BENGALURU CENTRAL UNIVERSITY

SYLLABUS FOR FIRST SEMESTER

M.Sc – PLANT SCIENCE & ANIMAL SCIENCE

2019-2020 onwards

HCT 101: SYSTEMATICS AND BIODIVERSITY

(4 Credits, 4 hr/week, 52 Lectures)

UNIT I Fundamental of Systematics: **07 hrs**

Biological classification, hierarchy of categories and higher taxa. Taxonomical characters – Procedures and keys. Species concepts: varieties, subspecies, sibling species and race. International code of Botanical nomenclatures, ICZN.

UNIT II Kingdoms of Life: **03 hrs**

General outline of kingdoms including Monera &Protista; broad outline diversity of plant and animal kingdoms.

UNIT III Methodologies in systematics: **05 hrs**

Morphology based taxonomy, numerical taxonomy, cyto-taxonomy and chemotaxonomy. DNS fingerprinting and markers for detection/evaluation of polymorphism.

UNIT IV Modern concepts: **07 hrs**

Genomic DNA: nuclear, chloroplast and mitochondrial genomes. DNA and RNA based taxonomy in plants and animals. Representative genes in modern taxonomy: COI, cytb, 16S, 18S, 28SrRNA, mat K, ITS1, ITS2, rDNA and trnl-F. Key features of DNA based phylogeny.

UNIT VGenomic Data Bases: **04 hrs**

Geneticdiversity-Assessing biodiversity, RFLP, RAPD, Allozymes and PCR.Primary nucleotide, nucleotide sequence databases: Gene Bank, tMBL, DDBL, and BOLDS. SNpedia, Corn, Bioinformatics and Harvester.

UNIT VIBiodiversity in Biosphere -Basic principles: **10 hrs**

Biodiversity, Domesticated Biodiversity, Agrobiodiversity, Introduced Biodiversity and Native Biodiversity. Components of Biodiversity: Ecosystems: Forests, Wetlands, Grasslands and Mangrove ecosystems. Classification of Habitats: Biomes, Species Diversity: α, β and γ diversity. Endemic species and patterns of distribution with special reference to India. Western Ghats and Silent valley as "biodiversity hot spots". Characterization, generation and maintenance, scope and constrains of biodiversity; genetic diversity, species diversity, eco-system diversity.

UNIT VII Biotic community and Interrelationships: **05 hrs**

Phytogeographical and Zoogeographical relations of species and population, interrelationship amongst organisms including parasitism, symbiosis and commensalism. Diversity adaptation in plants and animals

UNIT VIII Biodiversity and conservation: **06 hrs**

Biosphere reserves, resources and management. Global diversity hotspots, effect of manmade alterations of environment on biospheres. Agro based diversity, urban-peri-urban biodiversity, forest diversity. Biodiversity Indices, threat to biodiversity. Modern tools and techniques to assess biodiversity, strategies of conservation. Global programmes and concept of endangered species.

UNIT IX Conservation-approach: **05 hrs**

Landscape approach to biodiversity conservation, Corridor approach, individual species approach, habitat conservation approach. National biodiversity strategy and action plan.

REFERENCES

1. Biodiversity Conservation and Phylogenetic Systematics. Pelleus R and Gandcolas P (2011) Springer.NY.
2. Biodiversity: Perception, Peril and Preservation. PrabodhMaiti and PaulainMaiti (2011). PHI Learning. New Delhi
3. Principles of Animal Taxonomy. Simpson G G (2011). Oxford & IBH Pub.Company.
4. Plant Systematics. Balfour A (2016). SyrawoodPub.House. London
5. Text book of Biosystematics. Pullaiah T (2013). Regency Publishers. USA.
6. Biology of Biodiversity. Kato M (2007). Springer, NY.
7. Description of Taxonomy. Watson M.F., Lyal C.H.C. and Pendry C A. (2015). Cambridge University Press.
8. Biodiversity Taxonomy and Ecology. Sing G.K.M (2008). Alp books
9. Biology. Raven P., Johnson G, Mason K, Losos J and Singer S (2005). McGraw Hill.

HCT 102: ECOLOGY, ENVIRONMENTAL BIOLOGY AND EVOLUTION

(4 Credits. 4 hr/ week. 52 Lectures)

UNIT I - Concept of Ecology and Ecosystem: **05 hrs**

Evolutionary ecology, environmental concepts-laws and limiting factors, ecological models. Nature of ecosystem, production, food webs, energy flow through ecosystem, bio-geochemicalcycle, resilience of ecosystem, ecosystem management.

