

B. Sc., VI SEMESTER
Paper VIII: Environmental Biology, Zoogeography & Applied
zoology

(42Hours)

UNIT I: INTRODUCTION:

(7Hours)

Introduction: Ecological spectrum, levels of organization – meaning and definitions of ecology, different types, subdivisions of ecology, scope of ecology.

Environment: Component of environment: atmosphere - zones and gases, Hydrosphere – (Water) Physical and chemical properties. Lithosphere (Soil) – Types of soil based on texture, soil profile.

UNIT II: ECOLOGICAL FACTORS:

(7Hours)

Ecological factors: Abiotic and biotic factors. Abiotic factors – types of abiotic environmental factors: Light, Temperature, and Air. Topography – latitudes and altitudes, direction of mountain and valleys, steepness of slope.

Biotic factors: Animal relationships – Intraspecific: Aggregation, co-action, competition – Allee's and Gause's principles, social and communal relationships, assistance and parental care. Interspecific: Positive interaction – mutualism, commensalisms, proto-cooperation. Negative interactions– exploitation, parasitism, predation and competition with relevant examples.

Limiting factors – Leibig – Blackman's law of limiting factors, Shelford's law of tolerance.

UNIT III:

BIOGEOCHEMICAL CYCLES AND FOOD CHAIN:

(7 Hours)

Biogeochemical cycles and food chain: Definition, complete and incomplete cycles. Nitrogen and Phosphorous cycle. **Food chain:** Types of food chains with examples and food webs with examples. Ecological pyramids of number, biomass and energy with examples. Energy flow and laws of thermodynamics.

Population and community ecology: Population ecology – density, natality and mortality, age distribution. Community ecology – communities, bioindicators, community structure – ecological determinants, ecological stabilization, ecotone and edge effect. Ecological succession – basic types, general process, climax community. Alpha, beta, gamma diversity.

UNIT IV: Ecosystems and Pollution

(7 Hours)

Ecosystems: Concept, types and structure of ecosystem.

Fresh water ecosystem: Physico-chemical nature of fresh water. The pond as an ecosystem – abiotic components, producers and consumers, interaction between components.

Terrestrial ecology -Physico-chemical nature, classification, Biomes-forest, grassland and desert biomes (Types, environmental conditions, fauna and flora) and adaptation

Pollution: Definition and types, sources, effects and control of air pollution, water pollution, soil pollution and noise pollution.

UNIT V: ZOOGEOGRAPHY AND WILDLIFE CONSERVATION (7 Hours)

Zoogeography: Zoogeographical realms and their characteristic fauna. a brief account of Wallace line

Distribution of wild life (Fauna) in India: (Hot spots of India – The Western Ghats, North Eastern Himalayan region, Importance of wild life.)

Problems: Hunting, Habitat destruction and Over harvesting: Wild life conservation strategies- Insitu: wildlife Sanctuary, National park, Biosphere reservoir. Exsitu – Zoological garden, Botanical garden, seed bank, germplasm bank and sperm bank. Government and non-governmental organization (NGOs) Wild life (Protection) Act

Water pollution Act, Air pollution Act and Environment protection Act? Endangered fauna of India. Red data book. Ramsar convention act.

UNIT VI: BIOSTATISTICS AND APPLIED ZOOLOGY

Biostatistics: Introduction – Tabulation of data, Bar diagram, Histogram. Frequency distribution – mean, median and mode. Standard deviation & standard error. Chi-square test. (7 Hours)

Applied Zoology: Introduction, Rearing of animals for commercial purposes, definition and outlines of vermiculture, sericulture, apiculture, pearlculture, fishculture, poultry and dairy.

REFERENCES:

1. S.Anderson (1991) Managing on Wildlife, Resources, Prentive Hall, Englewood Chit, New Jermamy.
2. Elton, Plant ecology.
3. Kumar H.D. – Modern concepts of Ecology, Vikas Publishing House.
4. Nair, S.M. (1992) Endangered animals of India and their conservation M.B.J Delhi.
5. Odum E.P. (Revised edition) Fundamental of Ecology, W. B. Saunders Co.,
6. Prater S H, The book of Indian Animals. 1998.
7. Sharma P.D. (1991) Ecology and Environment – Rastogi Puplium
8. Singh H.R. (1989) An Introduction Animal Ecology and Environmental Biology, Shobanlal Magin chand & Co.,
9. WWF manuals.

Ecology and Animal relations

14 x 3 Hrs = 36 hrs

1. Estimation of dissolved oxygen in different water samples.
2. Estimation of dissolved carbon dioxide in different water samples.
3. Estimation of chlorides in different water samples.
4. Estimation of hardness of different water samples
5. Study of pond ecosystem: Biotic and Abiotic components.
6. Study of aquarium ecosystem.
7. Study of garden soil fauna using Berlese funnel.
8. Animal associations:
 Mutualism – Termites and Trichonympha.
 Commensalism – Echenies and shark
 Protocooperation – Hermit crab and Sea anemone.. -
9. Parasitism – Head louse, Bed bug, Mosquito, Ticks, Mites.
10. Predation – Snake and Frog.
11. Collection of data such as height, weight, blood groups etc., among students and calculation of mean standard deviations and errors, calculation of chi square values.
12. Construction of Graph, Histograms and Bar diagrams using the above data.
13. Identification of food fishes of Karnataka.
14. A brief account of vermiculture and preparation of vermicompost. Importance of vermicompost and vermiwash in agriculture

Scheme of Practical Examination

Time 3 Hours

Max Marks: 50
Practical proper: 35
Records: 05
Internal assessment: 10

Practical proper:

- | | |
|---|------------|
| 1. Estimation of any 2 parameters – by lots
(Dissolved O ₂ , CO ₂ , Chlorides, Hardness, Turbidity & PH of H₂O) | 8 + 8 = 16 |
| 2. Identify and comment upon animal association A & B | 4+4 = 08 |
| 3. Identify and comments upon C and D | 3x2 = 06 |
| 4. Biostatistics : Calculation of mean, standard deviation, Standard errors/chi square values/ graph, Histograms. | = 05 |
| 5. Records | = 05 |

Scheme of Valuation for Practical - VIII

- | | | | |
|---|------------|---|----|
| 1. Procedure – 2, Experiment 4 and results 2 | 8 x 2 | = | 16 |
| 2. Identification 1, diagram 1, association 2 | 1+1+2 x 2 | = | 08 |
| 3. Identification 1, diagram 1, importance 1 | 1+1+1= 3x2 | = | 06 |
| 4. Biostatistics Problems | | = | 05 |
| 5. Record | | = | 05 |

Environmental Biotechnology and Bioinformatics

I. Environmental Biotechnology

Unit-I

Introduction: Major issues in environment pollution. Role of Biotechnology to solve the problems. Biotechnological methods of pollution detection: General bioassay, cell biological methods, immunoassay, DNA based methods, use of biosensor. Biotechnological methods in pollution abatement: reduction of CO₂ emission, Waste water treatment – conventional waste treatment, Use of Algae, Eutrophication, Use of Cell Immobilization. 6h

Unit-II

Biodegradation: Degradation of Xenobiotic compounds-organic (chlorinated hydrocarbons, substituted simple aromatic compounds, polyaromatic hydrocarbons, pesticides and surfactants. Biohydrometallurgy and Biomining: Bioleaching, biosorption, and bio oxidation. oil degradation and creation of super bugs. 6h

Unit-III

Bioremediation: Bioremediation using naturally occurring microorganisms. Removal of oil spills and grease deposition: use of bacterial strains . use of genetically engineered microbes in pollution :creation of super bug 6h

Unit-IV

Treatment of Industrial wastes: Dairy, leather and Pharmaceutical industries. Genetically engineered microbes for waste treatment.

Ecofriendly bioproducts: Biomass resources, biogas, alcohol as a fuel and biodegradable plastics. 6h

II. Bioinformatics and Biostatistics

Unit-I

Bioinformatics and the Internet: Introduction, Internet basics, connecting to the internet electronic mail, File transfer protocol, The World Web.

