

## **GUIDELINES/CRITERIA FOR DOCTORAL RESEARCH AND ITS EVALUATION**

### **Preamble**

1. Research performed in pursuit of higher professional degrees should conform to a well-defined criteria, in consonance with the practices in vogue in reputed universities. Whereas each university may follow a criteria specific to its own perception and traditions, all such criteria do include the essential parameters enunciated in the following paragraphs. It is also important to keep in view the fact that research evaluation criteria vary with respect to the field of research i.e. Engineering, Basic Sciences, Information Technology, Medical etc. Not only that, the criteria also differ in relation to the higher professional degree being sought. Broadly speaking, an MSc/ MPhil level research aims to discovering a solution to a given problem, while the knowledge of the relevant field already exists. A Doctoral level research, on the other hand, mainly focuses to advance the boundary of known knowledge of a specific field, prior to developing a solution.

### **Research Criteria**

2. This paper deals with Doctoral research in engineering fields. The salient points of the proposed criteria are stated below:

- a. **Selection of Research Topics**. Generally speaking a research work could be categorized either as “Basic Research” or “Applied Research”. Basic Research aims to create new knowledge for its own sake and its results may not find immediate applications. Applied

research, on the other hand, aims to develop new knowledge for solving a specific problem. Most of the research performed in Basic Sciences belongs to the first category. The research performed in engineering fields comprises the second category. It is opined that NUST Engineering Institutions should select and pursue those research topics which create solutions of problems being faced by our industry. Hence, selection of research topics be undertaken with in-depth deliberation and analysis, to ensure optimum utilization of resources. In the final analysis, results accrued from an applied research should make a positive contribution to improving the quality of life directly or indirectly.

- b. **Clarity of Topic**. The research topic should be as clearly defined as possible, indicating its scope and constraints within which the research would be conducted. Because of uncertainties in research pursuits, the priorly defined topic may have to be adjusted and fine-tuned till successful completion of the research project.
- c. **Originality**. As stated earlier, the essential requirement of Doctoral research is to break new grounds and make some original contribution to the known knowledge of a specific subject. Needless to say that such a contribution may not necessarily be a complete new theory. It could comprise new extensions to the presently cognized knowledge or unique application of the existing knowledge, or even hybridizing knowledge of different subjects to create new knowledge. The research must bring out the original contribution quite clearly and unambiguously.

- d. **Mathematical Robustness.** The validity of the research work should be supported by proven and well-established Mathematical principles. It amounts to saying that the inferences accruing from a research work should be explainable through mathematical logic and not just through intuition, gut feeling, or the emphasis that inferences have been practically realized. This particular point may not have much relevance to the research performed in fields like Medical and Social and Basic Sciences.
- e. **Recommendations for further work.** Whereas, a successful research culminates in quantifiable results, there is always a scope for further improvements, newer innovations and realization of more proficient approaches to solving a problem. It is, therefore, of utmost importance that a researcher should point to the directions in which further work could be undertaken. Continuity in research pursuits is an essential hall-mark of all Doctoral research works, especially in engineering fields.

### **Guidelines for Guidance and Examinations Committee (GEC)**

1. The supervisor and GEC of a research student carry the responsibility to supervise and guide the research work right from the ab-initio till its successful culmination in tangible and verifiable results. It is a very demanding task and is always replete with challenges and uncertainties. The quality of supervision ultimately impacts the quality of research and its results. The supervisor and GEC, therefore, have an ethical and professional responsibilities to fulfill. Given below are a few suggestions to deal with aforesaid challenges effectively.

a. **Preparatory Steps**

- (1) To ensure that prospective candidate fulfills all conditions laid down in the HEC / NUST criteria for Doctoral candidates, prior to commencement of research work.
- (2) To specify 800/900 level (i.e. Graduate standards) courses to be taken by the student. These courses should aid in undertaking the perceived research work. The student should complete at least 48 credit hours worth of such courses, including the 30 credit hours already completed towards the MSc degree. If a student earns his MSc Degree from another university, or from another campus of NUST, then level and depth of the courses done will be evaluated by the GEC as per NUST regulations.
- (3) To ensure that the student earns at least 3.5 /400 as Cumulative Grade Point Average or scores 80% marks in the courses mentioned in para 2 a (2) above.
- (4) To specify the courses, in consultation with the student, in which his qualifier examination will be conducted.
- (5) To prepare question papers for written part of the Qualifier Exam. Similarly the GEC is also responsible for holding the Oral Part of the examination. The conduct of these examinations should confirm to the NUST Policy letter no 0920/05/PhD/Policy/Regn dated 10 Feb 2005.

b. **Supervision of Research**

- (1) Subsequent to successfully passing the qualifier examination, the student should start “LITERATURE SEARCH” phase. It

entails extensive search and in-depth study of latest research papers concerning various aspects of the chosen research topic. It is a critical phase because most of the contents of research papers will not be clear to the student. Therefore, the student would need a lot of help from the supervisor for explanation etc. Fortunately, now almost all NUST campuses have on-line facilities to search the requisite papers and journals. It is suggested that the student should be regularly meeting the supervisor at least once a month to discuss the contents of the research papers and resolving the difficulties. Depending on the student's progress in comprehending the literature, the frequency of these meetings could be readjusted.

