Syllabus for Life Sciences

PAPER 1 – SECTION A

1. General information on science and its interface with society to test the candidate's awareness of science, aptitude of scientific and quantitative reasonsing.

2. COMMON ELEMENTRY COMPUTER SCIENCE (Applicable to all candidates offering subject areas).

3. History of development of computers, Mainframe, Mini, Micro's and Super Computer Systems.

4. General awareness of computer Hardware i..e. CPU and other peripheral devices (input / output and auxiliary storage devices).

5. Basic knowledge of computer systems, software and programming languages i.e. Machine language, Assembly language and higher level language.

6. General awareness of popular commercial software packages like LOTUS, DBASE, WORDSTAR, other Scientific application packages.

PAPER I – SECTION B

1. Cell Biology : Structure and function of cells and intracellular organelies (of both prokaryotes and eukaryotes) : mechanism of cell division including (mitosis and meiosis) and cell differentiation : Cell – cell interaction ; Malignant growth ; Immune response ; Dosage compensation and mechanism of sex determination.

2. Biochemistry : Structure of atoms, molecules and chemical bonds. Principles of physical chemistry : Thermodynamics, Kinetics, dissociation and association constants ; Nucleic acid structure, genetic code, replication, transcription and translation : Structure, function and metabolism of carbohydrates, lipids and proteins ; Enzymes and coenzyme ; Respiration and photosynthesis.

3. Physology : Response to stress : Active transport across membranes ; Plant and animal hormones ; Nutrition (including vitamins) ; Reproduction in plants, microbes and animals.

4. Genetics : Principles of Mendelian inheritance, chromosome structure and function ; Gene Structure and regulation of gene expression. Linkage and genetic mapping ; Extrachromosomal inheritance (episomes, mitochondria and chloraplasts) ; Mutation : DNA damage and repair, chromosome aberration : Transposons ; Sex-linked inheritance and genetic disorders ; Somatic cell genetics ; Genome organization (in both prokaryotes and eukaryotes).

5. Evolutionary Biology : Origin of life (including aspects of prebiotic environment and molecular evolution) ; Concepts of evolution ; Theories of organic evolution ; Mechanisms of speciation ; Hardyweinberg genetic equilibrium, genetic polymorphism and selection ; Origin and evolution of economically important microbes, plants and animals.

6. Environmental Biology : Concept and dynamics of ecosystem, components, food chain and energy flow, productivity and biogeochemical cycles ; Types of ecosystems, Population ecology and biological control ; Community structure and organization ; Environmental pollution ; Sustainable development ; Economic importance of microbes, plants and animals.

7. Biodiversity and Taxonomy : Species concept, Biological nomenclature theories of biological classification, Structural biochemical and molecular systematics ; DNA finger printing, numerical taxonomy, Biodiversity, characterization, generation maintenance and loss : Magnitude and distribution of biodiversity, economic value, wildlife biology, conservation strategies, cryopreservation.

PAPER II

1. Principles of Taxonomy as applied to the systamics and Classification of Plant Kingdom : Taxonomic structure ; Biosystematics ; Plant geography ; Floristics.

2. Patterns of variation in morphology and life history in plants ; Broad outlines of classification AND evolutionary trends among algae, fungi, bryophytes and pteridophytes ; Principles of palaeobotany ; Economic importance of algae, fungi and lichens.

3. Comparative analomy and developmental morphology of gymnosperms and anglosperms : Histochemical and ultrastructural aspects of development ; Differentiation and morphogenesis.

4. Androgensis and gynogenesis ; Breeding system ; Pollination biology ; structural and functional aspects of polien and pistil ; Male sterility ; Seil and inter-specific incompatibility ; Fertilization ; Embryo and seed development.

5. Plants and civilization ; Centres of origin and gene diversity ; Botany, utilization, cultivation and improvement of plants of food, drug, fibre and industrial values ; Unexploited plants of potential economic value ; Plants as a source of renewable energy ; Genetic resources and their conservation.

6. Water Relation ; Mineral nutrition ; Photosynthesis and photorespiration ; Nitrogen, Phosphorous and Sulphur metabolism ; Stomatal physiology ; Source and sink relationship.
7. Physiology and biochemistry and seed dormancy and germination ; Hormonal

regulation of growth and development ; Photoregulation ; Growth responses, Physiology of flowering ; Senescence.

8. Principles of plant breeding ; Important conventional methods of breeding self and cross pollinated and vegetatively propagated crops ; Non-conventional methods ; Polyploidy : Genetic variability ; Plant diseases and defensive mechanisms.