Biological Database- DNA, protein, genomic mapping database, sequence alignment software-pair wise & multiple alignment, gene families . 6h

Unit-II

Information retrieval from databases: Databases similarity searching, FASTA, BLAST search, Multalign. Navigating the NCBI web site, gene bank, EMBL, OMIM, Pubmed. Human genome project. Genomics and Proteomics: Types of genomes, bacterial genome sequence project. Human genome project, Micro array technologies-types and applications. 6h

Unit-III

Biostatistics: Data structure, sampling methods, Collection, classification and tabulation, graphical presentation of data of data- histogram, bar graph and pie chart. 6h

Unit-IV

Measure of Central Frequency: Mean, median and mode, Measure of Dispersion: Range, semi-interquartil range, mean deviation, Standard deviation, coefficient of variation 6h

ENVIRONMENTAL MICROBIOLOGY

UNIT 1

No. of Hours: 15

MICROBIOLOGY OF SOIL

- A. Introduction: Definition, Soil types, Soil profile and Physical characteristics of soil- Mineral particles, Organic residues, Water and Gases. Soil fertility. Role of microorganisms in soil formation(in brief).
- B. Microbial flora of Soil: A brief account of Bacteria, Fungi, Algae, Actinomycetes, Protozoa and Viruses.
- C. Biogeochemical cycles : Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin
Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction
Phosphorus cycle: Phosphate immobilization and solubilisation.
Sulphur cycle: Microbes involved in sulphur cycle
Other elemental cycles: Iron and manganese
- D. Associated soil microorganisms with plants- the Rhizosphere and Rhizoplane microflora, Actinorrhizae, and Mycorrhizae (AM), Tripartite and Tetra partite association.
- E. Interaction among soil microorganisms – Neutralism, Mutualism, Commensalism, Antagonism and Parasitism. (In brief).
Microbe-Plant interaction: Symbiotic and non symbiotic interactions
Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria
Microbial succession in decomposition of plant organic matter

UNIT:II

No. of Hours: 15

MICROBIOLOGY OF AIR

- A. Introduction: Definition, history and development, aim and scope of aerobiology.
- B. Microbes and atmosphere: Atmospheric layers, sources of microorganisms, Air spora of indoor and outdoor environment. Factors affecting air spora. Significance of air borne microbes. Management of air-borne microbes. Human air borne diseases (Tuberculosis, Rhinitis and Aspergillosis).
- C. Techniques of trapping air-borne microorganisms: Impactors- The slit sampler, Hirst spore trap, Andersen sampler, Rotorod sampler, Vertical cylinder spore trap, Burkard spore traps. Impingers and Filtration. Advantages and disadvantages of the techniques.

UNIT-III

No. of Hours: 15

MICROBIOLOGY OF WATER

- A. Introduction: Natural waters- atmospheric water, surface water and ground water. Distribution of microorganisms in aquatic environment-Neuston, plankton (Phytoplankton, Zooplankton). Aquatic microorganisms-lakes,ponds, streams, rivers estuaries, and marine plankton. Lotic and benthic population.
- B. Water pollution: Sources, water borne diseases- Viral (jaundice), Bacterial (cholera) and Protozoan (amoebic dysentery). Biological indicator of water pollution.
- C. Determination of sanitary quality of water: SPC, Tests for coliforms, MPN, IMViC reactions and membrane filter.
- D. Water purification in Municipal water supply, Parameters of potable water (WHO).

MICROBIOLOGY OF WASTE WATER

- A. Introduction: Sources of waste water- Domestic, Agricultural and Industrial. Physical, chemical and microbiological characteristics of waste water
- B. Waste water treatment: Single dwelling unit-Septic tank. Municipal waste treatment – Primary (screening, coagulation and sedimentation), Secondary (trickling filter, activated sludge process, oxidation pond), Tertiary (reverse osmosis, ion exchange method and electro-dialysis in brief).
- C. Solid waste recycling- Anaerobic digestion process, Biogas and Composting.
- D. Microbes in extreme environments: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity & low nutrient levels. Microbial succession in decomposition of plant organic matter

UNIT:IV

No. of Hours: 15

MICROBIAL BIOREMEDIATION

In situ –Intrinsic, engineered and *Ex situ* bioremediation- Solid phase system (composting, composting process), Slurry phase system (aerated lagoons, low shear air lift reactor). Bioremediation of hydrocarbons- use of genetically engineered bacterial strains. Bioremediation of xenobiotics, Microbial leaching.

ENVIRONMENTAL MICROBIOLOGY PRACTICALS

1. a. Isolation and identification of fungi from soil by serial dilution method.
b. Isolation and enumeration of bacteria from soil by serial dilution method.
2. Study of AM fungi
3. Isolation of Nitrogen fixing bacteria- *Rhizobium*
4. Study of antagonism between microorganisms
5. Isolation of airborne microorganisms (Bacteria and Fungi) by Petriplate exposure method.
- 6-7. Demonstration of air samplers: equipments / photographs of vertical cylindrical spore trap, Rotorod sampler, Hirst's spore trap, Andersen's sampler, Liquid impingement method (bead bubbler device) and Membrane filter.
8. Microscopic observation of different water samples for biological indicators of water pollution.
9. a. Standard analysis of water sample
b. Determination of MPN.
10. IMViC reactions.
11. Water quality test by Hydrogen sulphide strip test.
12. Display of photographs of water purification process (Baffles, Flocculator, Clarifier, Sand filter, Back wash, Chlorinometer and Chloroscope).
13. a. Determination of biological oxygen demand (BOD) of water.
b. Determination of chemical oxygen demand (COD) of water.
14. a. Estimation of total solids in sewage.
b. Display of photographs - Septic tank, Trickling filter, Activated sludge process, Oxidation ponds, Sedimentation tank, and anaerobic digester.
15. a. Demonstration of composting
b. Display of photographs: composting, composting process, aerated lagoons, low shear air lift reactor and microbial leaching.

NOTE: Visit to water treatment plant/ sewage treatment plant/ industrial effluent treatment plant. Each student shall submit an independent report on the visit along with the practical record for the internal assessment.

Environmental Science
Ability Enhancement Compulsory Course (AECC – Environment Studies)

Unit 1 : Introduction to environmental studies

- Multidisciplinary nature of environmental studies;
- Scope and importance; Concept of sustainability and sustainable development.

(2 lectures)

Unit 2 : Ecosystems

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :
 - a) Forest ecosystem
 - b) Grassland ecosystem
 - c) Desert ecosystem
 - d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

(6 lectures)

Unit 3 : Natural Resources : Renewable and Non-renewable Resources

- Land resources and land use change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water : Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).
- Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

(8 lectures)

Unit 4 : Biodiversity and Conservation

- Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega-biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity : Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

(8 lectures)

Unit 5 : Environmental Pollution

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management : Control measures of urban and industrial waste.
- Pollution case studies.

(8 lectures)

Unit 6 : Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture

- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context. (7 lectures)

Unit 7 : Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management : floods, earthquake, cyclones and landslides.
- Environmental movements : Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

(6 lectures)

Unit 8 : Field work

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a local polluted site---Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems---pond, river, Delhi Ridge, etc.

(Equal to 5 lectures)

Suggested Readings:

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999.*Global Ethics and Environment*, London, Routledge.
4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll.*Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science*, 339: 36---37.
7. McCully, P. 1996. *Rivers no more: the environmental effects of dams*(pp. 29--64). Zed Books.
8. McNeill, John R. 2000. *Something New Under the Sun: An Environmental History of the Twentieth Century*.
9. Odum, E.P., Odum, H.T. & Andrews, J. 1971.*Fundamentals of Ecology*. Philadelphia: Saunders.
10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. *Environmental and Pollution Science*. Academic Press.
11. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012.*Environment*. 8th edition. John Wiley & Sons.
13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India*. Tripathi 1992.
14. Sengupta, R. 2003. *Ecology and economics: An approach to sustainable development*. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.
16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology: Voices from the Tropics*. John Wiley & Sons.
17. Thapar, V. 1998. *Land of the Tiger: A Natural History of the Indian Subcontinent*.
18. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
19. Wilson, E. O. 2006.*The Creation: An appeal to save life on earth*. New York: Norton.
20. World Commission on Environment and Development. 1987.*Our Common Future*. Oxford University Press.

ETHOLOGY AND WILDLIFE BIOLOGY

48 Hrs

PART – A: ETHOLOGY

UNIT - I

8 Hrs

- a. Descriptive versus experimental approaches
- b. Reflexes and complex behaviour- Latency, after discharge, summation, warm up, fatigue inhibition and feedback control
- c. Instinctive Behaviour - Fixed action pattern, Types of sign stimuli and releasers as triggers, Genetic basis of instinctive behaviour.

UNIT - II

8 Hrs

- a. Learning- Classical conditioning experiment, latent and insight learning. Social learning, learning sets and play.
- b. Development of behaviour- Causes of behavioral changes during development, development of bird song.
- c. Importance of early experience – Critical period- Filial imprinting, Sexual imprinting in birds, Imprinting like process in mammals.

