Alagappa University, Karaikudi

Pre-Registration Qualifying Entrance Examination for Ph.D. Program (2023 onwards)

Discipline: Molecular Biology

Unit I – Foundations of research

Research- classification of research – planning of research – selection of research problem – formulation of research design – review of literature – review and synopsis presentation. Research process, research designs – preparation of research report. Guidelines for preparing an article.

Unit II - Separation Techniques

Principles and applications of gel filtration, ion exchange, and affinity chromatography, thin layer and gas chromatography, high-pressure liquid chromatography (HPLC).Principles and types of electrophoresis - PAGE, SDS – PAGE, and Agarose gel electrophoresis. Isoelectric focusing. 2D gel Electrophoresis.

Unit III –Genomic and Proteomic Methods

Isolation of DNA/RNA, Quantification –Spectrophotometer, Primer design, Types of PCR, DNA Sequencing, Genotyping, mutation analysis –Real-Time PCR, Purification and quantification of Proteins, Isoelectric focusing, 2D gel Electrophoresis, spectrophotometry, Western Blot, ELISA

Unit IV - Biostatistics

Principles and practice of statistical methods in biological research, collection, classification, and Presentation of data – graphs, diagrams, and tables. Analysis of data. Averages, dispersion, correlation, Regression. Tool vibration – population, samples & sampling techniques. Point of interval estimation. Testing of hypothesis using t-test, chi-square test, and test for ANOVA

Unit-V - Bioinformatics

Sequence Analysis and Structure visualization software; Pairwise alignment and multiple alignment- database searching - Protein structure prediction- secondary and tertiary and motifs- Proteomic tools at ExPASy server- RNA structure analysis- Genomics- Prediction of genes, promoters, splice sites and regulatory regions-Genome comparisons, Phylogeny analysis.

UnitVI:

Discovery of DNA.Molecular basis of DNA as genetic material. Structure of DNA – A, B and Z form. Forms of DNA – DNA heteroduplex, circular, superhelical DNA, twisted circle. Properties of DNA - denaturation, renaturation, melting curve, hyperchromicity. Structure of RNA - types of RNA - tRNA, mRNA and rRNA.Replicationin

prokaryotesandeukaryotes;DNA repair–lightanddarkmechanisms;Mutations–causesandtypes,isolationandcharacterization ofmutants andrevertants. ProkaryoticandEukaryotictranscription,posttranscriptionalmodification, translation,posttranslationalmodification. Geneticrecombination (Homologous, non-homologous andsitespecificrecombination).

UnitVII:

Genetic code: Elucidation of triplet code, code characteristics, codon dictionary. Reading frames, sense and nonsense code. Degeneracy - wobble hypothesis, universality of genetic code. Process of translation in prokaryotes: Initiation and Termination. Role of rRNA in protein synthesis. Post translational modifications - post translational transport, signal hypothesis. Plasmids: Types of plasmids - F, R & Col plasmids. Properties of plasmids – sex factors, drug resistant, colicinogenic, *Agrobacterium*Ti and broad host range plasmid. Detection and purification of plasmid DNA. Transfer of plasmid DNA. Replication of plasmid.Control of copy number, plasmid amplification, curing and incompatability.Gene concept - regulation of bacterial gene expression. Lactose system - coordinate regulation, Lac components, positive and negative regulation, catabolite repression.Tryptophan operon - attenuation. Arabinose operon and its regulation.

UnitVIII:

DNA modifying enzymes – nucleases, polymerases, ligases. cloning vectors – plasmids, cosmids, phasmids, phagemids, expression vectors, plasmid vectors – $p^{BR}322$ and $p^{UC}18$, integrating shuttle vector –YAC vectors, viral vector – SV 40 and adeno virus. Lac Z promoter – expression system – Lambda, PL / PR Promoter, T^7 promoter, Sp6 promoter, SV – 40 promoter, CaMV 35s promoter. Cloning methodologies – α complementation, sticky and blunt end cloning. Cloning from mRNA – synthesis of cDNA, cloning cDNA– cDNA library. Cloning from genomic DNA – genomic library. Shot gun cloning. Screening of recombinant – phenotypic expression of characters – Blotting techniques – western, northern and southern.Mapping of human genes – Human genome project.

UnitIX:

Cloning of human insulin, interferon in *E.coli*. Recombinant vaccine development – HBs Ag in yeast. Cloning for commercial production of antibiotics (Penicillin). Bio steroid transformation. Production of biopolymers – Xanthum gum. Melanin biosynthesis in *E.coli*, adhesive biopolymer in yeast.

UnitX:

Gene silencing and antisense technology: Types and mechanism of gene silencing. Genetic factors of silencing, formation of antisense mRNA, inhibition of gene expression by antisense RNA. Gene silencing in crop plants: tomato. Si RNA and disease control. Plant

genetic engineering: Ti plasmid, CaMV vector, Direct DNA delivery methods – micro projectile bombardment, microinjection and electroporation. Gene therapy

References:

1. Brown, T.A. 2000. Gene Cloning, Fourth Edition, Chapman and Hall Publication, USA.
2. David Freifelder. D. 2008. Microbial Genetics, Eighteenth Edition, Narosa Publishing House, New Delhi.
3. Glick, B.K. and Pasternak, J.J. 2002. Molecular Biotechnology Principles and Applications of Recombinat DNA, ASM Press, Washington.
4. Jin Xiong. 2006. Essential Bioinformatics. 1st edition. Cambridge University Press.
5. Kornberg, A. and Baker, A. 1992. DNA Replication, Second Edition, W.H. Freeman andCompany, New York.
6. Malcolm Laurie A and Heyer Campbell J. 2006. Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Pearson Publishers
7. Primrose, S.B. and Twyman, R.M. 2009. Principles of Gene manipulation and Genomics, Seventh Edition, Blackwell publishing, UK.
8. Research Methodology 2004 – C.R.Kothari Second Edition. New Age International Publishers
9. Sandy B. Primrose and Richard Twyman. 2006. Principles of Gene Manipulation and Genomics, 7th Edition. Oxford Research.
10. Singer, M. and Paul Berg, 1991. Genes &Genomes, University Science Books, California.
11. Stanley R. Maloy, John E.C. and Freifelder, D. 2008. Microbial Genetics, Narosa Publishing House, New Delhi.
12. Stryer, L. 2010. Biochemistry, Seventh Edition, W.H. Freeman and Company, New York.
13. Thieman, W.J. and Palladino, M.A. 2009. Introduction to Biotechnology, Dorling Kindersley India Pvt. Ltd., Noida.
14. Turner, P.E., McLennan, A.G., Bates, A.D. and White, M.R.H. 1999. Instant Notes in Molecular Biology, Viva Books Ltd., New Delhi.