Research Methodology course work for Ph.D. students in Life Sciences – 2011

Classes commencing from 02 January 2012, between 3-4 pm

Course Summary

Courses	No. of credits
1. Theory	
1. Analytical techniques	4
2. Research ethics, Data analysis and Biostatistics	3
II. Lab Seminar & Record	5
Total	**12**

Analytical techniques: (4 credits; 100 marks)

1) **Module 1: Microscopy and Immunotechniques (12 hours)**

   a) Microscopy: Basic principles and applications of light and fluorescence microscopy, *in situ* hybridization and histology, confocal microscopy and applications of a confocal microscope (6 hours)
   b) Immunoblots, ELISA, Flow cytometry analysis and sorting (demo included) (6 hours)

2) **Module 2: Spectroscopy and Protein modeling (12 hours)**

   a) Spectroscopic techniques including UV-Visible, IR, fluorescence , CD spectra etc. (7 hours)
   b) Radiation safety and use of radio isotopes in the laboratory (2 hours)
   c) Protein dynamics and modeling (3 hours)

3) **Module 3: Protein separation and crystallization techniques; Proteomics (12 hours)**

   a) Chromatography and ultracentrifugation: principle and applications in analytical and preparative separation (6 hours)
   b) Mass spectrometry: Basic principles, MALDI-TOF, LC-MS (can include a demo) (3 hours)
   c) Crystallization and methods for determination of protein structure (3 hours)

4) **Module 4: Microbiological techniques; Genomics and introduction to basic bioinformatic analysis of genome sequence (12 hours)**

   a) Culture techniques and basics of microbial identification methods (4 hours)
   b) Functional genomics including microarrays, marker analysis, Single Nucleotide Polymorphisms, real time PCR, Next Generation Sequencing etc. (4 hours)
   c) Basics of sequence alignment, phylogenetic analysis (4 hours)

Research ethics, Data analysis and Biostatistics (<u>3credits; 75 marks)</u>

1. Institutional Review Board Permissions and adherence to community guidelines/standards
   (clinical trials, associations studies, genomics, microarrays, stem cells, human genetic disease analysis, animal studies etc.
2. Documentation of scientific observations and maintenance of raw data in a biology lab
3. Primary research articles and secondary content - commentaries, reviews, book length evaluations
4. Creative re-use, semantic enhancements and reproduction of open access scientific material
5. Publication ethics and IPR, copyright and Open Access licences
6. Competing interests
7. Malpractices and misconduct in scientific reporting - examples and case studies
8. Citations, evaluations, article-specific metrics and impact factors
9. Popular science communication, press and media management

a. concepts of confidence intervals & comparing groups
   Confidence Interval of a Proportion
   The Standard Deviation (mean, media, mode)
   Confidence Interval of a Difference between Means, ratio of two proportions, Case-Control using standard Statistical tests.
b. introduction to p values
   What is a P Value?
   Statistical significance and hypothesis testing
   Interpreting significant and not significant P values
   Multiple comparisons
c. correlation and regression
   Correlation
   An introduction to regression
   Simple linear regression

II. Lab work/Seminar (5credits, 125 marks)

- Supervisors are advised to decide the practical course structure required for the candidate and ask him/her to complete the practicals.
- Send a copy of the course structure to the Co-ordinator for the office record.
- The candidate will be assessed on submitting the record by the supervisor and another faculty member of the Department. The practical record should be submitted by the candidate to the Co-ordinator.
- The examinations for the theory courses will be held along with semester-end examinations.
- The candidate in consultation with the Ph.D. Mentor will be presenting the proposed topic of his/her research and this will be conducted by the individual Departments.