UNIT – III

8 Hrs

- a. Foraging and anti-predator behaviour:
 - i. Anti predator behaviour – avoiding detection through colour and Markings (Mullarian mimicry)
 - ii. Warning coloration
 - iii. Batesian mimicry
- b. Biological communication: Forms of signals, vision, audition and chemicals

UNIT – IV

8 Hrs

a. Sexual Behaviour

- i. Hormones and sexual behaviour – Selected examples of courtship and mating behaviour.
- ii. Pheromones in Insects and Mammals
- iii. Lee Boot, Whitten, Bruce, Collidge and Castro-Vandenberg effect/s
- iv. Selected examples of courtship and mating behaviour

b. Social organization

- i. Introduction
- ii. Advantages of grouping
- iii. Social organization in insects with special reference to ants and honeybees
- iv. Social organization in sub human primates
- v. Altruism

PART –B: WILDLIFE BIOLOGY

UNIT V

8 Hrs

- a. Scope and values of wildlife (Ecological, Aesthetic, Scientific, Recreational, Medicinal)
- b. Causes of wildlife depletion: Degradation and destruction of natural habitats, Exploitation for commercial purposes, Deforestation, Agricultural expansion, Urbanization and Industrialization, forest fires and hunting.
- c. Wildlife corridors, Human-wildlife conflicts
- d. Wildlife awareness and education, Wildlife and tribal welfare

UNIT VI

8 Hrs

- a. Conservation strategies: Red data book, protected area network, Role of NGOs in conservation.
- b. Wildlife act and legislation: Wildlife Protection Act 1972; Biological Diversity Act 2002.
- c. Wildlife conservation projects in India (with special reference to Project Tiger, Project Hungul and Gir Project)
- d. In-situ conservation: Bioreserves, National parks, Wildlife sanctuaries and Safari's in India
- e. Management of Bioreserves, National parks, Wildlife sanctuaries and Safaris.
- f. Ex-situ conservation: Zoo garden, Management of Zoos, Captive breeding, Artificial insemination, Cryopreservation (techniques and applications) Germplasm banks,

TUTORIALS – On the basis of the proposed chapters.

2x16 = 32 Hrs.

REFERENCES

- 1) Goodenough J.E., Mc Guire B. and Wallace R. A. (1993) Perspectives on Animal Behaviour. John Wiley and sons, New York.
- 2) Manning A. and Dawkins M.S. (1997).
- 3) Tinbergen (2006) Social behaviour in Animals. J.V. Publishing House Jodhpur India.
- 4) Vandenberg. J.E.(Ed) (1983). Pheromones and Reproduction in mammals. Academic Press. NewYork.
- 5) Agrawal, K.C. 2000. Biodiversity. Agrobios. India.
- 6) Negi,S.S and Bahuguna, V.K. 1983. An Introduction to wildlife management. Bishen Singh Mahendra Pal Singh. Dehara Dun, India.
- 7) NBA. 2004. The Biological Diversity Act (2002) and Biological Diversity Rules (2004). National Biodiversity Authority, India.
- 8) Saharia, V.B. 1982. Wildlife in India. Natraj Publishers. Dehara Dun.

- 9) Anderson S (1991) Managing on Wildlife Resources. Prentice Hall, Englewood Cliffs, New Jersey
- 10) Gee E.P (1964) The wildlife of India. E.P. Dulton and Co. N.Y
- 11) Hosetti B.B. (1997) Concepts in Wildlife Management. Daya Publishing House, Delhi
- 12) Hosetti B.B. and A. Kumar (1998) Environmental Impact Assessment and Management. Daya Publishing House Delhi
- 13) Khanna L.S. (1979) Principles and practices of silviculture. Khanna Bandhu, Dehradun
- 14) Nair S.C. (1991) The Sothern Western Ghats: A Biodiversity conservation plan. Indraprasta Press, New Delhi
- 15) Nair S.M. (1992) Endangered animals of India and their conservation, NBT, New Delhi
- 16) Peek M.J. (1986) A review of Wildlife Management, Prentice Hall, Englewood Cliffs, New Jersey
- 17) Prater S.H. (1971) The Book of Indian animals, 3rd Edn. Bombay Natural History Society, Bombay
- 18) Tikade B.K. (1983) Threatened animals of India, Zoological Survey of India, Calcutta

FOOD AND ENVIRONMENTAL BIOTECHNOLOGY (SOFT CORE) – 48 Hrs

Unit-I

12 Hrs

Fermented foods, milk-based products, fermented vegetables, fermented meats, fish, beverages, vinegar, mould fermentation - tempeh, soysauce, rice wine.

Enzymes in dairy industry, cheese making and whey processing, impact of enzyme technology (protein hydrolysates, bioactive peptides), Enzymatic processing of fruit juices; role of enzymes in baking, meat and meat processing, phytase in animal feeds, DNA-based methods for food authentication, comparative methods of toxicity testing in (novel) foods, biological approach to tailor-made foods, application of generic technologies in food and nutritional sciences; anti-cancer components in foods.

Unit-II

12 Hrs

Functional foods and Biotechnology: applying molecular, biochemical, cellular and bioprocessing concepts, use of specific phenolic metabolites from botanical species. Pre- and Pro-biotics, single cell protein, single cell lipids. Manipulation of fruit ripening process.

Food processing, principles and practices, food ingredients and processing aids from biotechnological processes, corn sweeteners, bacterial starter cultures, Food spoilage, preservation, mycotoxins in food commodities. Genetically modified foods, designer foods, Nutraceuticals, detection of GM foods.

Unit-III

12 Hrs

Renewable and non-renewable resources, current status of biotechnology in environment protection. Characterization of waste. Waste water management: Bioreactors for waste-water treatment, Aerobic biological treatments, anaerobic biological treatments, treatment of industrial effluents-dairy, distillery, paper and sugar industries. Membrane-based waste water treatment. Oil pollution – treatment with microorganisms.

Unit-IV

12 Hrs

Bioremediation: Concepts and principles, bioremediation using microbes, in situ and ex situ bioremediation, biosorption and bioaccumulation of heavy metals. Xenobiotics: Degradation capabilities of microorganisms with reference to toxicology, pesticides, herbicides, polycyclic aromatic hydrocarbons.

Renewable energy: Relevance of GMO to the environment.

Solid waste management: Waste as a source of energy, biotechnology in paper and pulp industry, production of oil and fuels from wood waste, anaerobic and aerobic composting, vermiculture, bio fuels.

Reference Books

1. Food Microbiology. Frazier, W. C. and Westhoff, D. C. Tata McGraw Hill.
2. Agriculture Bio-technology. Purohit. Agrobios India.
3. Food Bio-technology. Knorr, D. Marcel Dekker Inc.
4. Environmental Bio-technology. Jogand, S. N. Himalaya Publishing House, New Delhi.



JSS MAHAVIDYAPEETHA

JSS COLLEGE OF ARTS, COMMERCE & SCIENCE

(An Autonomous College of University of Mysore)

B.N. ROAD, MYSORE-570 025 KARNATAKA

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PG DIPLOMA IN HUMAN RIGHTS EDUCATION SYLLABUS

2019-20

**CO-ORDINATING DEPARTMENT
POLITICAL SCIENCE**

PG DIPLOMA IN HUMAN RIGHTS

Regulations:

- Duration : 1 Year / 2 semesters
- Eligibility : Any Graduate and also judges, lawyers, civil servants, political elites, teaching community at all levels, and last but not the least, the police, para-military and army personnel. (Note – Those among them interested to pursue the postgraduate diploma course should get encouragement and support by way of official sponsoring from the appropriate authorities),
- Intake : 30 students
- Admission Procedure : As per norms
- Scheme of Instruction and Examination : Enclosed
- Attendance : As per regulations
- Medium of Instruction : English / Kannada

SCHEME OF INSTRUCTION & EXAMINATION

I SEMESTER				
Papers	Teaching hours 32 hrs in a semester	Practicals / Extension Activities – Field Visit 16 hrs per semester	Examination hours	Max marks
Paper- I Foundations of Human Rights – I	2 hrs per week	16 hrs per semester	03	(I.A) 20+80=100
Paper – 2 Weaker Sections & Human Rights in India – I	2 hrs per week	16 hrs per semester	03	(I.A) 20+80=100
Paper-3 National Perspectives of Human Rights	2 hrs per week	16 hrs per semester	03	(I.A) 20+80=100
II SEMESTER				
Paper – 4 Foundations of Human Rights – II	2 hrs per week	16 hrs per semester	03	(I.A) 20+80=100
Paper – 5 International Perspective of Human Rights	2 hrs per week	16 hrs per semester	03	(I.A) 20+80=100
Paper – 6 Weaker Sections & Human Rights in India – II	2 hrs per week	16 hrs per semester	03	(I.A) 20+80=100

COMPOSITION OF INTERNAL ASSESSMENT

- Test / Assignment / Seminar - 10 Marks
- Extension Activities / Field Visit - 10 Marks

I. FOUNDATION OF HUMAN RIGHTS – I

Unit – I Understanding of Human Rights

Human Rights Concepts; Meaning and Definition, Nature and significance, Relationship between Rights and duties, Types of rights; civil, political, economic, social, cultural and environmental.

Unit II Evolution of Human Rights

Ancient, Modern and post-modern
Magna Carta, American Revolution, French Revolution, Marxist Revolution, Universal Declaration of Human Rights, International Covenant on Civil, Political, Economic, Social and Cultural Rights

Unit – III Theoretical perspectives of Human Rights

Doctrine of Natural Rights, Legal Theory, liberal Theory
Idealist Theory, Marxist Theory and Welfare Theory.

