. H., Kimball, P.C. and Jay, L. 1998. Virology. Prentice Hall, Englewood Cliff, New Jersey.
11. Dimmock, N. J., Easton A. J. and Leppard K. N. 2007. Introduction to Modern Virology (VI Ed.), Blackwell Publishing, UK.
12. Alexepoulos CJ and Mims CW. 1989. Introductory Mycology, Wiley Eastern Ltd., New Delhi.
13. Powar CB and Daginawala. 1991. General Microbiology, Vol - I and Vol - II Himalaya publishing house, Bombay.
14. Dubey RC and Maheshwari DK. 2002. A Text book of Microbiology, S.C.Chand and Company, Ltd. Ramnagar, New Delhi.
15. Ananthnarayan R and Panikar JCK. 1986. Text book of Microbiology. Orient Longman ltd. New Delhi.

PRACTICALS

BOT: HCP. 1.1. ALGAE, FUNGI, BACTERIA AND VIRUSES

1. Study of algal morphology and reproduction.
2. Algal community sampling from freshwater, marine, and terrestrial habitats.
3. Study of fungal morphology and reproductive structures.
4. Isolation and culturing of fungi.
5. Identification and study of lichens.
6. Bacterial morphology and staining techniques (Simple, Gram, Spore).
7. Bacterial growth and reproduction studies.

8. Diagnosis of locally available plant diseases caused by bacteria and fungi.
9. Study of viral diseases in plants.
10. Examination of mycoplasma and phytoplasma-related plant diseases.

REVISED SYLLABUS

I SEMESTER: HARD CORE THEORY-BOT: HCT-1.2
BRYOPHYTES, PTERIDOPHYTES, AND GYMNOSPERMS

Credits-04 **Theory-64 Hrs**

***Learning Objectives**: Aim of this course is to introduce students to the diversity, morphology, structure, reproduction, and evolutionary trends of Bryophytes, Pteridophytes, and Gymnosperms. Students will also learn about their ecological significance, economic importance, fossil records, and role in plant evolution and conservation. The course emphasizes both theoretical knowledge and practical understanding of these plant groups.*

***Course Outcome**: Course provides extensive knowledge on both fundamental and applied aspects of lower and higher non-flowering plants, including their morphology, reproduction, evolution, and economic significance. Further, the course equips students with practical skills to study, identify, and document Bryophytes, Pteridophytes, and Gymnosperms, as well as understand their conservation and ecological relevance.*

Unit I. Bryophyta: General Characters, Classification (Rothmuler), origin and distribution, Morphological, structural diversity and reproduction in Marchantiales (*Marchantia*), Jungermanniales (*Porella*), Metzgeriales (*Aneura*), Anthoceratales (*Anthoceros*), Sphagnales (*Sphagnum*), Bryales (*Funaria* and *Polytrichum*). Ecology and economic importance of Bryophytes. Fossil Bryophytes. Economic importance: with special reference to chemical constituents, bryophytes as indicator of pollution, Succession of bryophytes. Evolutionary trends in Sporophytes and gametophytes of Bryophytes. **16 h**

Unit II. Pteridophyta: General characters, Classification, origin and distribution, Morphological, structural diversity and reproduction in Psilotales (*Psilotum*), Lycopodiales (*Lycopodium*), Selaginnelales (*Selaginella*), Equisetales (*Equisetum*). Fossil Pteridophytes: Psilophytales, Lepidodendrales and Calamitales. **16 h**

Unit III. Pteropsida: Vegetative habits, anatomy and reproduction in Ophioglossales, Osmundales, Filicales, Marsiales and Salviniales; Stelar evolution in Pteridophytes; Heterospory and seed habit; Telome concept; Economic importance of Pteridophytes; Recent developments in Pteridophytes. **16h**

Unit IV. Gymnosperms: Introduction, classification and distribution; Morphology, anatomy and reproduction in Cycadales- *Cycas* and *Zamia*, Ginkgoales- *Ginkgo biloba*, Coniferales- *Pinus* and *Araucaria*, Gnetales- *Gnetum* and *Ephedra*; General account of vegetative and reproductive organs of Pteridosperms; Pentoxylales and Bennettitales- their affinities; Economic importance of Gymnosperms; Endangered and endemic taxa and their conservation. **16 h**

Suggested Readings/References:

