EY Ecology and Evolution

Section 1: Ecology

Fundamental Concepts: Abiotic and biotic components of ecosystems; Levels of biological organization (individuals, population, species, community, ecosystems, biomes); Niches; Habitats; Functional traits; Ecophysiology (e.g. physiological adaptations, homeostasis, acclimation).

Population Ecology: Population dynamics and growth (density dependent/independent); Meta-population ecology; Age-structured populations.

Interactions: Types of interactions (mutualism, symbiosis, commensalism, competition, parasitism, predation, etc.); Two species population models (Lotka-Voltera equations); Trophic levels and their direct and indirect interactions.

Community Ecology: Community assembly, structure and succession; Role of dispersal and habitat/environmental filtering; levels of diversity (alpha, beta, gamma); Species richness, Evenness and diversity indices; Relative abundance; Species-area relationships; Diversity gradients (e.g. latitudinal and altitudinal gradients); Theory of island biogeography.

Ecosystem Structure and Function: Primary and secondary productivity; Food web, energy flow, and biogeochemical cycles (e.g. carbon and nitrogen); Ecosystem properties (e.g. stability, resilience); Global biomes and biogeographic zones; Flora and fauna of India; Biogeography of India.

Section 2: Evolution

Fundamentals: Lamarckism; Darwinism; Modern Synthesis; Variation; Heritability; Natural selection; Fitness and adaptation; Types of selection (e.g. stabilizing, directional, disruptive).

Diversity of Life: Origin and history of life on earth; Paleobiological evidence; Diversity and classification of life; Classical taxonomy vs systematics (cladistics).

Life History Theory: Allocation of resources; Tradeoffs; r/K selection; Strategies (e.g. semelparity and iteroparity).

Interactions: Co-evolution (e.g. mutualism, arms race, co-speciation); Prey-predator interactions (e.g. mimicry, crypsis); Host-parasite interactions

Population and Quantitative Genetics: Origins of genetic variation; Mendelian genetics; Hardy-Weinberg equilibrium; Drift; Selection (one-locus two-alleles model); Population genetic structure (panmixia, gene flow, FST); Polygenic traits; Gene-environment interactions (phenotypic plasticity); Heritability; Epistasis and epigenetic inheritance.

Molecular Evolution and Phylogenetics: Mutation rates; Molecular clocks; Neutral processes; Rates of evolution; Chromosomal and genome evolution (e.g. hybridization, ploidy, introgression); Phylogenetic methods (parsimony; maximum likelihood, Bayesian, etc); Phylogeography

Macroevolution: Species concepts; Speciation and extinction; Adaptive radiation; Convergence; Biogeographic processes; Continental drift.

Section 3: Mathematics and Quantitative Ecology

Mathematics and Statistics in Ecology: Simple functions (linear, quadratic, exponential, logarithmic, etc); Concept of derivatives and slope of a function; Permutations and combinations; Basic probability (probability of

random events; Sequences of events, conditional probability, etc); Probability distributions (e.g. binomial, normal, Poisson); Descriptive statistics (mean, variance, coefficient of variation, confidence intervals, etc.).

Study design and Statistical methods: Statistical hypothesis testing; Concept of p-value; Type I and Type II error, Statistical tests (e.g. t- test, Chi-square test); Correlation, linear regression and ANOVA.

Section 4:	Behavioural Ecology

Classical Ethology and Sensory Ecology: Proximate and ultimate explanations for behaviour; Innate and learnt behavior; Basic mechanisms (e.g., neuroethology, behavioural endocrinology); Modes of communication (chemical, visual, etc); Movement (e.g. navigation).

Foraging and Reproduction: Optimal foraging theory; Space use (e.g. territoriality); Mating systems; Sexual selection and sexual conflict (runaway selection, good-genes, handicap principle, etc); Parental care.

Social Behaviour: Costs and benefits of group-living; Intraspecific competition (e.g. scramble and contest); Kin selection; Altruism.

Section 5:	Applied Ecology & Evolution

Biodiversity and Conservation: Biodiversity-ecosystem function relationships; Ecosystem services; Conservation (endemism, biodiversity hotspots, protected areas); Global conservation initiatives (e.g. COP, IUCN, CBD, CITES); Conservation genetics and methods (genetic diversity, inbreeding depression, DNA fingerprinting and DNA barcoding).

Disease Ecology and Evolution: Epidemiology; Zoonotic diseases; Antibiotic resistance.

Global Change: Causes, consequences, adaptation and mitigation of climate change; Threats to biodiversity (e.g. pollution, habitat loss and change); Invasive species.