FOREWORD

Recent expansion of higher education sector in Pakistan and abroad has necessitated the focus on quality of engineering education. The quality and competence of graduates and their relevance is critical for socio-economic uplift and technical manpower required to meet the needs of the country. Pakistan Engineering Council (PEC) is the Regulatory Body to undertake multiple tasks; one of these is to regulate the conduct of engineering education. The quality of engineering programs is ensured through a comprehensive process of accreditation adopting international best practices in vogue. Emphasis is placed on adherence to accreditation standards to ensure quality of engineering programs offered in public and private institutions. Consequently, Degree Awarding Institutions (DAIs) are expected to produce engineers of high caliber and high quality research to meet stakeholders’ requirements.

The PEC Act 1976 as amended in 2011 has set up an Engineering Accreditation Board (EAB), formerly known as Engineering Accreditation and Qualification Equivalence Committee (EA&QEC), to monitor the growth and quality of engineering education in Pakistan. For this purpose, the PEC EAB is tasked to evolve procedures, articulate the criteria, define parameters and establish appropriate benchmarks.

The PEC EAB has carried out countrywide awareness programs and other essential activities such as benchmarking and finalization of the evaluation procedures. The program visits for Accreditation commenced in early nineties and provided considerable experience in the assessment process. As a result, various formats / performa used in the assessment process have been revised and updated accordingly.

A major achievement in this regard was publication of first Manual of Accreditation in 2007. This revised Manual of Accreditation (Second Edition 2014) is a continuation of the previous efforts and has significantly changed the procedure from quantitative to qualitative assessment. It has also incorporated all aspects of Outcome Based Education (OBE) in Engineering programs offered in country and its Outcome Based Assessment (OBA).

It is expected that this Manual will provide guidelines to institutions and other stakeholders to meet the required quality assurance standards. PEC acknowledges the support and efforts of engineers, and academicians who contributed in revision and updation of this document, especially members of Working Group / Task Force on Revision of Accreditation Manual and members of EAB. Special thanks are also due for PEC Mentors (BEM, Malaysia and IES, Singapore) for their feedback and valuable suggestions.

Engr. Syed Abdul Qadir Shah
Chairman
Pakistan Engineering Council
February 2014
PREAMBLE

Pakistan Engineering Council (PEC) was enacted in 1976 by the Parliament as an autonomous statutory body to regulate the engineering profession in the country. According to PEC Act 1976 (amended in 2011), the Council was assigned the functions of accreditation of Engineering Qualifications and maintaining a register of persons qualified from an accredited engineering program to practice as Registered or Professional Engineers. Evidently, the purpose of recognition of engineering qualifications is to oversee the growth and quality of technical education in the country. In the past, evaluation of an engineering program was carried out through the inspectors of examinations following well described guidelines. However, over a period of time the process of accreditation was formalized and the first Manual of Accreditation was published in 2007 for implementation by Engineering Accreditation and Qualification Equivalence Committee (EA&QEC). This manual included concepts of quality assurance in Engineering Education adopted by developed countries. Recently, after achieving the Provisional Signatory status of Washington Accord (WA) of International Engineering Alliance (IEA) in 2010, the revision of Accreditation Manual was undertaken to harmonize with the practices of WA-Signatories. The Engineering Accreditation Board (EAB) has now replaced EA&QEC to carry out the assessment of various engineering programs in the country and has published the 2nd Edition (Edition 2014) incorporating WA guidelines and the feedback of local stakeholders, various relevant international forums as well as WA-Mentors. Whereas the Higher Education Commission (HEC) of Pakistan is responsible for quality assurance on institutional level; EAB, which works in harmony with HEC, is responsible for the accreditation of engineering programs in the country.