1. Puri, P. 1980. *Bryophytes*. Atma Ram and Sons, Delhi.
2. Parihar, N. S. 1996. *Bryophytes*. Central Book Depot, Allahabad.
3. Goffinet, B., & Shaw, J. A. 2009. *Bryophyte Biology*. Cambridge University Press, NewYork.
4. Parihar, N. S. 1996. *Biology and Morphology of Pteridophytes*. Central Book Depot, Allahabad.
5. Sporne, K. R. 1991. *The Morphology of Pteridophytes*. B.I. Publishing Pvt. Ltd., Bombay.
6. Parihar, N. S. 1977. *The Morphology of Pteridophytes*. Central Book Depot, Allahabad, India.
7. Sporne, K. R. 1962. *The Morphology of Pteridophytes: The Structure of Ferns and Allied Plants*. Hutchinson & Co.
8. Nair, M. C., Rajesh, K. P., & Madhusudanan, P. V. *Bryophytes of Wayanad in Western Ghats*. Malabar Natural History Society, Kozhikode.
9. Andrews, H. N. 1961. *Studies in Paleobotany*. John Wiley, New York.
10. Bhatnagar, S. P., & Moitra, A. 1996. *Gymnosperms*. New Age International Ltd., New Delhi.
11. Chamberlain, C. J. 1986. *Gymnosperms – Structure and Evolution*. CBS Publishers, New Delhi.
12. Chopra, G. L., & Verma, V. 1988. *Gymnosperms*. Pradeep Publications, Jalandhar.
13. Harris, T. M. 1973. *Cycas and the Cycadales*. Central Book Depot, Allahabad.
14. Shukla, A. C., & Misra, S. P. 1975. *Essentials of Paleobotany*. Vikas Publishing House Pvt. Ltd., New Delhi.
15. Sporne, N. E. 1965. *The Morphology of Gymnosperms*. Hutchinson and Company (Publishers) Ltd., U.K.

PRACTICALS

BOT: HCP. 1.2. BRYOPHYTES, PTERIDOPHYTES, AND GYMNOSPERMS

1. Thallus structure, anatomy and reproductive features of *Marchantia, Anthoceros, Porella, Funaria* and *Polytrichum*.
2. Habit, anatomy and reproductive features of *Psilotum, Lycopodium, Selaginella, Equisetum, Ophioglossum* and *Osmunda*.
3. Habit anatomy and reproductive features of *Pteris, Marselia,* and *Salvinia*.
4. Habit anatomy and reproductive features of *Zamia, Ginkgo, Araucaria, Podocarpus, Agathis, Ephedra* and *Gnetum*.
5. Types of fossils and fossiliferous rocks.
6. Study of available fossil specimen and slides of Pteridophytes and Gymnosperms.

Note: Submission of Herbarium specimen (05).

REVISED SYLLABUS

I SEMESTER: HARD CORE THEORY-BOT: HCT-1.3
PLANT SYSTEMATICS AND PHYTOGEOGRAPHY

Credits-04 **Theory-64 Hrs**

Learning Objectives: *Aim of this course is to introduce students to the principles and systems of plant taxonomy and nomenclature, the preparation and maintenance of Herbaria and botanical gardens, and the classification of angiosperms as per modern phylogenetic systems. Students will also gain knowledge on the principles of phytogeography, distribution patterns of plants, major floristic regions of the world and India, and factors influencing plant migration and endemism.*

Course Outcome: *Course provides extensive knowledge on both fundamental and applied aspects of plant taxonomy, nomenclature, phytogeography, and floristics. Further, the course equips students with practical skills in herbarium preparation, plant identification, understanding of plant distribution patterns, and interpretation of floristic and phytogeographical data relevant to conservation, biodiversity studies, and ecological research.*

Unit I: Taxonomy: Pre-Darwinian, Post Darwinian, Phylogenetic systems of classification-Cronquist, Takthajan and Thorne and APG systems of classification; Herbarium: Brief account on the herbaria of World and India, Preparation of herbarium specimens, Maintenance and importance of Herbaria; Botanical gardens- A brief account on the botanical gardens of India & World- their importance; Botanical Survey of India. **16 h**

Unit II: Plant Nomenclature: Principles, procedures, rules and recommendations; ICN-Principles, priority, valid publication, effective publication and citation; ICNCP-Classification, documentation and registration of cultivated plant species; Angiosperms families: characteristics, interrelationships, economic and medicinal importance and classification as per APG-IV of the following clades and families;

ANA Grade: Amborellaceae, Nymphaeaceae, Austrobaileyaceae.
Magnoliids: Magnoliaceae, Annonaceae, Lauraceae, Piperaceae.
Monocots: Poaceae, Orchidaceae, Arecaceae (Palmae), Zingiberaceae.
Basal Eudicots: Papaveraceae, Ranunculaceae.
Core Eudicots: Dilleniaceae, Caryophyllaceae.
Super rosids:

- Saxifragales: Crassulaceae, Saxifragaceae.
- Rosids: Zygophyllaceae, Fabaceae, Euphorbiaceae, Rutaceae, Malvaceae, Cucurbitaceae.