- (2) After completion of the literature search phase, the student must hold a defence for justifying the chosen research topic. This defence must be attended by the entire GEC and the supervisor may also like to elaborate on the broad limiting constraints within which the research would be confined.
- (3) As the student progresses in the research work, the supervisor should continue to ensure that his ward does not embark on a route which is already known to lead to a dead-end. To avoid this situation, and it does happen quite often, the student be asked to make a detailed presentation to his GEC at least once in three months. During this phase, as and when deemed appropriate by the supervisor, the student be exhorted to attend conferences / seminars / workshops pertaining to his research area. He should also be encouraged to author, initially,

conference level papers and, in due course, contribute papers in journals of repute. Only those journals having some impact factor and included in the HEC's database be selected for this purpose.

- (4) If the supervisor and GEC feel satisfied that sufficient research work has been successfully accomplished, the student be asked to commence the writing phase. The supervisor has to ensure that writing of the thesis is not taken lightly by the student. The experience shows that a good Doctoral thesis may take 6 to 12 months to write, with no intervening discontinuities.
- (5). In the meantime the supervisor and GEC need to identify a panel of two foreign and one local expert who will review the thesis and give their respective opinion about its acceptability for the award of the PhD degree.

#### **Procedure for Evaluation of Thesis**

4. Evaluation of a Doctoral thesis is an equally difficult and challenging task and demands a deep professional and ethical approach on the part of the evaluator. A thorough evaluation of a Doctoral thesis requires many weeks to complete. In this context, the following points are suggested to ensure a comprehensive evaluation of a thesis:-

- a. **Chronology and Linguistic Aspects.** The evaluator should ascertain that the thesis is well written and follows a chronological sequence. Also, that it is free of linguistic and grammatical errors. Each chapter should define the scope of the chapter, followed by the requisite elaborative details and, at the end, a crisp summary of the chapter's subject. The overall subject matter should flow smoothly from one

chapter to another till the last one, giving main conclusions and recommendations.

- b. **Affirmation of Meeting the Research Criteria.** The evaluator should determine whether the thesis conforms to the research criteria outlined earlier, i.e. it has originality, its mathematical contents are sound, and that all accruing results and inferences have been unambiguously verified. The thesis should also recommend various directions of future work.
- c. **Guarding Against Plagiarism.** Plagiarism means using or reproducing someone else's research results without giving due credit to the original author/ researcher through citing the references. The evaluator has to ensure that no plagiarized material is contained in the thesis. Even a minor content of plagiarized material disqualifies the entire thesis in Toto and it becomes a case for strong disciplinary action not only against the student but against the thesis supervisor as well. The thesis should contain the complete bibliography of all the referenced papers, journals and books.
- d. **Complementary Material.** The evaluator should also go through the complementary materials placed in the thesis, i.e. software codes, computer printouts etc, equally diligently to vouch for their originality and correctness as well.
- e. **Incorporating the Evaluator's Comments.** The supervisor and each GEC members should also review the thesis in detail. They should meet to discuss the comments and observations of each evaluator. It is the responsibility of the supervisor to make sure that the student

incorporates due changes and improvements in the thesis to remove all shortcomings as noted by each GEC member.

- f. **Seeking External Evaluators Opinion.** It is only when the supervisor and all GEC members feel fully satisfied that the subject thesis be sent to two foreign and one local expert for independent review and evaluation. These external evaluator may also direct certain changes in the thesis. Again, the supervisor should ensure that the view and observations of the external evaluators are dully incorporated in the thesis and the action be confirmed to the originator of the observations.
- g. **Open Defence.** After receiving the satisfactory report / remarks from external evaluators the prospective student should be asked to defend his research work in an open defence. The open defence will be arranged in consultation with HQ NUST.
- h. **Remuneration for External and Internal Evaluators.** As stated earlier, evaluating a Doctoral thesis is a time consuming task which places ample responsibility on the evaluators. Therefore in keeping with the International practice in vogue, the evaluators should be paid to accomplish this onerous responsibility. It is opined that each external evaluator be paid a sum of \$1000 and the local expert be given Rs. 20,000/- for their services.