In recent years, professional preparation of engineers at the undergraduate (Cycle I) and advanced levels (Cycle II & III) has undergone significant changes due to a variety of factors including knowledge explosion, new tools and techniques of teaching. A key new element has been interdisciplinary redesign of engineering programs where teams of scholars from different disciplines of knowledge design and implement programs. Each program, while focusing on knowledge profile, design skills and solution to complex engineering problems, also demand understanding of a wider range of peripheral supportive disciplines. Interdisciplinary engineering programs not only demand a solid foundation of mathematics, basic and social sciences but also integrating hitherto isolated engineering systems. Therefore, Engineers of the future need to be competent in their chosen fields of specialization and are also required to develop synthesizing skills to solve complex engineering design problems. Engineering education in the 21st century emphasizes the institutional ability and agility to adopt emerging technologies. These developments have also transformed the process of accreditation and quality assurance.

This Manual is targeted to provide details for accreditation of an engineering program in Pakistan. It serves to facilitate Engineering Institutions to meet the minimum standard stipulated for the accreditation of their existing engineering programs or newly proposed programs. The Manual emphasizes on elements of program learning outcomes required in the engineering curriculum and to adopt Continual Quality Improvement (CQI) procedures covering Outcome-Based Education (OBE).
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<td>Pakistan Engineering Council</td>
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<tr>
<td>GB</td>
<td>Governing Body</td>
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<td>EAB</td>
<td>Engineering Accreditation Board / Engineering Accreditation and Qualification Equivalence Committee (EA&amp;QEC)</td>
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<td>CQI</td>
<td>Continual Quality Improvement</td>
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<td>PE</td>
<td>Professional Engineer</td>
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<td>ABET</td>
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<td>EMF</td>
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<td>Minimum faculty Strength</td>
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<td>IES</td>
<td>Institution of Engineers Singapore</td>
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<td>DAI</td>
<td>Degree Awarding Institution</td>
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<td>PEO</td>
<td>Program Educational Objectives</td>
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Glossary
CHAPTER – 1

ACCREDITATION POLICY
1.1 Introduction

PEC is a statutory body to regulate the engineering profession including quality of engineering education. EAB is the autonomous entity, working under PEC umbrella, entrusted with the task to perform functions related to accreditation of engineering programs under the relevant provisions of PEC Act 1976 and Bye-laws. This chapter describes the need for accreditation and relevant policy guidelines and provisions of the Act.

Accreditation is a process of quality assurance, through which a program in an approved institution is critically appraised at intervals not exceeding five years to verify that the program meets the norms and standards prescribed by the PEC EAB from time to time. Accreditation provides assurance that the academic aims and learning objectives of the program are pursued and achieved through the resources currently available, and that the institution running the program has demonstrated capabilities to ensure effectiveness of the educational program(s), Continual Quality Improvement (CQI) and following the spirit of Outcome-Based Education (OBE) over the period of accreditation cycle. New institutions planning to offer engineering programs must complete a process of initial assessment by PEC before launching a program and admitting the initial class of students.

A major policy adopted by the PEC EAB is to accord accreditation, not at the institution level, but at the program level for a four-year undergraduate engineering program after 12 years of initial education/schooling. Furthermore, the accreditation status for the programs are decided in terms of Accreditation up to five years, Deferred / Pended up to one year for the removal of deficiencies, and Not Accredited, depending upon the overall expert assessment by the team (nature of observations, deficiencies, concerns etc.) and after rejoinder from a concerned institution.

1.2 Need for Accreditation

a. The overwhelming objective of the accreditation process is to recognize and acknowledge the value-addition in transforming students admitted to the program into capable technical professionals, having sound knowledge of fundamentals and an acceptable level of professional skills and personal competence for ready employability in responsible technical assignments.

b. The need and demand for accreditation of technical educational programs in Pakistan has arisen because of the expansion in the number and variety of such educational institutions and programs. Though education in Engineering and Technology continues to be available only to less than ten percent of eligible students, it is not possible to meaningfully sustain the present growth rate without a parallel exercise in quality assessment of the program(s). Such an exercise will ensure that the institution running the program(s) has the necessary facilities,
equipment and faculty resources for the programs, to deliver technically competent manpower that meets the local employers’ requirements and thereof global job market in the Engineering and Technology sectors.