REFERENCES

1. Dube, M.P. and Neeta Bora, (Ed.), (2000), Perspective on Human Rights, New Delhi: Anamika Publishers
2. Freeman, Michael, (2003), Human Rights: An interdisciplinary Approach, Cambridge: Polity Press
3. Hargopal, G. (1999): Political Economy of Human Rights, Hyderabad: Himalaya.
4. Jacobs. Francis G and R.C.A White, (1996), The European Convention of Human Rights, Oxford: Clarendon University Press
5. Kannabiran, K.G (2003), the wages of Impunity: Power, Justice and Human Rights, New Delhi: Orient Longman.

Note – 32 hours theory classes and 16 hours extension activities to be conducted, making totally 48 hours of academic activities.

II. Weaker Sections and Human Rights in India – I

Unit I Constitution and Human Rights

Fundamental Rights, Fundamental Duties, Relationship between them, Directive Principles of State Policies, International Human Rights and the Indian Constitution

Unit II Theory and Practice of Human Rights of the Dalits in India

Special Laws and the constitutional Provisions for the Protection of the Rights of the Dalits, National Commission for SC / ST, Protection of Civil Liberties Act, (1955), Scheduled Castes and Scheduled Tribes Act, 1989.
Social discrimination and caste violence in India

Unit-III Women and Human Rights

Special Laws for the Protection of Women: Suppression of Immoral Traffic Act (1956), Maternity Benefit Act (1961), Dowry Prohibition Act (1961), Equal Remuneration Act (1976), Medical Termination of Pregnancy Act (1971), Commission of Sati (Prevention) Act (1982)

REFERENCES

1. Alam, Aftab, (ed.), (1999), Human Rights in India: Issues and Challenges, New Delhi: Raj Publications.
2. Dikshit, R.C., (1998), Human Rights and the Law, Universal and Indian, Deep and Deep, New Delhi:
3. Jha, R.C., (1995), Resurrecting: Human Rights in India, Sheridan Book Company, New Delhi 4, Paul, R.C (2000),
4. Paul, R.C., Situation of Human Rights in India, Commonwealth Publishers New Delhi,
5. Ray, Arun, (2004), National Human Rights Commissions in India: Formation, Functioning and Future Prospects, Atlantic, New Delhi.

Note – 32 hours theory classes and 16 hours extension activities to be conducted, making totally 48 hours of academic activities.

III. National Perspectives of Human Rights

Unit I Human rights and duties in India

Evolution, Ideals enshrined in the Preamble, Special rights for vulnerable Sections, Discrimination: Racial, Gender, Religious and Caste Women and Children, Importance of Sensitization and Internalization of Human Rights and Values.

Unit II Protection and enforcement of rights and duties in India

Judiciary, National and State Human Rights Commissions, Other grievance redressal mechanisms, NGOs, Social Movements, Pressure groups, Mass media, Human Rights Violations; Within the Family, Riots and Violence in Connection with Inter-Community Tensions, Unequal Access to Natural Resources

Unit III Contemporary issues in Human Rights

Right to Clean Environment and Public Safety – Issues of Industrial Pollution, Prevention, Rehabilitation.
Safety Aspect of New Technologies – Chemical and Nuclear Technologies, Issues of Waste Disposal, Protection of Environment, Bio-technology and Human Rights

REFERENCES

1. M.R. Ishay, The History of Human Rights, Orient Longman, New Delhi, 2004.
2. Kalin and Kunzli, The Law of International Human Rights Protection, OUP, Clarendon, 2009
3. R.H. Callaway and J. Harrelson-Stephens (eds.), Explaining International Human Rights, Viva, New Delhi, 2010.
4. Desai, A.R (ed), (1986), Violations of Democratic Rights in India, Bombay: Popular Prakashan.
5. Sathe S.P., (2004), Judicial Activism in India, New Delhi : OUP.

Note – 32 hours theory classes and 16 hours extension activities to be conducted, making totally 48 hours of academic activities.

IV. Foundations of Human Rights – II

Unit – I Human Duties and Responsibilities

Concept of Duties and Responsibilities

Classification of Human duties,

Duties towards self, family, community and state.

Unit – II Issues in Human Rights

Poverty, Inequality, Unemployment, Underemployment,

Migration, refugees, displacement.

Unit – III Human Rights and Human Values

Concepts of Liberty, Equality, Justice and fraternity,

Humanity, Compassion, Virtues and Social dignity.

REFERENCES

1. Dube, M.P. and Neeta Bora, (Ed.), (2000), Perspective on Human Rights, New Delhi: Anamika Publishers
2. Freeman, Michael, (2003), Human Rights: An Interdisciplinary Approach, Cambridge: Polity Press
3. Hargopal, G, (1999), Political Economy of Human Rights, Hyderabad: Himalaya,
4. Jacobs, Francis G and R.C.A White, (1996), The European Convention of Human Rights, Oxford: Clarendon University Press
5. Kannabiran, K.G. (2003), The wages of Impunity: Power, Justice and Human Rights, New Delhi: Orient Longman.

Note – 32 hours theory classes and 16 hours extension activities to be conducted, making totally 48 hours of academic activities.

V. International Perspectives of Human Rights

Unit I International Concern and Obligation towards Human Rights

Development of International Concern, UN and human rights,
UN Charter on Human Rights, Universal Declaration of Human Rights,
International Covenant on Civil and Political Right.,
International Convenant on Economic, Social and Cultural Rights
UN Declaration on Duties and Responsibilities of Individuals 1997.
UN High Commission for Human Rights, UNICEF, UNESCO, WHO, ILO,
ECOSOC

Unit – II American and European Human Rights Systems

American Convention on Human Rights (1969),
Inter-American Commission on Human Rights (1959),
American Court of Human Rights.
European Convention on the Protection of Human Rights and Fundamental
Freedoms (1950), European Social Charter (1966),
European Monitoring and Enforcement Machinery, European court of
Human Rights, European Commission of Rights.

Unit III UN and the Right of Self-Determination of People

Self-Determination under UN System; Meaning, Nature and Scope
Right of Self-Determination and Domestic Jurisdiction.

REFERENCES

1. M.R. Ishay, The History of Human Rights, Orient Longman, New Delhi, 2004.
2. Kalin and Kunzli, The Law of International Human Rights Protection, OUP, Clarendon, 2009.
3. R.H. Callaway and J. Harrelson-Stephens (eds.), Explaining International Human Rights, Viva, New Delhi, 2010.
4. Alston, Phillip (ed.), (1992), The United Nations and Human Rights: A Critical Appraisal, Oxford: Clarendon Press.
5. Bachr, Peter R, (1999), Human Rights: Universality in Practice, New York: Palgrave.

Note – 32 hours theory classes and 16 hours extension activities to be conducted, making totally 48 hours of academic activities.

VI. Weaker Sections and Human Rights in India – II

- Unit I Social Status of Women in Contemporary Indian Society**
Poverty, Illiteracy, Lack of Independence,
Oppressive Social Customs and Gender Bias, Violence against Women at
Public and Private Domain
- Unit II Minorities and Human Rights**
Constitutional Framework: Fundamental Rights, Directive Principle and
Fundamental Duties, Special provision under Article 26 to 30, 331, 333,
336 and 337 of the constitution, special laws and policies: National
Commission for Minorities Act 1992.
- Unit III Problems of Implementations of Human Rights and Role of NGO's:**
Poverty and Inaccessibility of Legal Protection, Social Prejudices, Abuse of
Executive Power, Death Torture in Police Custody etc. Lack of
Accountability and Transparency in Government Functioning, the Right to
Information. A Historical Perspective of Civil Liberties Groups and Civil
Liberties in India, People Union for Democratic Rights, People Union for
Civil Liberties, NGO's and Civil Rights Movements in India.

REFERENCES

1. Alam, Aftab, (ed.), (1999), Human Rights in India: Issues and Challenges, New Delhi : Raj Publications.
2. Dikshit, R.C., (1998), Human Rights and the Law, Universal and Indian, Deep and Deep, New Delhi:
3. Jha, R.C., (1995), Resurrecting: Human Rights in India, Sheridan Book Company, New Delhi
4. Paul, R.C., (2000)
4. Paul, R.C., Situation of Human Rights in India, Commonwealth Publishers New Delhi
5. Ray, Arun, (2004), National Human Rights Commissions in India: Formation, Functioning and Future Prospects, Atlantic, New Delhi.

Note – 32 hours theory classes and 16 hours extension activities to be conducted, making totally 48 hours of academic activities.

Scheme of Examination for PG – Diploma in Human Rights

Each paper taught at Postgraduate Diploma course in Human Rights shall have 32 hours of theory classes and 16 of hours extension activities, making totally 48 hours of academic activities. Each paper prescribed for PG Diploma course in Human Rights is for hundred marks (100), which includes both external assessment and internal assessment. Eighty marks (80) are assigned for external assessment only twenty marks (20) are kept for internal assessment, as shown here.