UNIT II Limiting Factors: **06 hrs**

Concept of limiting factors-Liebig's law of the minimum, Shelford's law of tolerance. Population and community ecology. Natality, mortality, growth rate as factors determining the population density-population interactions. Types of community-structure-community succession and homeostasis.

UNIT III Habitat Ecology: **03 hrs**

Freshwater habitat-marine habitat-estuarine habitat-terrestrial habitat.Case study of the Western Ghats and the Silent Valley. Eco-tourism.

UNIT IV Resource Ecology and Management: **04 hrs**

Concept-classification; non-renewable and renewable resources-conventional and non-conventional source and energy. Conservation of natural resources, use of alternate energy sources.

UNIT V Environmental Pollution: **06 hrs**

Air, water,soil and land pollution. Impact of pollutants on general fauna, flora and ecosystem. Factors influencing environmental concentration of toxicants and toxicity. Environmental monitoring of pollutants. Major conventions and agreements for environmental protection.Rehabilitation of lakes in and around Bangalore.

UNIT VI Climate change: **04 hrs**

Environmental stresses and their management, global climatic pattern, global warming, atmospheric ozone, acid and nitrogen deposition, coping with climatic variations. El-Nino effect.

UNIT VII Bioremediation: **09 hrs**

Major classes of contaminants. Uptake, biotransformation, detoxification, elimination and accumulation of toxicants. Factors influencing bioaccumulation from food and trophic transfer. Pesticides and other chemical in agriculture, industry and hygiene and their disposal. Impact of chemicals on biodiversity of microbes, animals and plants. Bioindicator and biomarkers of environmental health. Biodegradation and bioremediation of chemicals. Rehabilitation of degraded water bodies, mangroves, rural landscape and unbalanced soils.

UNIT VIII Evolutionary concepts: **06 hrs**

Evolution of Eukaryotes from Prokaryotes. Lamarckism, Darwinism-merits and demerits. Modern synthetictheory, theory of population genetics leading to Neo-Darwinism.

UNIT IX Evidences and Elemental forces of evolution: **09 hrs**

Paleobiological- concepts of stratigraphy and geological time scale; fossil study. Anatomical- vestigial organs; homologous and analogous organs(concept of parallelism and convergence in evolution). Taxonomic – Transitional forms/evolutionary intermediates; living fossils. Phylogenetic- a) Fossil based. B) Molecular based-protein model (Cyt-C); C) Gene model (ne). Mutation, Selection (types of selection, selection coefficient, selection in natural population). Random genetic drift, Migration.

REFERENCES

1. Fundamentals of Ecology. Eugene P. Odum(1972). W.B. Saunders company. London
2. Environmental Biology. Michael Reiss and Jenny Chapman (2000) Cambridge Press .UK
3. P.,ncipals of Ecotoxicology. Butler, O.C. (1978). John Wiley & Sons. USA.
4. Environment and Ecology. Majid Husain (2015) Access Publishing.UK
5. Environmental Science. Cunningham and Saigo (1999). McGraw Hill. 5th Edition. London
6. A primer of Conservational Biology. Primark (2001) Sinauer. 2nd Ed.
7. Process of Organic evolution. Stebbins, G.L. (1989). Prentice Hall of India. New Delhi
8. Evolutionary Biology. Douglas, .J. Futuyma. (1997). Sinauer Associates.
9. Evolution: Making Sense of Life. Zimmer C and Elmen D J. (2013). Roberts & Co. NY

HCT 103: BIOCHEMISTRY AND BIOPHYSICS

(4 Credits, 4 hr/ week, 52 Lectures)

UNIT I Molecules and their characteristic features: **06 hrs**

Review of basic concepts of solution chemistry – acid, base, ionic strength, principles of thermodynamics: chemical potential, free energy, entropy, enthalpy, heat capacity; dimensions of atoms, bonds: covalent and non-covalent bonds and molecules. Dihedral angles, steric conflict, classes of organic compounds and functional groups.

UNIT I Amino acids, peptides and polypeptides: **06 hrs**

Chemical reactions and physical properties, three dimensional structures of proteins, the Ramachandran plot, α helix, β sheet. Structure of collagen,conformational map, tertiary structure, quaternary structure.

UNIT III Carbohydrates and Lipids: **07 hrs**

Sugars and polysaccharides: chemistry, classification and function; glycoproteins: structure and function. Fatty acids- Saturated, unsaturated and eicosanoids; phosphor and spingolipids- structure, classification, lipoprotein, liposomes and prostaglandins

UNIT IV Nucleic acids: **04 hrs**

Nucleotides, single and double- stranded DNA structures, types of DNA, RNA world.