1.3 Scope and Objectives

i. to assure that the graduates of PEC accredited programs possess sufficient academic background and knowledge for pursuing their professional career in engineering

ii. to assure potential stakeholders and public at large in identifying those specific programs which meet the PEC standards for compliance to accreditation criteria.

iii. to encourage improvement of standards of professional engineering education in the country through implementation of CQI.

iv. to provide guidelines for the upgradation of existing programs and for the development of new programs.

1.4 Provisions of PEC Act for Accreditation

The Preamble of the Act clearly states that “whereas the Council shall regulate the engineering profession with the vision that the engineering profession shall function as a key driving force for achieving rapid and sustainable growth in all national, economic and social fields; whereas the Council shall as its mission set and maintain realistic and internationally relevant standards of professional competence and ethics for engineers, and licensed engineers, and engineering institutions to competently and professionally promote and uphold the standards; and whereas the Council, covering the entire spectrum of engineering disciplines, shall function as an apex body to encourage and promote the pursuit of excellence in engineering profession and to regulate the quality of engineering education and the practice of engineering and thereby promote rapid growth in economic and social fields in Pakistan.”

The jurisdiction/authority to accredit the Engineering Programs of an institution offering any engineering Program and register engineers as such rests solely with the PEC and the relevant provisions of the PEC Act 1976 (amended in 2011) described in Section 2(ii), 8(a), 8(b), 10, 14(1) (2) and 16(1) are reproduced below:

Section 2(ii):
“accredited engineering qualification” means any of the qualification included in the First Schedule or the Second Schedule;”
Section 8(a):
“maintenance of a Register of persons qualified to work as registered engineers, professional engineers, consulting engineers, constructors and operators;”

Section 8(b):
“accreditation of engineering qualifications for the purpose of registration of registered engineers, professional engineers;”

Section 10 (1) & (2):
“10(1) The engineering qualifications granted by engineering institutions in Pakistan which are included in the First Schedule shall be the accredited engineering qualifications for the purposes of this Act.

(2) Any engineering institution in Pakistan which grants an engineering qualification not included in the First Schedule may apply to the Council to have such qualification accredited and the Council may, by notification in the official Gazette, amend the First Schedule so as to include such qualification therein.

Section 14 (1):
“14(1) The Council shall constitute an Accreditation Committee for organizing and carrying out a comprehensive program of accreditation of engineering universities, colleges and institutions etc. according to the criteria approved by the Governing Body in consultation with Higher Education Commission”.

Section 16 (1):
“16(1) The Council shall maintain in the prescribed manner a Register in which shall be entered the names and other particulars of persons possessing accredited engineering and qualifications whose application for registration as registered engineers, professional engineers, consulting engineers, constructors and operators are, from time to time, granted by the Council.”

Furthermore, under Section 27 of the Act, undertaking of “Professional Engineering Work”, without registration with the Council has been made an offence, and subject to penalize due to infringement of a law / regulations.
1.5 Engineering Accreditation Board (EAB) of PEC

The Governing Body of PEC constitutes EAB for a three year term, not exceeding the term of Governing Body, by nominating its Chairman and the some Members from the house having relevant experience and interest. The chairman EAB may coopt additional members from academia and industry in order to make it broad based with balanced representation, ensuring continuity of one-third members from the outgoing EAB.

Chairman EAB guides and monitors the accreditation process, sanctions the approvals for the visitation schedules and composition of teams, resolves any conflicts between the visitation reports and rejoinders of the institutions regarding the accreditation of the programs. He acts as the Chief Executive for all EAB functions at PEC.

Deputy Chairman, EAB may also be appointed to assist the chairman in the accreditation process and acts as a chairman in his absence for a particular meeting/tasks.

The Accreditation Department at PEC Head Office will serve as the Secretariat of the EAB and is facilitated by PEC Branch offices. The EAB shall meet at such time and place and at such frequency as decided by the chairman; however, it shall meet at least three times in a calendar year. To assist EAB in its task, panels of subject experts shall be drawn to constitute the Site Visiting Teams as PEC Program Evaluators (PEC PEVs) for undertaking the evaluation of the programs.