[Maximum Marks 100 (external marks 80 + internal marks 20 = total 100)]

Under external assessment an examination is given for 80 marks. For awarding 20 internal marks a test / seminar / assignment is to be made for 10 marks and the remaining 10 marks are for extension activities/ field visits, (visiting institutions working for human rights, review of books and article, model building, interactions with media persons, meeting disadvantaged groups, visiting family courts, remand homes, prisons, old age homes etc).

An examination of 03 hours duration has been finalized for 80 marks of external assessment. The question paper will have of two parts namely Part – A and Part – B. The Part – A consists of 07 questions, each carrying ten marks and the candidate shall answer any five of his choice. The Part – B consists of 03 questions, each carrying fifteen marks and the candidate shall write any two of his choice. Along with this a model question paper has also been provided.

MODEL QUESTION PAPER

Title of the paper along with semester

Max. Marks : 80

Time: 3 hours

Part – A

Note –1. Answer any five of the following questions.

2. Each question carries 10 marks.

5 x 10 = 50

Question No. 1

Question No. 2

Question No. 3

Question No. 4

Question No. 5

Question No. 6

Question No. 7

Part – B

Note – 1. Answer any two of the following questions.

2. Each question carries 15 marks

2 x 15 = 30

Question No. 8

Question No. 9

Question No. 10

**III-SEMESTER
THEORY PAPER- III
HUMAN GEOGRAPHY**

Unit	Topic	Total teaching hours: 42
Unit I	1. Meaning, field, scope, nature and importance of Human Geography.	03
	2. Schools of Human Geography- Determinism, Possibilism and probabalism	04
Unit II	1. Evolution of mankind: Classification of Races: Caucasoid, Mangoloid & Negroid.	04
	2. Religions of Mankind: meaning and classification – Christianity, Islam, Hinduism & Buddhism.	04
	3. Population: Growth, Density & Distribution of population.	04
Unit III	1. Human Settlements: Rural and Urban- Functions and Patterns.	07
	2. Human Migration: Causes& Consequences, Internal and International migration- Problems.	07
Unit IV	1. Human adaptation to the environment: i) Cold region- Eskimos. ii) Hot region- Pigmies iii) Temperate region- Khirghiz iv) Plateau- Soligas v) Mountains- Nagas.	09

MICROBIOLOGICAL ANALYSIS OF AIR AND WATER

UNIT: I

No of Hours: 10

AIR MICROBIOLOGY

Bioaerosols, Air borne microorganisms (bacteria, Viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres, allergens

Air Sample Collection and Analysis

Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi.

Control Measures

Fate of bioaerosols, inactivation mechanisms – UV light, HEPA filters, desiccation and Incineration

UNIT:II

No of Hours: 5

WATER MICROBIOLOGY

Water borne diseases and their management: Cholera, Typhoid, Gastroenteritis and Traveller's diarrhoea.

UNIT: III

No of Hours: 5

MICROBIOLOGICAL ANALYSIS OF WATER

Sample Collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests

UNIT: IV

No of Hours: 5

CONTROL MEASURES

Precipitation, chemical disinfection, filtration, high temperature, UV light

Laboratory exposure to students: demonstration of air borne and water borne microbes.

Even semester

Paper Code: SWSC-2

Paper title: PERSONAL AND PROFESSIONAL GROWTH.

INTRODUCTION

The course aims at enhancing personal and professional effectiveness by developing a continuous awareness and deeper insight into one's being. It encourages value clarification, upholding of professional ethics, and ability to make effective choices for integration. It provides opportunities to understand stress, stressors and methods to handle stress experienced.

OBJECTIVES

- a. Understand self as a being, as one in the process of becoming and experience self-awareness.
- b. Examine own values and attitudes and explore choices made to express self in own environment.
- c. Develop positive life skills and practice self-help methods for integration and for stress reduction.
- d. Understand and uphold professional values and ethics.

Course Content:

UNIT I

Self and Self Awareness: Understand self through a cognitive construct/paradigm (two/three models from among those available may be offered as workshops). Suggested approaches are: Rational Emotive Therapy, Gestalt Approach, Transactional Analysis, Reality Therapy, Yoga for Therapy, Meditation Techniques.

Explore self as being, and understand the process of becoming. (through observation)

Practice consciously measures to sustain and experience continuous awareness.

Observation and Reflection: Theory and techniques.

Communication Choices: Communication mode and patterns and effectiveness, Interpersonal communication, nature of choices made.

UNIT II

Emotions and their Expression: Emotions, nature of expression.

Understand own pattern of communication, choices made to express emotions, modes used, examine need for change.

Communication: Informal and knowledge and skills of rapid reading, writing, creative writing, report writing and public speaking.

UNIT III

Creativity and Self: Understand brain functions: Creativity, need and development
Life Style: Conscious life style - enhanced life skills: Communication, decision making, empathy, critical thinking, use of time and money, building and sustaining bonds-relational, collegial and personal.
Self defeating behaviour - nature and impact. Choices for change.

UNIT IV

Values, Attitude and Professional Ethics: Values and attitudes - their role in life, Value conflict - its impact, value clarification.

Integration: Through Eastern and Western approaches experience the processes of integration. Approaches recommended are: Yoga as a science, meditation (tool for meditation - own choice).

Stress / Burn out - Self help Methods: Stress, Stressors, nature and impact of stress, its expression, and burnout.

Spirituality and Growth.

REFERENCES:

1. Becavar, D. (Ed.) 1997 The Family, Spirituality and Social Work, Journal of Family Social Work, Vol.2, No.4,
2. Bhattacharya, K. 1971 The Indian Concept of Self, Bulletin Ramakrishna Mission Institute of Culture, 22(8), August 1971. 304 - 13.
3. Burke, R, 1. 1982 Personality, Self-Image and Situational Characteristics of Effective Helpers in Work Settings, The Journal of Psychology, Vol. 112,213.
4. Byrne, D. 1966 Self-Concept, Ch. 12, 434. An Introduction to Personality: A Research Approach. New Jersey: Prentice Hall Inc.
5. Crum,J. K. 1976 The Art of Inner-listening. Theosophist, 97 (8), May 1976, 64-65.

6. Feldman Robert S 1997 Understanding Psychology, 4th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi.
7. Grossbard, H 1954 'Methodology for Developing Self-Awareness, Journal of Social Casework, Vol. 35, No.9, 380-386.
8. Hamilton, G. 1954 Self-Awareness in Professional Education', Journal of Social Casework, Vol. 35, No.9, 371-379.
9. Haskar, S. L. 1976 Know Thyself, Triveni 45(2), 88.
10. Paul, Brunton. 1975 The Hidden Teaching Beyond Yoga, Triveni, 44 (3), 91.
11. Ramakumar,. O. 1970 Intelligence and Self-concept, Education and Psychology Review, 10 (3), 154 -57.
12. Ritajanada. (Translated by John Phillip) 1996 The Practice of Meditation, Mylapore, Chennai: Ramakrishna Math Printing Press.
13. Singh, N. P. 1970 The Concept of Self in Modern Psychology, Indian Education Review, 5 (1), 84 -99.

Semester II
Core Course Botany –Paper II
Plant Ecology, Morphology and Taxonomy
(Credits: Theory-4, Practicals- 4 hours of 2 credits)

THEORY
Lectures: 60

Unit 1: Plant Ecology

A. Introduction to Ecology and significance. (6 Lectures)

Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids, pond and forest ecosystem, Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous

B. Ecological factors (6 Lectures)

Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance.

C. Plant communities (6 Lectures)

Morphological Adaptation of hydrophytes and xerophytes, Succession; Processes and types, Characters; Ecotone and edge effect .

D: Phytogeography (4 Lectures)

Principle biogeographical zones; Endemism

Unit 2: Leaf and Floral Morphology (08 Lectures)

A. Structure of a typical leaf (*Hibiscus*), variation in leaf morphology, types of leaves, phyllotaxy.

B. Parts of a typical flower (*Tribulus terrestris* / *Muntingia calabura*), Variation in floral morphology and floral organs in detail (aestivation and placentation).

Unit 3: Taxonomy

A. Introduction to plant taxonomy (10 Lectures)

1. Principles of taxonomy
2. Taxonomic hierarchy Ranks, categories and taxonomic groups
2. Types of classification (artificial, natural and phylogenetic)
3. Systems of classification-Bentham and Hooker, Engler and Prantl
4. Plant Nomenclature-Binomial system
5. ICN principles
6. Recent trends in Taxonomy: a brief account of Chemotaxonomy, Cytotaxonomy. & APG System of Classification

B. Herbarium technique (6 Lectures)

1. Herbarium (mentioning important herbaria and botanical gardens of the world and India)
2. Botanical gardens
3. Flora and their importance
4. Botanical survey of India (B.S.I) and its function.