UNIT V Enzymology: **07 hrs**

Classification, specific activity, coenzymes. Kinetics of enzyme reactions, regulation of enzymatic activity. Isoenzymes: structure and function.

UNIT VI Light and Biomolecules: **04 hrs**

Properties of light and laser light, Polarisation of light, linear and circular dichroism (CD), CD spectra of protein and nucleic acids.

UNIT VII Spectrometry and X-ray diffraction: **06 hrs**

Principles of spectroscopy, ionization, protein mass determination, MALDI-MS, ESI-MS. Methods of glowing crystals, theory of x-ray diffraction, Bragg's law, x-ray scattering in reciprocal space, low-angle x-ray scattering, fibre diffraction of helices.

UNIT VIII Fluorescence and Infrared spectroscopy (IR): **06 hrs**

Phenomenon of fluorescence, fluorescence life time, fluorescence anisotropy, fluorophores, linear polarization of fluorescence, Fluorescence resonance energy transfer (FRET) and its biological applications.

UNIT IX Electron Spin Resonance (ESR) and Nuclear Magnetic Resonance (NMR) spectroscopy: **06 hrs**

Magnetic phenomena, principles, spin labels, free radicals. Theory of nuclear resonance, chemical shift and shielding, spin-spin interaction, coupling constant and coupling behaviour, two-dimensional NMR in protein structural studies. NMR in bio-medical research.

REFERENCES:

1. Basic concepts of Biochemistry. Gilbert H.F. (2002). McGraw Hill Professional. New York.
2. Biochemistry. Down M.B. (1999). Lipincott Willam & Wilkins. London
3. Biochemistry. Cambell M and Farrell D (2005). Thomas Books/Cole.
4. Biochemistry. Stryer L. (1999). Freeman and Company, New York.
5. Biochemistry with clinical correlations. Devlin, T.M. (2006). Wiley-Liss Inc. NY.
6. Biochemistry. Mathew, Van Holde and Ahem (2001). 3rd Ed. Pub Pearson education
7. Biochemistry & Molecular Biology of plants. American Society of Plant Physiologists. (Buchanan, B.B., W.Gruissem & Jones R.L. (2015).2nd edition) Rock Ville, USA, Maryland.
8. Principles of Biochemistry. Cox, M., Michael, Nelson,L.D. (2008 5th edition.W.H. Freeman and company, Newyork.
9. Biochemistry. Voet, D and Voet, J.G. (2011), 4th edition J.Wiley and sons

HCT 104: CELL BIOLOGY AND GENETICS

(4Credits, 4 hr/ week, 52 Lectures)

UNIT I Biomembranes: **02 hrs**

Structural organization: Phospholipid bilayer, integral proteins and fluid mosaic model; transport across cell membrane.

UNIT II Cell organelles: **08 hrs**

Structure, functions andbiogenesis of ER, Golgi bodies, Mitochondria, Chloroplast, Lysosomes, Nucleolus.

UNIT III Protein Sorting and Targeting: **08 hrs**

Processing through endomembrane system, synthesis and targeting of mitochondrial and chloroplast and peroxisomal proteins. Insertion of membrane proteins into ER, receptor mediated endocytosis, exocytosis and molecular mechanism of vesicular traffic.

UNIT IV Cell Cycle, Signalling and Programed Cell Death: **10 hrs**

Cell growth, division and differentiation, mechanism regulating mitotic events, cell-cycle control in mammals and checkpoints in cell-cycle regulation.Cell-cell interactions, Cell surface and intracellular receptors, interaction of signalling pathways, signalling from plasma membrane to nucleus. Secondary messengers.Apoptosis; mitochondrial dependent and independent pathways, factors influencing apoptosis, role of secondary messengers in cell death. Necrosis and necroptosis.

UNIT V Mendelian Genetics and deviation: **04 hrs**

Mendelian laws,allelic variation and gene function, Incomplete dominance, multiple allele, gene action, gene interaction, penetrance, expressivity, epistasis, pleiotropy, Chromosomal theories of inheritance. Non disjunction as proof, Sex linked inheritance.

UNIT VI Mutations and mutagenesis: **06 hrs**

Mutations- Spontaneous induced mutation, conditional lethal mutations –base substitution mutation, Missense, Nonsense and Silent mutations; Chemical, Physical and Biological mutagenesis and Detection of mutations. Molecular basis and applications. Concept of gene- Fine structure of gene, Split gene, Jumping gene, Overlapping gene & multiple genes.