Super asterids:

- Caryophyllales: Plumbaginaceae, Amaranthaceae, Nyctaginaceae.
- Asterids: Rubiaceae, Lamiaceae, Asteraceae, Apocynaceae, Solanaceae. **16 h**

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Unit III: Principles of Phytogeography: Origin of islands and continents- Pangea, Panthalasa, Laurasia, Gondwana land; Plate tectonics and continental drift; theory of tolerance; Endemism; Major terrestrial biomes in the world. Phytogeographical regions of the World & India; General characters of flora of India; Native taxa; Naturalization of exotic taxa. **16 h**

Unit IV: Floristics: Six major floristic regions of world; Australian Kingdom, Cape Kingdom, Antarctic Kingdom, Palaeotropical Kingdom, Neotropical Kingdom, Boreal Kingdom; Floristic regions of India; eight floristic regions: the western Himalayas, the eastern Himalayas, Assam, the Indus plain, the Ganga plain, the Deccan, Malabar and the Andamans. Plant distribution and migration- Contism, dricontinism and endemic distribution; Age and area hypothesis; Wills theory; Vicaridas and theory of tolerance. **16 h**.

Suggested Readings/References:

1. A dictionary of flowering plants and ferns: Airy-Show, H.K (Cambridge,1983).
2. An introduction to plant nomenclature: Bennet, S.S.R. (Dehradun 1979).
3. The evolution and classification of flowering plants: Cronquist, A (London 1968).
4. An introduction to plant taxonomy: Jeffery, C (Cambridge Univ Press 1982).
5. Taxonomy of Angiosperms: Jhori, B.M. & Bhatnagar, S P (Narosa, New Delhi. 1994).
6. Plant Systematics: Jones, S. B. & Luchsinger, A. E. (McGrew Hill 1979).
7. Taxonomy of vascular plants: Lawrence, G H M (Mac Millen, London 1951).
8. Taxonomy of angiosperms: Naik, N (1984).
9. Vegetation of the Earth- Ecological systems of the geo-biosphere: Heinrich Walter (2002).
10. An Advance text book on biodiversity: Krishnamurthy KV (IBH, New Delhi, 2003).

PRACTICALS

BOT: HCP. 1.3. PLANT SYSTEMATICS AND PHYTOGEOGRAPHY

1. Description of plants using technical terms
2. Identification of plants to family level.
3. Identification of plants to species level using flora
4. Preparation of Dichotomous key for identification
5. Listing of endangered species
6. Floristic regions of India.
7. Evolutionary concepts
8. Drawing maps of continental drift
9. Listing plants of GUG campus
10. Studying species distribution and its measurements
11. Examples of exotic / invasive species

Note: Submission of 5 Maps / Photographs /Herbaria during practical examination

REVISED SYLLABUS

I SEMESTER: SOFT CORE THEORY- BOT: SCT-1.1
BIODIVERSITY AND CONSERVATION

Credits-04 **Theory-64 Hrs**

***Learning Objectives**: Aim of this course is to introduce students to the concepts, importance, and current status of biodiversity at the species, genetic, and ecosystem levels. Students will gain knowledge of threats to biodiversity, including habitat loss, overexploitation, invasive species, and climate change. The course also focuses on conservation strategies, both in situ and ex situ, legal frameworks, and policies for biodiversity protection, with emphasis on India and local regions such as Raichur.*

***Course Outcome**: Course provides comprehensive knowledge on both basic and applied aspects of biodiversity and its conservation. Further, the course equips students with practical understanding of strategies for preserving species, ecosystems, and genetic resources, along with awareness of legal, policy, and organizational frameworks for biodiversity management and conservation practices in India and worldwide.*

Unit I: Biodiversity: Definition, concept and importance of biodiversity; Species biodiversity, genetic diversity, ecosystem diversity; Basic concepts of conservation biology, history of conservation biology, the value of biodiversity and conservation, current practice in conservation. Rio de Jeneiro Earth Summit 1992, biodiversity and agenda 21; Biodiversity of the World, India and Karnataka; Hotspots of World and India; Mega biodiversity centres of World and India. **16 h**

Unit II: Threats to Biodiversity: Habitat loss, pollution, species introduction, global climate change, overexploitation, poaching of wildlife. Rare species, genetic diversity of rare species, habitat loss and fragmentation. Extinction: mass extinction, extinction process, ecosystem degradation, over exploitation, invasive species. Human factors: social factors, economics, politics and action. Man wildlife conflicts. Endangered and endemic species of India, common plant species, common animal species. **16 h**

