

**DEPARTMENT OF BIOTECHNOLOGY
KURUKSHETRA UNIVERSITY KURUKSHETRA**

Syllabus for Ph. D. Entrance Test - 2011

Paper-I Biotechnology (Objective Type)

Max. Marks: 100

Time: One Hour

Note: Fifty objective type questions are to be set spread over the entire syllabus. All questions are compulsory. Each question will be of two marks.

Cell Signaling, Cell Death, Cell Renewal and Cancer: Cell Signaling pathways, apoptosis, role of cell survival factors, development and causes of cancer, tumour viruses, oncogenes, tumour suppressor genes, application of molecular biology for cancer prevention and treatment.

Genome Organization, Mutation and Site-Specific Recombination: Genome size and complexity, Gene organization, Multigene families, Pseudogenes, Repetitive DNA, Hot spots, Signature Tagged Mutagenesis (STM), Gene trap vector, Gene conversion, Recombinases and their function, cre-lox recombination.

DNA Replication, DNA Repair, RNA and Protein Synthesis and Processing: Prokaryotic transcription, Eukaryotic transcription: RNA polymerases and transcription factors, RNA processing and turnover, Protein folding and processing

Transcription Regulation in Prokaryotes and Eukaryotes: Positive and negative control of transcription, Repression and activation, Organization and regulation of Lac, Trp and Ara operon in *E. coli.*, Eukaryotic activators, DNA binding domains, Transcriptional repressors, Gene silencing, Epigenetic gene regulation

Recombinant DNA Technology: Tools and techniques- Restriction Endonucleases, DNA manipulating enzymes, Cloning vectors, Gene libraries, Screening strategies, DNA amplification (PCR and its types-RT-PCR, Real Time PCR, Allele specific.PCR, Multiplex PCR), DNA markers for genetic mapping (RAPD, RFLP, SSCP, SNPs, STS), Manipulation of Gene expression in *E.coli*, Heterologous protein production in Eukaryotes- *Saccharomyces cerevisiae* and Mammalian cell expression system; Gene Expression Regulation studies- Gel retardation assay, Reporter genes, DNA foot printing, HRT, HART; Regulatory RNAs (Interfering and antisense RNA) and gene expression

Microbial Growth, Fermentation and Improvement: Isolation, Preservation and Improvement of industrially important microorganisms, Kinetics of microbial growth and product formation, Fermentation system; batch and continuous system, fed batch system, multistage system, solid state fermentation.

Biotechniques: Affinity chromatography, High pressure liquid chromatography (HPLC); Agarose gel electrophoresis, Pulse field gel electrophoresis, SDS-PAGE, Isoelectrofocusing, 2-Dimensional electrophoresis, ELISA, flow cytometry, Hybridoma technology

Bioinformatics: Biological Databases, Information Retrieval from Biological Databases, Unique Requirements of Database Searching, Heuristic Database Searching, Basic Local Alignment Search Tool (BLAST), FASTA, Comparison of FASTA and BLAST.

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Ph. D. Entrance Test Syllabus-2011

Paper II Biotechnology (Descriptive Type)

Max. Marks: 100

Time: Two Hours

Note: Total Eight questions are to set, two questions from each Section-A, B, C, & D. Each question will have five parts and each part will be of five marks. Candidates will have to attempt One question from each section.

SECTION-A

Gene Cloning: Tools and techniques-Purification of total cell DNA and plasmid DNA, Yield Analysis, Nucleic acid hybridization, Restriction Endonucleases, DNA manipulating enzymes, Cloning vectors-Plasmid, bacteriophage, phagemid, cosmid and YAC, Gene libraries- genomic library, cDNA library, Screening strategies- Colony and plaque hybridization, Abundance probing, Heterologous probing, Immunological screening.

DNA Amplification, Mapping and Sequencing: Polymerase Chain Reaction- Principle, Types (RT-PCR, Real time PCR, Multiplex PCR) and applications of PCR; DNA markers for genetic mapping- RAPD, RFLP, SNPs, SSCP, STS; DNA sequencing techniques- Sanger's dideoxynucleotide, Automated DNA sequencing, Pyrosequencing

Gene Expression and Regulation: Manipulation of gene expression in prokaryotes- Problems with production of recombinant proteins in *E. coli*, Optimizing expression of foreign genes in *E. coli*; Heterologous protein production in Eukaryotes- *Saccharomyces cerevisiae* and Mammalian cell expression system; Gene expression regulatory studies- Gel retardation assay, Reporter genes, DNA footprinting, HRT, HART; Regulatory RNAs (Interfering and antisense RNA) and gene expression

SECTION-B

Microbial Fermentation and Biotechnological Improvement of Industrially Useful Microbes: Improvement of industrially important microorganisms, Fermentation system- batch, continuous and fed batch system; Microbial production of alcohol and their improvement by genetic engineering, overproduction of primary and secondary metabolites; Biomass production- single cell protein (SCP) production

Bioremediation, Biosensors, Bioleaching, and Biofertilizers: Bioremediation of fuel oils and lubricants in soil and water. Microbial degradation of xenobiotics, Biosensors for environmental applications, Indicator organisms; Microbes in oil recovery and bioleaching; Bio fertilizers.

Enzyme Technology: Enzyme immobilization and its importance; enzyme inhibitors and drug design; enzymes as biosensors, ribozyme, abzyme, Applications of enzymes in medicine, textile, leather and detergent industry.

SECTION-C

Plant Genetic Transformation: Organization of plant genome – Nuclear genome, Chloroplast genome and mitochondrial genome, Transposon and T – DNA tagging, Direct and *Agrobacterium* mediated transformation, Gene silencing in transgenic plants.

Strategies for Introducing Biotic and Abiotic Stress Resistance/Tolerance: Viral resistance, fungal resistance, insect resistance, herbicide resistance, various abiotic stresses.

Genetic Engineering of Plants for Molecular Farming/Pharming: Production of medically relevant proteins in plants, nutritional enhancement of plants (carbohydrates, seed storage proteins, vitamins), manipulation of flower colors and other value addition compounds (like industrial enzymes). Concerns about GMOs – environmental, biosafety and ethics.

SECTION-D

Applications of Animal Cell Culture: virology, cancer research, gene therapy, drug development and cytotoxicity, animal cloning, cryopreservation of cells.

Stem Cell Technology: Basics of stem cells, Embryonic, adult and amniotic fluid stem cells, Applications of stem cells.

Gene Transfer into Animal Cells and Transgenic animals: Direct and viral vectors for gene transfer into animal cells;. **Transgenic animals:** Transgenic mice: Methodology and applications; Transgenic cattle, Livestock transgenesis- production of drugs using animals.

Animal Genomics: Role of animal genomics for health and biomedical sciences. Models used in animal genomics, Functional genomics and livestock traits assessment, Livestock in the post genomic era of biology and medicine.

Animal Cloning: Principles and techniques of cloning, Applications of animal cloning.