UNIT VII Sex Determination and dosage compensation: **06 hrs**

Sex chromosomes, Chromosomal and molecular basis of sex determination in *C.elegans*, *Drosophila*, man and *Melandrium*. Dosage compensation- Genic balance, Gene dose.

UNITVIIIMolecular organisation of eukaryotic chromosome: **03 hrs**

Centromere, Telomere, Nucleosome, Nucleomere, Kinetochore, Chromosome banding.

UNIT IX Population Genetics: **05 hrs**

Genotype and allelic frequency, Hardy-Weinberg equilibrium, non-random mating.Consequences of homozygosity, factors affecting gene frequencies, inbreeding, heterosis, mutation-effecton allele frequencies, migration and genetic drift.

REFERENCES:

1. Cell Biology. Karp, G. (2016). McGraw Hill book Co. NY, 16th Edition.
2. The Cell: Molecular approach. Cooper, G.M. (2009). ASM Press, USA.
3. Molecular Biology of the Cell. Alberts M, Johnson A, Raff M, Bray D and Lewis J (2008) 6th edition. Garland Sciences, NY
4. 4. Molecular Biology. Lodish, Berk, Zipursky, Matsudaira, Baltimore and Darnell (2006). Freeman Press, London.
5. Cell Biology. Pollard P and Earnshaw W.C. (2002). Saunders.
6. Genes. Benjamin Lewin. (1995). Oxford University Press.
7. Principles of Genetics. Snustad D.P. & Simmons M.J. (2015) John Wiley.
8. An Introduction to Genetic Analysis. Griffith A J P, Miller J H, Suzuki D T, Lewontin R C, Gelbert W M (2002). Freeman and Company.
9. Essential Genetics: A Genomic Perspective. Hartl D L.and Jones E W. (2002). Jones & Bartlet.
10. Lewin's Genes XI. Krebs, J. E., Goldstein E.S., Kilpatrick S.T. (2014). Jones & Bartlet
11. Modern Genetic analysis: Integrating Genes and Genomes. Griffiths A J G, Gilbert W M and Miller J H and Lewontin R C. (2003). W.H. Freeman Co. NY.

SC 105: BIOSTATISTICS AND BIOINFORMATICS

(4 Credits, 4 hr/ week, 52 Lectures)

UNIT I Statistics in biology: **05 hrs**

Importance of statistics in biology, samples and populations, variables in biology, accuracy and precision, collection and condensation of data, types of biological data and graphical representation of the data (histogram/ogive curve/frequency curve).

UNTI II Descriptive Statistics: **05 hrs**

Measures of central tendency; mean, mode and median. Concept of variation, measure ofvariation such as variance, standard deviation, coefficient of variation.

UNIT III Introduction to probability distribution: **06 hrs**

Elements of probability, relative frequency approach, Binomial and Poisson distribution. Normal distribution: frequency distribution of continuous variables, properties of normal distribution, application of normal distribution, applying a normal distribution to observed data.

UNIT IV Regression and correlation analysis, curve fitting: **05 hrs**

Simple linear regression equation and testing significance of regression, data transformation in regression, hypothesis about correlation coefficient, multiple regression equation, polynomial regression and curve fitting.

UNIT V Hypothesis testing: **07 hrs**

Tests of simple hypothesis using normal and t-distribution. Types of errors. Test of significance: parametric and non-parametric tests, T-tests, Chi-square test for goodness of fit.F-test of comparing variance, one way ANOVA. Mann-Whitney test, Kruskal-Wallis test.

UNIT VI Introduction to Bioinformatics: **05 hrs**

Branches of Bioinformatics, applications of Bioinformatics. Biological databases: Classification, Biological data retrieval systems.

UNIT VII Sequence comparison and Database Search: **09 hrs**

Global alignment, Pair wise alignment, local alignment, multiple sequence alignment, scoring a multiple alignment, multiple sequence alignment methods. Progressive alignment, iterative methods, pattern searching in DNA and protein sequences, PAM matrices, BLAST, FAST and FASTA. Identification of peptide finger print by nano LC-MS/MS database searching by using MASCOT and OMSSA. Introduction to microarray technology.

UNIT VIII Molecular phylogenetics: **05 hrs**

Application of phylogenetic trees, basic terminology-taxa, taxonomy, root, leaf, node, branch, clad, dendrogram, rooted tree, unrooted tree and scaled tree.