C:Angiosperm families (14 Lectures)

Study of the following families according to Bentham and Hooker's system of classification.

Malvaceae ,Fabaceae (Papilionaceae, Caesalpiniaceae and Mimosaceae), Apiaceae
Apocynaceae and Acanthaceae.

Practical

1. Study of instruments used to measure microclimatic variables: Soil thermometer, Maximum and Minimum Thermometer, Anemometer, Psychrometer/Hygrometer, Rain gauge.
2. Determination of pH and analysis of two soil samples and plant extracts and Porosity of water in soil of three habitats.
3. (I) Study of morphological adaptations of the following
 - a. Hydrophytes Eg: *Hydrilla. Pistia and Eichhornia*
 - b. Xerophytes Eg: *Opuntia, Euphorbia Tirucalli, Nerium and Casuarina*

(II) Study of biotic interactions of the following:

 - a. Stem parasite Eg: *Cuscuta.*
 - b. Root parasite Eg: *Striga.*
 - c. Epiphytes, Eg: *Vanda*
 - d. Predatory plants (Insectivorous plants) Eg: *Nepenthes.*
4. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
5. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law
6. Study of leaf, types, phyllotaxy and its modifications.
7. Parts of a typical flower (*Tribulus terrestris / Muntingia calabura*), Variation in floral morphology.
8. Floral organs in detail with their variations.
9. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification).

Brassicaceae and Malvaceae

- 10 Fabaceae (Papilionaceae, Caesalpinaceae and Mimosaceae)
- 11 Apiaceae, Apocynaceae
- 12 Solanaceae, Acanthaceae,
- 13 Lamiaceae, Asteraceae

14 Liliaceae, Arecaceae

15 Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (To be submitted in the record book).

Suggested Readings

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.

2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.

3. Simpson, M.G. (2006). Plant Systematics. Elsevier Academic Press, San Diego, CA, U.S.A.

4. Singh, G. (2012). Plant Systematics: Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd

Paper code: SWBSC-2

Paper Title: POPULATION AND ENVIRONMENT

INTRODUCTION

The content has two aspects to it. Population dynamics and its relatedness to the environment, natural resources, utilization and their preservation.

OBJECTIVES:

- a. Understand characteristics, determinants of population growth.
- b. Examine population policy, plan and initiatives.
- c. Understand inter-relatedness of human life, living organisms and environment.
- d. Examine utilization and management of resources.
- e. Develop skills to participate in activities related to the two areas.

2. Family planning Association of India
Family planning Counseling Guide,
Population Reports Service Series J.N 35
and 36
3. Fisher, W.F 1997
Towards Sustainable Development
(Struggling over India's Narmada River),
New Delhi: Rawat Publications.
4. Gadgil, and Guha. 1997
This Fissured Land - An Ecological History
of India: Delhi: Oxford University Press.
5. Kleinman.R (Ed.) 1998
Family Planning Handbook for Doctors,
Hertford: IPPF
6. Krishna. M. 1995
Air Pollution and Control, Kakinada:
Kaushal and Co.
7. Miller, Jr. Tyler, G and
Armstrong. 1982
Living in the Environment, California:
Wordsworth International Group.
8. Mohan, R. 1985
"Urbanization in India's Future",
Population and Development Review, Vol.
11(4)
9. Oxford, 1987
Our Common Future, Delhi: Oxford
University Press.
10. Prasad, R.K
Population Planning, Policy and
Programmes, New Delhi: Deep and Deep
Publications.
11. Reddy, Laxmi, M.V.1994
Population Education, New Delhi: Asish
Publication.
12. Ryding, S.O. 1992
Environmental Management Handbook,
Ahmedabad: IOS Press.
13. Sapru, R.K (Ed.) 1987
Environment Management in India, Vol. II,
New Delhi: Ashish Publishing House
14. Satapathy, N. 1998
Sustainable Development (An Alternative
Paradigm), Ahmedabad: Karnavati
Publications.
15. Seshadri and Pandey, J (Eds.)
1991
Population Education, A Natural Source
Book, New Delhi: NCERT.
16. Sharma, P.D. 1995
Ecology and Environment, New Delhi:
Rastogi Publishers.

V SEMESTER
THEORY PAPER VI
POPULATION GEOGRAPHY
(CHOICE PAPER II)

Unit	Topic	Total teaching hours: 42
I.	Meaning , Field, Scope, Nature and importance of population Geography	02
II.	Population Growth, density and Distribution. Demographic cycle Factors and patterns of Fertility and Mortality	10
III.	Composition of population Literacy - Growth and distribution Age structure - pyramids Sex ratio - patterns of sex ratio Life expectancy - patterns Occupational Structure	10
IV.	Human migration - causes, types and consequences.	10
V	Problems of population in Developed and Developing Countries. Ethnic, Racial, Linguistic and Religious problems	10

HC02: CORPORATE GOVERNANCE AND BUSINESS ETHICS

Course Objectives: This subject aims to:

- a. Enable the student to understand the concept of corporate governance;
- b. Help students to know about corporate ethics and cultural influences;
- c. impart knowledge of corporate social responsibility and accountability; and
- d. Give information about the corporate governance reforming committee reports in India.

Pedagogy:

The subject matter will be presented through lecture, class discussion, student presentation, guest lectures and laboratory experiences.

Module 1: Business ethics: Ethics; Doctrine of Trusteeship: Unethical practices; Good ethics and Good Business. Corporate Ethics: Concept and Importance – Benefits of corporate Ethics- Corporate Philosophy and Culture – Managing Ethics and Legal Compliance – Case Analysis.

Module 2: Social Responsibility of Business; Doctrine of Social Responsibilities of Business, Dimensions of Social Responsibility, and Assumptions of S.R. Corporate Social Responsibility: Corporate Crimes – Company and Society Relations – corporate Social Challenges – Corporate Accountability – Business and Ecology –Case Analysis.

Module 3: Concept of Corporate Governance: It's Importance –Agency Theory – Benefits of Good Corporate Governance – Present Scenario – Case Studies.

Module 4: Corporate Governance In India: Reforming BOD –Birla Committee – Naresh Chandra Committee – Narayana Murthy Committee – Audit Committee – Corporate Governance Code – The Future Scenario , E-Governance Importance, Requirements and Challenges in Present Scenario – Case Studies.

References:

Business ethics by L.P. Hartman, (Tata Mc Graw Hill)

Business ethics by W.H.Shaw, (Thomson)

Corporate management and Accountability by L.C. Gupta (Mc Millan Institute for FM and Research, Chennai-1974)

Strategic Management by Hill, Ireland and Horkisson (Thomson)

Business and society by Keith Davis (Mc Graw Hill)

Corporate Governance - Fernando

Business ethics and corporate Governance – Bansal Sandeep, Bansal Sanjiv, Bansal Rama – Kalyani Publishers.

Corporate Governance

B.COM.2019-20

4Hours/Week

Course Objectives:

- To enhance the student's knowledge about the corporate philosophy & ethics.
- To make the student gain knowledge about Corporate Governance in India

Unit 1 Introduction to Corporate Governance

Meaning, Definition, need and importance. Benefits of corporate governance. Cadbury Committee Report in UK.

12Hours

Unit-2 Business Ethics

Concept, importance & benefits – corporate philosophy & ethics – Managing ethics & legal compliance.

10Hours

Unit-3 Theories of Corporate Governance

Agency theory, Stewardship theory & Stakeholder theory.

10Hours

Unit-4 Mechanism & Control

4 ps of corporate governance (people, purpose, process & performance) – wealth creation, management & distribution – disclosure in office documents – A brief note on clause 49

of listing agreements of company with stock exchanges. Compliance aspect of corporate governance.

14Hours

Unit-5 Corporate Governance in India

Reforming constitution of Board of Directors – A brief study of Kumara Birla Mangalam Committee – Naresh Chandra Committee – Narayan Murthy Committee –

Corporate Governance code –

Board subcommittee for compliance with Corporate Governance regulation.

14Hours

Books for References:

1. Corporate Governance – Subhash Chandra Das
2. Corporate Governance – Kesho Prasad
3. Corporate Governance – Ashwathappa

Corporate Governance

BBA 2019-20

4Hours/Week

Course objectives:

- To makethestudentstogainknowledgeaboutCorporateGovernanceinIndia
- To enhance the knowledge of thestudents about the Corporate philosophy ðics.

Unit 1Introduction toCorporateGovernance

Meaning,Definition,needandimportance.Benefitsofcorporategovernance.Cadburycommittee reportinUK.

12Hours

Unit 2CorporateEthics

Concept,importance&benefits–corporatephilosophyðics–
Managingethics&legalcompliance.