The major functions of EAB are described below:

i. to implement PEC accreditation policy.
ii. to formulate guidelines and procedures for accreditation and the launch of new program.
iii. to evaluate the programs at regular intervals not exceeding five years, with the third-year being the preparatory period for the next accreditation.
iv. to appoint an Evaluation Team to accredit each engineering program.
v. to receive and review evaluation reports by the Evaluation Teams, and to communicate its findings to the institutions concerned for their rejoinder
vi. to decide on whether accreditation should be granted, as well as the conditions to be imposed, if there is such a need.
vii. to publish a directory of all accredited programs (First Schedule) periodically.
viii. to respond to PEC on complaints and appeals regarding the accreditation process / decisions.
ix. to represent PEC in mutual recognition agreements on academic qualifications with other countries and international forums.

x. to report its work periodically to PEC Governing Body.

Institutions are expected to continue to maintain the minimum standards to satisfy the laid down criteria on which accreditation have been initially given to a program. If, at any time, the EAB considers that an accredited program is no longer in conformity with the criteria, the accreditation given may be suspended or withdrawn. The reasons for the same, however, will be communicated to the concerned institution.

1.6 Launching of New Programs

Institutions desirous of starting an engineering program are advised to carefully study the Guidelines for Launching a New Program.

1.6.1 Zero Visit

Institutions should apply for zero visit by providing detailed information to PEC according to the questionnaire for conformance evaluation of the essential requirements of starting a new engineering program as provided in the above referenced document. Zero visit is mandatory and the details / deadlines to submit the application are as per the prevailing EAB policy accessible through PEC website.

1.6.2 Interim Visit

The programs approved by EAB through zero visit, are required to apply for an interim visit at the end of first year of each new program, to ascertain its preparedness for the next phases. The institution has to provide detailed documentation as per the questionnaire for critical analysis along with the progress based on the zero visit report, to ensure quality of engineering program(s). The details / deadlines to submit the application for the interim visit are as per the prevailing EAB policy accessible through PEC website.

1.7 Change-of-Scope Visit

An accredited program would be required to apply for a Change-of-Scope visit under the following circumstances:

i. An increase in the student enrollment
ii. A change in the scope of the program objective / curriculum / nomenclature
iii. Addition of new stream / specialization in the program’s scheme of study

The application for this visit must be submitted at-least 6-months before the date of effectively / implementation of the proposed change.
1.8 Qualifying Requirements

The qualifying requirements are meant to screen out Programs that do not meet the core requirements of the assessment criteria. Failure to meet any one of the qualifying requirements may disqualify the Program from further assessment / process. There are 7 components of the qualifying requirements and each Program is expected to have all the components. These components are:

i. Applicant institution must satisfy the legal status/requirement of the relevant body(ies), specifying the particular legal arrangements as a Charter/DAI institution, Constituent or Affiliated institution, or any other type etc.

ii. A minimum of 128 credit hours of which minimum of 65% credit hours must be from core engineering courses offered over a period of four years (8 semesters).

iii. Final year project (minimum 6 credit hours)

iv. Full-time engineering faculty (minimum of 8), and matching student : faculty ratio of 25:1

v. Progress on / Compliance Report on the last PEC visit observations / EAB decision.

vi. Summary of initiatives to adopt Outcome Based Assessment (Program Learning Objectives and Outcomes)

vii. Duly completed and signed SAR as per described format.

In case of the first accreditation of a new program, the institute should also provide the compliance reports on the Zero / Interim visits.

If the Program has met all the qualifying requirements, a detailed assessment of the Program based on the accreditation criteria as explained in the relevant sections will be carried out.

1.9 Provision for withdrawal

The institutions have the option to withdraw a program during the accreditation process by a written request to the Visiting Team Convener, after being informed of its strengths and weaknesses, but before the Visiting Team holds formal discussion among its members for finalizing the Report. However, the accreditation visit fee will not be refunded.