9. Principles of taxonomy as applied to the systematics and classification of the animal kingdom ; Classification and interrelationship amongst the major invertebrate phyla ; Minor invertebrate phyla, Functional anatomy of the nonchordates ; Larval forms and their evolutionary significance.

10. Classification and comparative anatomy of protochordates and chordates ; Origin, evolution and distribution of chordates groups : Adaptive radiation.

11. History of mammalian organ systems, nutrition, digestion and absorption ; Circulation (open and closed circular, lymphatic systems, blood composition and function) ; Muscular contraction and electric organs ; Excretion and osmoregulation : Nerve conduction and neurotransmitters ; major sense organs and receptors; Homeostatic (neural and hormonal) ; Bioluminescence ;

12. Gametogenesis in animals : Molecular events during fertilization, Cieavage patterns and fate maps, Concepts of determination, competence and induction, totipotency and nuclear transfer experiments : Cell differentiation and differential gene activity ; Morphogenetic determinants in egg cytoplasm ; Role of maternal contributions in early embryonic development ; Genetic regulations of early embryonic development in Drosophila ; Homeotic genes.

13. Feeding, learning, social and sexual behavior of animals ; Parental care; Circulation rhythms ; Mimicry ; Migration of fishes and birds ; Sociobiology; Physiological adaptation at high altitude.

14. Important human and veterinary parasites (protozoans and halminths) ; Life cycle and biology of Plasmodium, Trypanosoma ; Ascans, Wuchereria, Fasciola, Schistosoma and Leishmania ; Molecular, cellular and physiological basis of host – parasite interactions.

15. Arthropodsand vectors of human diseases (mosquitoes, lice, flies and tickes) ; Mode of transmission of pathogens by vectors ; Chemical, biological and environmental control of anthropoid vectors ; Biology and control of chief insect pests of agricultural importance ; Plant host-insect interaction, insect pest management ; useful insects : Silkworm.

16. The law of DNA constancy and C-value paradox : Numerical, and structural changes in chromosomes ; Molecular basis of spontaneous and induced mutations and their role in evolution ; Environmental mutagenesis and toxicity testing ; Population genetics.

17. Structure of pro-and eukaryotic cells ; membrane structure and function ; Intracellular compartments, proteinsorting, secretory and endocytic pathways ; Cyloskeleton ; Nucleus ; Mitochondria and chloroplasts and their genetic organization ; cell cycle ; Structure and organization of chromatin, polytene and lamphrush chromosomes ; Dosage compensation and sex determination and sex-linked inheritance.

18. Interactions between environment and biota ; Concept of habitat and ecological niches ; Limiting factor ; Energy flow, food chain, food web and tropic levels ; Ecological pyramids and recycling, biotic community – concept, structure, dominance, fluctuation and succession ; N. P. C. and S cycles in nature.

19. Ecosystem dynamics and management ; Stability and complexity of ecosystems ; Speciation and extinctions ; Environmental impact assessment, Principles of conservation ; Conservation strategies ; Sustainable development.

20. Physico-chemical properties of water ; Kinds of acquatic habitats (fresh water and marine); Distribution of and impact of environmental factors on the aquatic biota ; Productivity mineral cycles and biodegradation in different aquatic ecosystems ; Fish and Fisheries of India with respect to the management of estuarine, coastal water systems and man-made reservoirs ; Biology and ecology of reservoirs.

21. Structure, classification, genetics, reproduction and physiology of bacteria and viruses (of bacteria, plants and animals) ; Mycoplasma protozoa and yeast (a general accounts).

22. Microbial fermentation ; Antibiotics, organic acids and vitamins ; Microbes in decomposition and recycling processes ; Symbiotic and asymblotic N2 – fixation ; Microbiology of water, air, soil and sewage ; Microbes as pathological agents in plants, animals and man ; General design and applications of a biofermenter. Biofertilizer.

23. Antigen : Structure and functions of different clauses of immunoglobulins ; Primary and secondary immune response ; Lymphocytes and accessory cells ; Humoral and cell mediated immunity ; MHC ; Mechanism of immune response and generation of immunological diversity ; Genetic _____ of immune response ; Elector mechanisms ; Applications of immunological techniques.

24. Enzyme Kinetics (negative and positive cooperativity) ; Regulation of enzymatic activity ; Active sites ; Coenzymes ; Activators and inhibitors, isoenzymes, allosteric enzymes, Ribozyme and abzyme.