10Hours

Unit 3TheoriesofCorporateGovernance

Theoriesofcorporategovernance–Agencytheory,Stewardshiptheory&Stakeholdertheory.

10Hours

Unit4Mechanism&Control

4 ps of corporate governance (people, purpose, process & performance) – wealth creation,management & distribution – disclosure in office documents – A brief note on clause 49

oflistingagreementsofcompanywithstockexchanges.Complianceaspectofcorporategovernance.

14Hours

Unit5CorporateGovernancein India

Corporate Governance in India – Reformation,constitution of Board of Directors – A briefstudyofKumaraBirlaMangalamCommittee–NareshChandraCommittee–NarayanmurthyCommittee–CorporateGovernancecode-Board,subcommitteeofcompliance withCorporateGovernance regulation.

14Hours

BooksforReferences:

1. CorporateGovernance–SubhashChandraDas
2. CorporateGovernance –KeshoPrasad
3. CorporateGovernance–Ashwathappa

**AUDITING AND CORPORATE
GOVERNANCE B.COM-CBCS
SCHEME 2019-20**

Marks: 100L:T;P-5:1:0

Objective:

To provide knowledge of auditing principles, procedures and techniques in accordance with current legal requirements and professional standards and to give an overview of the principles of Corporate Governance and Corporate Social Responsibility

Unit1:Introduction

Auditing: Introduction, Meaning, Objectives, Basic Principles and Techniques; Classification of Audit, Audit Planning, Internal Control – Internal Check and Internal Audit; Audit Procedure – Vouching and verification of Assets & Liabilities.

Unit2:Auditor'sresponsibility

Auditor's responsibility to consider frauds and errors in financial statements. Recognizing errors and frauds - Responsibility - Prevention of frauds and errors. Professional code and ethics (in brief). Computer based audit procedures.

Unit3: Special Areas of Audit

Special Areas of Audit: Special features of Cost audit, Tax audit, and Management audit; Recent Trends in Auditing: Basic considerations of audit in EDP Environment; Auditing Standards; Relevant Case Studies/Problems;

Unit4:CorporateGovernance

Conceptual framework of Corporate Governance: Theories & Models, Broad Committees; Corporate Governance Reforms. Major Corporate Scandals in India and Abroad: Common Governance Problems Noticed in various Corporate Failures. Codes & Standards on Corporate Governance

Unit5:BusinessEthics

Morality and ethics, business values and ethics, approaches and practices of business ethics, corporate ethics, ethics program, codes of ethics, ethics committee; Ethical Behaviour: Concepts and advantages; Rating Agencies; Green Governance; Clause 49 and Listing Agreement.

Unit6:CorporateSocialResponsibility(CSR):

Concept of CSR, Corporate Philanthropy, Strategic Planning and Corporate Social Responsibility; Relationship of CSR with Corporate Sustainability; CSR and Business Ethics, CSR and Corporate Governance; CSR provisions under the Companies Act 2013; CSR Committee; CSR Models, Codes, and Standards on CSR.

Suggested Readings:

1. RavinderKumarandVirenderSharma,*AuditingPrinciplesandPractice*,PHILearning
2. ArunaJha,*Auditing*.TaxmannPublication.
3. A.K.Singh,andGuptaLovleen.*AuditingTheoryandPractice*.GalgotiaPublishingCompan
y.
4. AnilKumar,*Corporate Governance: Theory and Practice*,IndianBookHouse,NewDelhi
5. MCKuchhal,*ModernIndianCompanyLaw*,ShriMahavirBookDepot.(Publishers).(Relev
antChapters)
6. KVBhanumurthyandUshaKrishna,*Politics,EthicsandSocialResponsibilityofBusiness*,
PearsonEducation
7. NBalasubramanian,ACasebookonCorporateGovernanceandStewardship,McGraw
HillEducation
8. B.N.Ghosh,BusinessEthicsandCorporateGovernance,McGrawHillEducation
9. SKMandal,*EthicsinBusinessandCorporateGovernance*,McGrawHillEducation
10. Bob Tricker, *Corporate Governance-Principles, Policies, and Practice* (Indian
Edition),OxfordUniversityPress
11. ChristineMallin,*Corporate Governance(IndianEdition)*,OxfordUniversityPress
12. RelevantPublicationsofICAIon*Auditing*(CARO).
13. Sharma,J.P.,*CorporateGovernance,BusinessEthics,andCSR*,AneBooksPvtLtd,NewDelhi

14. Note:Latesteditionoftextbooksmaybeused.

ENTREPRENEURSHIP DEVELOPMENT

B.COM.2019-20

4Hours/Week

Course Objectives:

- To make the students to acquire knowledge about entrepreneurship
- To familiarize them regarding the assistance from various institutions.

Unit-1 Entrepreneur

Meaning, Definition, functions, classification of entrepreneur, characteristics of successful entrepreneur. Entrepreneurship – Growth of entrepreneurship in India – Role of entrepreneurship in economic development, Challenges of women entrepreneurs.

12hours

Unit-2 Entrepreneurial Motivation

Meaning & Definition. Motivating factors – Compelling and facilitating factors – entrepreneurial ambition.

12hours

Unit-3 Identification of business opportunities

Legal requirements for establishment of new unit- Licensing, clearance certificate from Agencies. Project management – Feasibility & viability analysis – technical and financial project report preparation.

12hours

Unit-4 Entrepreneurship Development Programme

Meaning, need, Objectives, phases of EDP – A study of problems of EDP, Entrepreneurial training – Meaning, importance and types.

12hours

Unit-5 A Study of Special Institutions

SFC, IDBI, MSME & DICs – Concessions, incentives & subsidies to entrepreneurs. A brief study of RUDSET.

12hours

Books for Reference:

1. Small Business Management and Entrepreneurship – Renu Arora
2. Small Business Management and Entrepreneurship – Vasant Desai
3. Small Business Management and Entrepreneurship – C.B. Gupta & K.L. Srinivasan
4. Entrepreneurship and Small Business Management – S.P. Singh
5. Entrepreneurship Development – S.S. Khanka

ENTREPRENEURSHIP DEVELOPMENT

BBA 2019-20

4Hours/week

Course objectives:

- To make the student to acquire knowledge about entrepreneurship
- To familiarize them regarding the assistance from various institutions.

Unit –1 Introduction to Entrepreneurship

Entrepreneur – Meaning, Definition, functions, classification of entrepreneur, characteristics of successful entrepreneur. Entrepreneurship – Growth of entrepreneurship in India – Role of entrepreneurship in economic development, Challenges of women entrepreneurs.

12Hours

Unit-2 Entrepreneurial Motivation

Meaning & Definition. Motivating factors – Compelling and facilitating factors – entrepreneurial ambition.

10Hours

Unit–3 Identification of business opportunities

Identification of business opportunities. Legal requirements for establishment of new unit - Licensing, clearance certificate from Agencies.

Project management – Feasibility & viability analysis – technical and financial project report preparation.

12Hours

Unit–4 Entrepreneurship Development Programme

Meaning, need, Objectives, phases, of EDP – A study of problems of EDP, Entrepreneurial Training – Meaning, Importance and Types.

14Hours

Unit–5 Assistance from Financial Institutions

A study of Institutions with special reference to SFC, IDBI, MSME & DICs – Concessions, incentives & subsidies. A brief study of RUDSET.

12Hours

Books for Reference:

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ENTREPRENEURSHIP DEVELOPMENT

BBA- CBCSS SCHEME- 2019-20

Max.Marks:100

L:T:P –3:1:0

Objective: This course provides students with a strong introduction to the concept of 'Entrepreneurship', create new businesses by generating innovative business ideas useful community and manage their enterprises successfully with a positive impact on the society.

Unit 1: Entrepreneurial Development Perspective:

Concept of entrepreneurship development and their dynamics. Importance of skill, knowledge and motivation in ED. Entrepreneurial Competition, generation of business, ideas and final selection of an activity. Market survey report and business plan preparation. Pooling of resources, forms enterprise ownership and their details.

Unit 2: Enterprise Management

Logistics and launching formalities, probable pitfalls, managing money, men, machinery, material and marketing. Support organization, entrepreneurial growth, following the law of the land and social obligation. Managing organisation for innovation and creativity. Importance of leadership, business ethics and business skills on good team building

Unit 3: Running A Family Business:

Concept, structure and kinds of family firms. Understanding its reputation and brand. Enhancing the knowledge and skill. Managing family and shareholders relationship. Managing leadership succession and understanding the group dynamics, encouraging family women into business. Identifying the changed customer needs and encouraging growth and change in the family business.

Unit 4: Social Entrepreneurship:

Introduction, Role and Characteristics of Social Entrepreneurs, Starting of a Non-profits Organization innovatively through local resources in a social context, sustainability, Business Strategies and Scaling up.

Unit 5: Role Of Government And Financial Institutions

Role of Central and State Government in promoting entrepreneurship. Types of schemes, loans, incentives, grants and subsidies. Different types of financial institutions, role of commercial banks, types of loans for MSME schemes, appraisal, sanctions, repayment.