The purpose of this provision is to enable the institutions to improve the program quality after making the necessary investments and corrections to overcome the indicated weaknesses, rather than be assigned a ‘Not Accredited’ status. The institution can apply again for the accreditation of program(s) being withdrawn together with the prescribed fees.
CHAPTER – 2

ACCREDITATION PROCESS
2.1 Introduction

This chapter highlights the process and procedures pertaining to the program accreditation by PEC. The accreditation process, whether for a first accreditation or re-accreditation, involves a comprehensive assessment which starts with a review of the information submitted in SAR, followed by a detailed on-site accreditation visit by the Evaluation Team appointed by EAB; and preparation of the accreditation report on findings and recommendations by the team.

2.2 Accreditation Decisions

The EAB may decide about the accreditation status of an individual program in one of the following ways:

i. **Accredited for FULL Five years**: Programs meeting or exceeding all accreditation criteria, though with some concerns or minor weaknesses.

ii. **Accredited for less than five years**: Programs meeting all the accreditation criteria, but no severe deficiency though may have some major weaknesses / serious concerns.

iii. **Deferred / Pended up to one year to ensure removal of deficiencies**: In case program has a few severe deficiencies which can be removed within a specified period of time. Re-consideration would require an evidence based compliance report or a confirmatory-visit once the deficiencies are removed.

iv. **Not Accredited**: Programs not ready for accreditation due to non-conformance to one or more criteria or serious deficiencies in major attributes.

2.3 Types of Accreditation Visits

In relation to accreditation of engineering programs following are various types of visits conducted by PEC:

2.3.1 Accreditation Visit

An institution applying for accreditation visit is expected to fulfill all the requirements pertaining to faculty, curriculum, laboratories, library, infrastructure, finances and other allied facilities as per the accreditation guidelines. Program seeking accreditation for the first time is required to ensure submission of SAR to PEC before the commencement of 7th semester, and the accreditation visit during final year. The programs seeking renewal of accreditation status (Re-Accreditation) should apply within last year, but not exceeding six months before the expiry, of the accreditation period granted.
2.3.2 Confirmatory Visit

This visit is necessitated only if required by the EAB as a result of any deferred / pended / conditional accreditation decision, based on the accreditation visit report of the program, to confirm the removal of deficiencies.

2.4 Appeals

In case an institution wishes to appeal for a review of the action on accreditation taken by the EAB, a written application along with the prescribed fee should be sent to the Secretariat within 30 days of the date of notification of the action. On receipt of such an application, and being satisfied about its prima facie case, the Chairman PEC may appoint a special Committee, consisting of a minimum of three members including Vice Chairman PEC as Chairman and two subject specialists who were not initially involved in the visitation, to conduct the appeal review. A meeting of the committee will be convened, wherein the institution and the members of EAB may be invited to present their cases. The committee may also visit the institution, if necessary. The recommendations of this committee will be considered by the Chairman PEC for making final decision; the same will be communicated to EAB.

2.5 Accreditation Process

Program accreditation process is initiated by preliminary scrutiny (through check list) at PEC Secretariat (Accreditation Department) after submission of formal accreditation request (i.e. SAR). Institutions are expected to submit detailed dossier including required information as per Annexure and requisite fee.

Various steps involved in accreditation process are outlined in the flow diagram as illustrated in Figure1. Each step involved has timeline for its activities, the accreditation process generally completes in six to nine months period. Institutions are therefore, advised to submit their application well in advance preferably one year before the expiry of last accreditation term / batch.
Institution Submits (AC-I) Self-assessed

1st Scrutiny/analysis by Accreditation Dept.

Visit planning & Scheduling

Detailing Evaluation Team (by Chairman EAB)

Physical Visit, Major Findings of the Evaluation Team and Sharing with Institution (withdrawal possible)

Submission of Evaluation Team Report to EAB

Institutional Feedback (Rejoinder)

Refer to EAB Decision Meeting

Communicating Decisions to:

University

Appeal (If any)

PEC BOG

SRO / Notification Enlistment in Schedule-I

Final Decision

The process has time line for each activity/process

Figure 1. PEC Accreditation Process Flow Diagram
After taking action on above steps, should a program be successful in obtaining accreditation, the entire process will be repeated at the expiry of the specified accreditation period. The maximum period of accreditation shall be 5 years. However, if accreditation is pended due to deficiencies identified, the institution is required to provide a compliance report to PEC within given time highlighting the corrective measures taken along with the evidence. This may be followed by a confirmatory visit.

