

## CSIR NET UNIT 13 SYLLABUS

### METHODS IN BIOLOGY

CSIR NET UNIT 13 includes topics like molecular biology and recombinant DNA methods, histochemical and immunotechniques, biophysical methods, statistical methods, radiolabeling techniques, microscopic techniques, electrophysiological methods, and methods in field biology. Topics include DNA sequencing, molecular cloning, immunoprecipitation, statistical analysis, radiolabeling, microscopy, electrophysiology, and field biology methods.

#### CSIR NET UNIT 13

#### Topics

##### A) Molecular Biology and Recombinant DNA Methods

- Isolation and purification of RNA, DNA (genomic and plasmid), and proteins
- Different separation methods
- Analysis of RNA, DNA, and proteins by one and two-dimensional gel electrophoresis, Isoelectric focusing gels
- Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems
- Expression of recombinant proteins using bacterial, animal, and plant vectors
- Isolation of specific nucleic acid sequences
- Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC, and YAC vectors
- In vitro mutagenesis and deletion techniques, gene knockout in bacterial and eukaryotic organisms
- Protein sequencing methods, detection of post-translation modification of proteins
- DNA sequencing methods, strategies for genome sequencing

- Methods for analysis of gene expression at RNA and protein level, large-scale expression, such as microarray-based techniques
- Isolation, separation, and analysis of carbohydrate and lipid molecules
- RFLP, RAPD, and AFLP techniques

#### B) Histochemical and Immunotechniques

- Antibody generation
- Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow cytometry, and immunofluorescence microscopy
- Detection of molecules in living cells, in situ localization by techniques such as FISH and GISH

#### C) Biophysical Method

- Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR, and ESR spectroscopy
- Molecular structure determination using X-ray diffraction and NMR
- Molecular analysis using light scattering, different types of mass spectrometry, and surface plasma resonance methods

#### D) Statistical Methods

- Measures of central tendency and dispersal
- Probability distributions (Binomial, Poisson, and normal)
- Sampling distribution
- Difference between parametric and non-parametric statistics
- Confidence Interval
- Errors

- Levels of significance
- Regression and Correlation
- t-test
- Analysis of variance
- X2 test
- Basic introduction to Multivariate statistics, etc.

#### E) Radiolabeling Techniques

- Detection and measurement of different types of radioisotopes normally used in biology
- Incorporation of radioisotopes in biological tissues and cells
- Molecular imaging of radioactive material
- Safety guidelines

#### F) Microscopic Techniques

- Visualization of cells and subcellular components by light microscopy
- Resolving powers of different microscopes
- Microscopy of living cells
- Scanning and transmission microscopes
- Different fixation and staining techniques for EM
- Freeze-etch and freeze-fracture methods for EM
- Image processing methods in microscopy

G) Electrophysiological  
Methods

- Single neuron recording
- Patch-clamp recording
- ECG
- Brain activity recording
- Lesion and stimulation of the brain
- Pharmacological testing
- PET, MRI, fMRI, CAT

H) Methods in Field Biology

- Methods of estimating population density of animals and plants
- Ranging patterns through direct, indirect, and remote observations
- Sampling methods in the study of behavior
- Habitat characterization: ground and remote sensing methods

**Study tips for CSIR NET UNIT 13:** Practice hands-on techniques in molecular cloning and immune techniques, understand principles of biophysical methods, utilize statistical tools for data analysis, and explore applications of electrophysiological methods. Familiarize yourself with microscopic techniques and their applications, and gain practical experience in field biology methods.