Suggested Readings:

1. Entrepreneurship – Tata McGraw hill
2. Entrepreneurship and Small Business – New Jersey: Palgrave
3. Creativity and Entrepreneurship – Jhon Kao
4. Corporate Creativity Tata McGraw hill
5. Innovative Entrepreneurship – Practice and Principles – Drucker P.F.

Note: Latest edition of the text books should be used.

ENTREPRENEURSHIP

B.COM.-CBCS SCHEME-2019-20

Marks:100

L:T:P-4:0:0

Objective: The purpose of the paper is to orient the learner towards entrepreneurship as a career option using their innovation and creativity

Unit1:DynamicsofEntrepreneurship

Concept, importance, scope and potential in India, Need for Entrepreneurship in India- Advantages of Entrepreneurship over wage employment. Elements of Entrepreneurship. Importance of knowledge and skill and motivation, Entrepreneurial competencies, Types of Entrepreneurs/Entrepreneurship.

Unit2:SelectionandManagementofanEnterprise

Business ideas- Generation, Selection of the final idea, procedure involved in selection of business idea. SWAT analysis. Final selection of the activity. Controlling and market survey, preparation of market survey report, benefits of preparation, mapping and pooling of resources, launching formalities probable pitfalls. Managing the Enterprise- Managing men, materials, machinery, money and marketing. Entrepreneurial growth- Types of growth

Unit3:EntrepreneurshipinIndianScenario

Concept of business groups and role of business house in India, Family businesses in India. The contemporary role model of Indian business, their values, business philosophy and behavioural orientation. Importance of conflict management in family businesses. Social Entrepreneurship: need and importance in India. Role of Women in Entrepreneurship

Unit4:Supportorganizationsandfinancialinstitutions

Role of Central Government and State Governments in promoting Entrepreneurship- Types of schemes, incentives, loans, grants and subsidies. Export oriented units, fiscal and tax concessions, role of District Industries Center (DIC), SISI, EDII, NIESBUD, NEDB . Role of Industries/Entrepreneurs associations and self help groups. Estimation of funds for finance. Role of Commercial Banks, Lending policies for MSMEs, Scheme of banks, MUDRA Bank. Financial institutions- IDBI, SIDBI, ICICI, SFC. The concept, role and functions of business incubators and investors, venture capitalists and private equity fund.

Suggested Readings:

1. Kuratko and Rao, *Entrepreneurship: A South Asian Perspective*, Cengage Learning.
2. Robert Hisrich, Michael Peters, Dean Shepherd, *Entrepreneurship*, McGraw-Hill Education
3. Desai, Vasant. *DynamicsofEntrepreneurialDevelopmentandManagement*. Mumbai, Himalaya Publishing House.
4. Dollinger, Mare J. *Entrepreneurship: Strategies and Resources*. Illinois, Irwin.
5. Holt, David H. *Entrepreneurship: New Venture Creation*. Prentice-Hall of India, New Delhi.
6. Plsek, Paul E. *Creativity, Innovation and Quality*. (Eastern Economic Edition), New Delhi: Prentice-Hall of India. ISBN-81-203-1690-8.
7. Singh, Nagendra P. *Emerging Trends in Entrepreneurship Development*. New Delhi: ASEED.
8. SSKhanka, *Entrepreneurial Development*, S. Chand & Co, Delhi.

Note: Latest edition of textbooks may be used.

ENTREPRENEURSHIP DEVELOPMENT

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9. Corporate Creativity – Tata McGraw hill
10. Innovative Entrepreneurship – Practice and Principles – Drucker P.F.

Note: Latest edition of the text books should be used.

ENVIRONMENTAL BIOLOGY

32 Hrs

UNIT - I

16 Hrs

A. Ecosystem Introduction: Historical account, Scope, Basic concepts and Approaches to the study of Environmental Biology. Components of Environment - An overview of abiotic factors and Biotic factors. Concepts of habitat and Ecological niche. Ecotone and Edge effect. Food chains, Food-webs and their structure in Ecological Pyramids in aquatic, terrestrial and parasitic Environments.

B. Population Ecology: Introduction. An overview of important population attributes – Density, Natality, Growth rates, Growth forms and concept of carrying capacity, Patterns in human population growth and its explosion -Remedial measures. Mortality - life tables and survivorship curve, sex ratio, age distribution, dispersal and dispersion, aggregation and Allee's principle, population fluctuation and cyclic oscillations and Population interactions.

UNIT - II

A. Bioecology of Freshwater Zooplankton: Definition, Types and adaptations of Zooplankton. Brief study of organizations, life cycles and Ecological importance of Rotifers, Cladocerans, Copepods-Calanoids, Harpacticoids and Cyclopoids, and Ostracods. Mass culturing of Zooplankton.

B. Microbial Ecology: Ecological role, beneficial and pathogenic Microorganisms. Indicator Microorganisms. Role of microorganisms in biodegrading and bioremediation of organic and metal pollution.

UNIT – III

Pollution, Conservation and Management of Environment

16 Hrs

Pollution - Global and Indian scenario. Brief account of – sources, biological effects and control measures of major Air and Noise pollution with special reference to present scenario in India. Role and objectives of Pollution Control Board Water pollution-causes and impact with reference to major Indian rivers. Marine pollution. Basis and impact of photochemical smog and green house effect.

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UNIT – IV

Conservation and management of natural resources- types, need, strategies of conservation, sustainable development, significance of non - conventional energy resources: solar, wind, nuclear and bio –energy. National and International Organizations.. Impact of development of Agricultural, Industrial and Life styles on environment and their assessment (EIA) Environmental management and sustainability of Biosphere. **Space ecology** – man in space, Earth’s space environment, Asteroids, comets and Plants. **Ecological Tourism**-advantages and disadvantages, ecotourism projects in India.International ecotourism society.

PRACTICALS:

4 X 16 = 64 Hrs

1. Field visit to Sewage pond, Natural lake (and if possible river): Collection of water samples and study of physico-chemical parameters such as colour, pH, temperature, conductivity, total solids and turbidity
2. Estimation of Dissolved Oxygen in three natural (sewage, pond and Tap) water samples.
3. Estimation of free Carbon di-Oxide in three natural (sewage, pond and Tap) water samples.
4. To study the relationship between Dissolved Oxygen and free Carbon di-Oxide, if any, in three natural (sewage, pond and Tap) water samples.
5. Repetition of Practical’s listed in sl no. 2 and 3.
6. Determination of BOD in three natural (sewage, pond and Tap) water samples
7. Determination of COD in three natural (sewage, pond and Tap) water samples
8. To study the relationship between BOD and COD, if any, in three natural (sewage, pond and Tap) water samples
9. Repetition of Practical’s listed in sl no. 6 and 7.
10. Estimation of Phosphate concentration in three natural (sewage, pond and Tap) water samples.
11. Estimation of Nitrate concentration in three natural (sewage, pond and Tap) water samples.
12. Repetition of Practical’s listed in sl no. 9 and 10.
13. Collection, observation of planktons (Phytoplankton and Zooplankton) from polluted and non-polluted water bodies.
14. Estimations of bacterial abundance in different water samples – using DMT.
15. Visit to RNHM, Mysore, to study models of freshwater, marine, estuarine and terrestrial habitats.
16. Survey of Animal Population - to visit different habitats/areas in and around Mysore and collect data on some population attributes, application of Bio-statistical tests to the collected data and its interpretation.

REFERENCES

- 1) Begon, Harper and Townsend, 1995. Ecology: Individuals, populations and community. II edition. Blackwell Series, U.S.A.
- 2) Bhatia, H.S. 1998: A Text book on Environmental Pollution and Control, Galgotia, New Delhi.

- 3) Clarke, G.L. 1963. Elements of Ecology, . Wiley Eastern Limited. New Delhi.
- 4) Emmel, T.C. 1976. Population Biology, Harper and Row publishers, N.Y.
- 5) Kormondy, E.J. 1978. Concepts of Ecology, Prentice Hall of India Pvt. Ltd., New Delhi.
- 6) Odum E.P. 1971. Fundamentals of Ecology. III Edition. W.B. Saunder's Co., Philadelphia.
- 7) Odum, E.P. 1983. Basic Ecology, Holt Saunders, Japan.
- 8) Paul Colinvaux, 1986: Ecology. John Wiley and Sons, N.Y.
- 9) Peter Stilling, Ecology: Theory and applications. 2nd ed. Prentice Hall, International Edn.
- 10) Richard Brewer, 1988. The Science of Ecology, Saunders College of Publishers, Harcourt Brace publ. N.Y
- 11) Sharma, P.D. 1996: Ecology and Environment Rastogi, Publications, Meerut.

For Practicals:

1. APHA, 1992: Standard methods for examination of water and waste water, 18th edition