Unit III: Conservation of Biodiversity: Strategies for conservation: In situ and ex situ conservation- environmental assessment, protected areas-biosphere reserves, national parks, sanctuaries, tiger reserves-project tiger. Ex-situ Conservation- Managed ecosystems, biological resources and gene banks, botanical gardens, bio-parks, simulated ex situ conservation strategies, valuing biological resources, ecotourism. Strategies for Conservation: Top-down and bottom- up protocols for conservation. **16 h**

Unit IV: Legal aspects of biodiversity conservation: Policy, priority setting and future strategies with emphasis to India and Raichur region. Conservation Practices in India and World- Organizations involved in resource conservation IUCN, WWF, UNEP, UNESCO, Biodiversity International, IPGRI, FAO, BSI, ZSI. Phytogeography- Hotspots of India and world. General account on activities of DBT, BSI, NBPGR, ZSI, FSI, NBFGR and NBAGR NFPTCR, Sacred groves, Biodiversity register. **16 h**

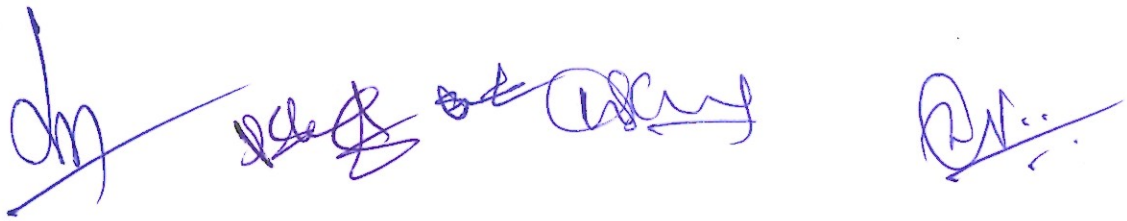
Suggested Readings/References:

1. Global Biodiversity Assessment: Heywood V M and Watson RT (Cambridge Univ Press,1985).
2. Biodiversity: Implications for global security: Swaminathan MN & Jain RS (Macmillan,1982).
3. Understanding biodiversity, life sustainability and equity: Kothari (1987).
4. Essentials of Conservation Biology: Longman, Richard B, Primack (1993)
5. Global Biodiversity Assessment: Heywood VH & Watson RT (1995).
6. Natural Products from Plants: Peter B, Kaufman et al. (1999).
7. Biodiversity and its Conservation in India: Negi S S (1993).
8. Introduction to environment impact assessment: Glasson J, Therivel R & Chadwick A (UCL, London 1995).
9. Red Data Book of Indian Plants vols I-III: Nayar MP & Sastry ARK (1987, 1989, 1990).
10. The Useful Plants in India: CSIR (1986).

PRACTICALS

BOT: SCP. 1.1. BIODIVERSITY AND CONSERVATION:

1. Field survey of important plants of the region.
2. Study of the characters and threatened plants included in the theory.
3. Survey of important timber yielding trees of the region.
4. Determination of the minimum size of the quadrat suitable for an area using 'Species area curve' method.
5. Determination of Importance Value Index (IVI) of the plant species in the community by quadrant method.
6. Study of Phytogeographic maps of world and India.
7. Map of Hot spots, Continental drift.
8. Study of Endangered plants species of Kalyana Karnataka region.



REVISED SYLLABUS

I SEMESTER: SOFT CORE THEORY- BOT: SCT. 1.2
MICROBIAL TECHNOLOGY

Credits-04 **Theory-64 Hrs**

***Learning Objectives**: Aim of this course is to introduce students to the fundamentals of microbiology, microbial applications in agriculture and industry, and the principles of immunology. Students will learn about microbial diversity, their roles in soil fertility, biocontrol, fermentation, and food production, as well as immune system components, mechanisms of innate and acquired immunity, and diagnostic immunotechniques.*

***Course Outcome**: Course provides extensive knowledge on both basic and applied aspects of microbes, their industrial and agricultural applications, and the immune responses of humans to microbial infections. Further, the course equips students with practical skills in understanding microbial inoculants, industrial microbial processes, immunological assays, and diagnostic techniques relevant to research, healthcare, and biotechnology.*

Unit I. Microbial Technology: Introduction to microbiology, Spontaneous generation theory, Biogenesis theory, Branches of Microbiology and Scope of microbiology. Factors influencing soil microbial population; Biology of symbiotic and non-symbiotic nitrogen fixation, preparation of different types of inoculants- nitrogen fixers, phosphate solubilizers, PGPR- plant growth promoting rhizobacteria; Cyanobacteria and other bacteria, and their applications in agriculture; Microbes in GM crop production; Microbes as biocontrol agents- Baculoviruses, *Bacillus thurinigiensis*, *Bacillus sphaericus*, *Bacillus popilae*; Microbe derived inhibitors. Antibiotic resistance in bacteria. **16 h**

