Department of Physics and Astrophysics
University of Delhi

Guidelines for Ph.D. course work (draft for DRC meeting)

All doctoral students admitted August 2015 onwards (under the purview of Ordinance VI-B, as amended in 5 August 2015 and 17 February 2016) have to comply with the following coursework requirements in the Department of Physics and Astrophysics:

1. **Research Methodology I – Statistics and Computer Applications (PHYS 601)** : A one semester course of 4 contact hours per week (i.e. 48 in total). This course includes an introduction to operating systems and software, experimental data analysis and certain statistical and computational techniques, the details of which are mentioned below. The evaluation would be via a *final examination* and a *project work* with weightage 75% and 25% respectively.

2. **Research Methodology II – Literature survey, Scientific writing and Presentation (PHYS 602)** : A course based on the survey of literature pertaining to proposed area of research and writing/presentation skills, which is to be evaluated via a *written documentation* as well as a *oral presentation*, with equal weightage, viz. 50% each. The write-up has to be submitted to the department atleast 10 working days prior to the oral presentation.

The above would be governed by the following clause E-3 of Ordinance VI B (revised 17 February 2016):

- The DRC shall satisfy itself that each student has completed the requirement of coursework. The BRS shall provide a certificate of completion of coursework to each student. If the result is unsatisfactory, the student may be allowed to reappear only once, within one year. If the result is still found unsatisfactory, the DRC may recommend cancellation of his/her registration and this may be reported to the BRS.

Details of **PHYS 601: Research Methodology I – Statistics and Computer Applications**

(i) **Introduction to operating systems and softwares** [4 contact hours]

Linux, gnuplot, xmgrace, Octave/Scilab/R(GNU S).

(ii) **Experimental data analysis** [12 contact hours]

Measurements and errors in data, error analysis — statistic and systematic, random variables, probability distribution and their moments, central limit theorem and Gaussian distribution, filters, multi-variate data, covariance matrix.

(iii) **Hypothesis testing and Goodness of fit** [12 contact hours]

Null hypothesis, statistics formulation, robust statistics, Kolmogorov-Smirnov test, chi-squared test, p-value, least squares fitting, interpolation and extrapolation, spline fitting, estimation of parameters, maximum likelihood method.

(iv) **Monte-Carlo techniques** [8 contact hours]

Random number generation from an arbitrary probability distribution, function minimization and numerical experiments.

(v) **Time-series analysis** [12 contact hours]

Data sampling, Nyquist theorem, auto and cross correlation, FFT, spectral power analysis, white and coloured noise, entropy, singular value decomposition and principal component analysis.

Note: For every topic, lectures will be accompanied by examples that need to be implemented on the computer. While there will be no supervised laboratory session in this course, students are expected to make use of Departmental Computer Facilities for their computational practical work.

The Final examination (75% of total) would consist of both written and computational components. The project (25% of total) would be assigned by the instructor, and the students would be expected to submit a written project report and working code where applicable.

Details of **PHYS 602: Research Methodology II – Literature survey, Scientific writing and Presentation**

The evaluation of literature survey and preparation for the proposed research would be based on a written documentation and a oral presentation.

Guidelines for the **written documentation**:

(a) Formatting: 30-40 pages (including figures, tables and bibliography), preferably in LaTeX with line-spacing – 1.5, and font – Times New Roman (12 pt).

(b) Salient itemization:

(i) A brief overview of the subject area and the specific field of research. (10% of total)

(ii) A general survey of existing literature in the specific field of research, and an elucidation of the plausible avenues (open problems) in that field. (40% of total)

(iii) A clear and concise account of the motivation for the chosen topic of research for Ph.D., the plan of work, the methodology and techniques to be applied. (50% of total)

(c) Structuring:

(i) Title of the research topic and abstract.

(ii) Introduction (up to a maximum of 3 pages).

(iii) Overview of the subject area and the field of research (maximum 3 pages).

(iv) Literature survey and discussion on open problems in the field of research (8-10 pages).

(v) Topic of research: motivation, planning, methodology, etc. (8-10 pages).

(vi) Relevant work done or in progress, if any (up to a maximum of 8 pages).

(vii) Summary and discussions (up to a maximum of 2 pages).

(viii) Bibliography (up to 2 pages).

Guidelines for the **oral presentation**:

(a) Allotted time: 40 mins + 20 mins (for questionnaire).

(b) Maximum number of slides: 20 (ideally 12-15).

(c) Plan of the talk: (i) a brief overview of the subject area and the specific field of research, (ii) the scope of research in the chosen field (based on literature survey), (iii) motivation for the topic of research, work plan, methodology etc., (iv) a brief account of the work completed or in progress (if any), and (v) summary and discussions.

Mode of Evaluation:

PHYS 601: Statistics and Computer Applications

The Final examination (75% of total) as well as the project (25% of total) would be at the sole discretion of the Instructor.

Written documentation and Oral presentation

There would be an **Evaluation Committee** consisting of *Supervisor* and *Co-Supervisor* (if any), two *Advisory board* members, and two *External* members from within the department.

Supervisor and Co-Supervisor (1 or 2), Advisory board members (2), and Externals (2).

Guidelines for Evaluation:

1. Written document on **Research background, planning and methodology**:

(a) Whether the prescribed format and structure are followed. (20% of total)

(b) On the writing skills and the scientific and language-wise clarity overall. (30% of total)

(c) On the technical aspects, such as the overall understanding of the subject, clarity in describing the methodology, appropriateness in the sectioning, structuring of the equations, setting up of the figures and tables, appropriateness in the cross-referencing, etc. (50% of total)

2. Oral presentation on **Area and Topic of research**:

(a) Quality and technical clarity of the slides, or blackboard presentation (if any). (30% of total)

(b) On the power of oral expressions and blackboard clarifications (if asked for). (30% of total)

(c) On the ability of addressing/responding to Questions. (40% of total)