25. Van der Waal's electrostatic, hydrogen bonding and hydrophobic interaction ; Primary structure and proteins and nucleic acids ; Conformation of proteins and polypeptides (secondary Tartiary quaternary and domain structure); Reverse turns and Ramachandran plot ; Structural polymorphism of DNA, RNA and three dimensional structure of tRNA ; Structure of carbohydrates, polysacohanides, glyceproteins and

peptide – glycans ; Helixcoli transition ; Energy terms in biopolymer conformational calculation.

26. Glycolysis and TCA cycle ; Glycogen breakdown and synthesis ; Gluconeogenesis ; Interconversion of hexoses and pentoses ; Amino acid metabolism ; Coordinated control of metabolism ; Biosynthesis of purines and pyrimidinas ; Oxidation of lipids ; Biosynthesis of fatty acids ; Trigfycandes ; Phospholipids ; Sterols.

27. Energy metabolism (concept of free energy) ; Thermodynamic principles in biology ; Energy rich bonds ; Weak interactions ; Coupled reactions and oxidative phosphorylations ; Group transfer ; Biological energy transducers ; Bioenergietics.

28. Fine structure of gene, Eukaryotic genome organization (structure of chromalin ; coding and non coding sequences, satellite DNA) ; DNA damage and repair, DNA replication, amplification and rearrangements.

29. Organization of transcriptional units ; Mechanism of transcription of prokaryotes and eukaryotes ; RNA processing (capping, polyadenylation, splicing, introns and exons) ; Ribonuleoproteins, structure of mRNA ; Genetic code and protein synthesis.

30. Regulation of gene expression in pro and eukaryotes ; Attenuation and antitermination ; Operon concept ; DNA methylation ; Heterochromatization, Transposition ; Regulatory sequences and transacting factors ; Environmental regulation of gene expression.

31. Biochemistry and molecular biology of cancer ; Oncongenes ; Chemical carcinogenesis ; Genetic and metabolic disorders : Hormonal imbalances ; Drug metabolism and detoxification ; Genetic load and genetic counseling.

32. Lysogeny and lytic cycle in bacteriophages ; Bacterial transformation ; Host cell restriction ; Transduction ; Complementation ; Molecular recombination ; DNA ligases ; Topoisomarases ; Gyrases ; Methylases ; Nucleases ; Restriction endonucleases ; Plasmids and bacteriophage base vectors for cDNA and genomic libraries.

33. Principles and methods of genetic engineering and Gene targeting ; Applications in agriculture, health and industry.

34. Cell and tissue culture in plants and animals ; Primary culture ; Cell line ; Cell ciones ; Cellus cultures ; Somaclonal variation ; Micropropagation ; Somatic embryogenesis ; Haploidy ; Protoplast fusion and somatic hydridization ; Cybrides ; Genetransfer methods in plants and in animals; Transgenic biology ; Allopheny ; Artificial seeds ; Hybridoma technology.

35. Structure and organization of membranes Glycoconjugates and proteins in membrane systems ; Ion transport, Na + / K + ATPase ; Molecular basis of signal transduction in bacteria, plants and animals. Model membranes.

36. Principles and application of light, phase contrast, fluorescence, scanning and transmission electron microscopy, Cytophotometry and flow cytometry, fixation and staining.

37. Principles and applications of gel-filtration, ion-exchange and affinity chromatography ; Thin layer and gas chromatography ; High pressure liquid (HPLC) chromatography ; Electrophoresis and electrofocussing ; Ultracentrifugation (velocity and buoyant).

38. Principles and techniques of nucleic acid hybridization and Cot curves ; Sequencing of Proteins and nucleic acids ; Southern, Northern and South-Western blotting techniques ; Polymerase chain reaction ; Methods for measuring nucleic acid and protein interactions.

39. Principles of biophysical methods used for analysis of biopolymer structure, X-ray diffraction, fluorescence, UV, GRO, CO, Visible, NMR and ESR spectroscopy ; Hydrodynamic methods, Atomic absorption and plasma emission spectroscopy.

40. Principles and applications of tracer techniques in biology ; Radiation dosimetry ; Radioactive isotopes and half life of isotopes ; Effect of radiation on biological system ; Autoradiography ; Cerenkoy radiation ; Liquid spectrometry.

41. Principles and practice of statistical methods in biological research ; samples and populations ; Basic statistics – average, statistics of dispersion, coefficient of variation ; Standard error ; Confidence limits ; Probability distributions binomial, Poisson and normal ; Tests of statistical significance ; Simple correlation of regression ; Analysis of variance.