UNIT IX Molecular Clocks: **05 hrs**

Basic steps of phylogenetic tree construction, Data based methods-UPGMA, NJ algorithm, Character based methods-Maximum parsimony method, maximum likelihood method, validating phylogenetic methods-bootstrapping and jack-knifing, study of Phylip, NJ plot, Clustal X softwares.

REFERENCES

1. Statistics for Biologists. Cambell R.C. (1967). Cambridge University Press. UK.
2. Biological data analysis, a practical approach. Fry, J.C. (1993). IRL Press. UK.
3. Statisitcal Methods. Snedecor, P.S. (2000). Affiliated East-West press. New Delhi.
4. Biostatistics: A Foundation for Analysis in Health Science. Wayne W Daniel and Cross Chad L. (2013). 10th edition. Wiley. ISBN-13:978-118302798
5. Applied Calculus. Hughus-Hallet. (2005). Wiley Publishers
6. Bioinformatics and Functional Genomics. Pevsner J (2003). John Wiley &Sons.Inc
7. Molecular Modelling Principles and Applications. Andrew R (2001). 2nd Edition. Prentice Hall.
8. ICRF Handbook of genomic analysis. Spurr B D, Young S P, Bryant S P. (2009). Blackwell Science Publishers.
9. A Practical approach to Microarray Data Analysis. Daniel P, Berrar.Dubitzky W and Granzow M. (2003). Kluwer Academic Publishers.
10. Protein structure, stability and folding. Murphy K. P (ed.) (2001). Humana Press.
11. Bioinformatics, Principles and Applications. Ghosh Z and Mallick B (2008). Oxford University Press<New Delhi.
12. Introduction to Bioinformatics. Attwood. T. (2006). Pearson Education. Singapore.

HCP 101 & 102: SYSTEMATICS AND BIODIVERSITY & ECOLOGY, ENVIRONMENTAL BIOLOGY AND EVOLUTION (4 Credits)

HCP 101: (4 hr/week, 52hrs)

1. Construction of dichotomous key
2. Construction of Cladogram
3. Identification and classification of wild Plants and animals (at least 20 species of invertebrates and 20 species of vertebrates from different groups) found in any localities
4. Identification (photographs) – Critically endangered, endangered and vulnerable plants and animals of India.
5. Biodiversity indices -Problem solving: Shannon -Wiener diversity index, Simpson index, Sorenson index, Evenness index, and Marglef species richness index.
6. Field activities: field visits- zoos, sanctuaries, national parks, forests.
7. Planting and maintenance of larval host plants of different butterfly species in the campus.

HCP 102: (4 hr/week, 52hrs)

1. Estimation of chloride, sulphate in water samples.
2. Estimation of the B.O.D. (Demonstration) and C.O.D. in water sample
3. Estimation of carbon-di-oxide and oxygen during photosynthesis in aquatic bodies.
4. Thermal lag studies in terrestrial habitat.
5. Study of vegetation by quadrate method.
6. Estimation of soil biomass and soil organisms. (Wet and dry methods)
7. Identification and observation of - a) Hospital waste (Solid waste) b) Pollution indicator species
8. Population ecology- Population growth in *Paramecium*/ *Drosophila* larva.

HCP 103 & 104: BIOCHEMISTRY, BIOPHYSICS & CELL BIOLOGY AND GENETICS (4 Credits)

HCP 103: (4 hr/week, 52hr)

1. pH : Structure and operation of pH meter; Preparation of phosphate and citrate buffers
2. Colorimetric/Spectrophotometric estimation of biomolecules:
   a) Total free amino acids (Ninhydrin reagent method)
   b) Total Protein (Lowry et al 1951 method)
   c) Total soluble carbohydrate (Anthrone reagent method)
   d) Total cholesterol (Zlatkis et al method)
3. Effect of Temperature, pH and substrate concentration on salivary amylase activity.
4. Estimation of inorganic phosphate (Fiske-Subburao method)
5. Absorption spectra of amino acids, protein and nucleic acids by Spectrophotometer
6. Verification of Beer Lambert Law
7. Fluorescent Microscopy; Staining with fluorescent dyes & image processing.

HCP 104: (4 hr/week, 52hr)

1. Vital staining of mitochondria
2. Squash and smear preparation of mitotic and meiotic chromosomes (*Allium cepa* and *Rhoeo* sp., Grasshoppers)
3. Karyotype study (at least two species)
4. Preparation of polytene chromosomes
5. Counting of cells by haemocytometer
6. Preparation of semi-permanent slides
7. Genetic problems