Unit II. Microbes in industry: Industrial production of organic compounds- ethanol, acetone, citric acid, lactic acid, amino acids; Microbial enzymes-amylase, protease, pectinase and lipase; Microbes in food and dairy- Pasteurization, sterilization of milk, fermented dairy products, Foods made by microbial activity- cheese making, pickles; Microbes in food spoilage, food poisoning, food infection; Microbial toxins and their impact on human health; Probiotics and their importance in health care, production of SCP and their nutritional value; Edible mushrooms and their cultivation. **16 h**

Unit III. Immunology: An overview of immune system, Scope of immunology, Phagocytes, Natural killer cells, mast cells, basophils, Dendritic cells and other cells of the inmate immune system. Immunity: Types: Innate immunity: (nonspecific) physical, biochemical and genetic factors involved in governing innate immunity, molecules of inmate immunity- complement, acute phase proteins and interferons; Acquired immunity: (specific) natural, artificial, passive immunity, Humoral or antibody mediated immunity, cell mediated immunity. **16 h**

Unit IV. Immune responses: During bacterial, parasitic and viral infections, congenital and acquired immunodeficiency syndrome; Vaccines. Antigens: nature and types. a) Antibodies- Structure of lgG. Classes of antibodies and their functional diversity, b) Human blood types and Rh factors, c) Antigen-antibody reactions-salient features. Agglutination reaction- Widal

test, Neutralisation test, Opsonisation. Precipitation reaction- VDRL Test. Immunotechniques- RIA, ELISA. Complement system (in brief)- complement fixation test.

16 h

Suggested Readings/References:

1. Michel J, Pelczar Jr.EC and Krieg CR. 2005. Microbiology, Mc.Graw-Hill, New Delhi.
2. Powar CB and Daginawala. 1991. General Microbiology, Vol – I and Vol – II Himalaya publishing house, Bombay.
3. Dubey RC and Maheshwari DK. 2002. A Text book of Microbiology, S.C.Chand and Company, Ltd. Ramnagar, New Delhi.
4. Reddy S and Ram. 2007. Microbial Physiology. Scientific Publishers, Jodhpur, 385pp.
5. Sullia SB and Shantharam S. 1998. General Microbiology. Oxford and IBH publishing Co.Pvt.Ltd. New Delhi.
6. Schlegel HG. 1986. General Microbiology. Cambridge University Press. London, 587pp.
7. Sharma R. 2006. Text book of Microbiology. Mittal Publications. New Delhi. 305pp.
8. Sharma PD. 1999. Microbiology and Plant Pathology. Rastogi publications. Meerut, India.
9. Roger S, Ingrahan Y, Wheelis JL, Mark L and Page PR. 1990. Microbial World 5th edition. Prentice-Hall India, Pvt. Ltd. New Delhi.
10. Waste Water Microbiology 2nd Ed: G Bitton
11. Environmental Biotechnology: S N Jogdand
12. Industrial Microbiology: Agrawal and Parihar
13. Handbook of microalgal culture: Biotechnology and Applied Phycology: Amos Richmond (2004)
14. Microalgae: Biotechnology and Microbiology: Wolfgang Becker E. (1994).
15. Soil Microbiology Science: Subba Rao, N S (1999)
16. Biosurfactants: Kosaric, N (Marcel Dekker Inc 1993)
17. Sullia SB. and Shantharam S. 2005. General Microbiology, Oxford and IBH, New Delhi.
18. Vasanthkumari R. 2007. A textbook of Microbiology, BI Publications Pvt. Ltd., New Delhi.

PRACTICALS

BOT: SCP- 1.2. MICROBIAL TECHNOLOGY

1. Method of sterilization, preparation of media and stains.
2. Isolation of bacteria, fungi and actinomycetes, cyanobacteria and VAM.
3. Production and estimation of Citric acid by *Aspergillus niger*.
4. Extraction and Chromatographic separation of secondary metabolites from bacteria and fungi.
5. Estimation of extracellular amylase activity.
6. Estimation of extracellular protease activity.

7. Sterilization methods.
8. Demonstration of microbial antagonism.
9. Determination of spore concentration (Heamocytometer).
10. Immunoelectrophoresis.
11. Isolation and characterization of Phosphate solubilizers.
12. Estimation of antimicrobial activity using standard (NCCLS/CLSA) guidelines.