2.6 Activities in the Normal Accreditation Visit

2.6.1 Composition of PEC Evaluation Team

The Visiting Team consists of a Convener, two PEVs, and a member from PEC staff to provide secretarial support. The Visiting Team includes senior academicians/ engineers having no conflict of interest with the institution to be visited, and who are selected on the basis of their high standing in the profession, ability to assess curricula, competence in appraisal based on overall objectives and performance towards the achievements of set goals. The PEVs from academia will have an earned doctorate and minimum of five years of teaching, research and practical experience. Representative from industry possessing minimum Master’s qualification and considerable professional experience may be included as a PEV. PEVs are selected based on relevant qualification, professional experience and accreditation training. PEC secretariat will maintain an updated list of qualified PEVs pertaining to all engineering disciplines. PEC shall arrange and conduct accreditation training workshops for potential PEVs.

Upon finalization of evaluation team, institution may request for certain designated PEVs to be excluded from the team in case of any conflict of interest by submitting a justified reason in writing to PEC within a week after receiving the schedule of visiting team. In case of valid reason(s), Convener / Chairman EAB will replace the designated evaluation team member(s).

2.6.2 The Convener

The Convener of the Visiting Team has the overall responsibility for the accreditation visit. The Convener assigns duties to each team member keeping in view the overall perspective. He should be familiar with the accreditation process and gather in advance the earlier reports, if any. He has the responsibility for the preparation of the consolidated team report and its timely submission, for the consideration of the EAB. The Convener of the visiting team may preferably be a member of the EAB.

One of the senior members of the Visiting Team will be appointed to take on the role of the Convener, if the Convener is unable to undertake the visit for unforeseen circumstances.
2.6.3 Program Evaluators

The program evaluators (PEVs) are responsible for the evaluation of an individual program. Usually there are two PEVs (preferably one from industry) for each program. The member from an industry or user organization can be included only in the final visit during 3rd or 4th year of the program. The latter can sometimes serve as an expert for more than one program depending on his competence and abilities. However, in case two programs with substantial similarity in course contents are being offered within a Department, a single set of two/three PEVs may be chosen for both the programs. For programs in emerging or inter-disciplinary areas, more PEVs can be included in the team according to need.

The duties of the PEVs include evaluation with reference to the criteria given earlier, through physical verification of infrastructure/ facilities, records, interviews with administrators, faculty, alumni, students / stakeholders and other activities, which they find necessary for the total performance appraisal. The PEVs are also required to mention strengths and weaknesses against each criterion in the worksheet.

The PEVs deputed for accreditation purposes should be senior professionals having enough requisite teaching / research experience. Availability of these PEVs may be sought well in advance and the candidate institution will be informed about the composition of the visiting team. The candidate institution may object to the assignment of a PEV provided it submits proof of any verifiable conflict of interest with the assigned PEVs.

In case a PEV is unable to undertake the visit due to circumstances beyond his/ her control, the Convener of the team will nominate another PEV in consultation with PEC, keeping in view the guidelines for selection of PEVs.

2.6.4 PEC Staff Member

The member is responsible to provide all secretarial facilities, coordinate between visiting team members and the institute, and ensure availability of relevant information. PEC representative shall give detailed briefing about the visit, institutional data and previous accreditation visit report(s) to the convener. PEC representative will also ensure compilation of visit report on the last day of visit for submission to the EAB. They will also help to provide necessary policy level updates to the visitation team when and where required.

2.6.5 Activities during the Visit

Normally, the visiting team requires two days to complete the evaluation of a program. However, for multiple programs, the visit may be scheduled for three days. In this case the visit will be planned to hold respective presentations in a combined session followed by visit to common facilities during the first day. All relevant
documents and information should be made available and displayed in the exhibit room for scrutiny and analysis. Qualitative facts such as professional attitude, commitment to academics and R&D activities, conduciveness of environment, and morale of the faculty and students should also be taken into consideration while evaluating the program.

Following activities are expected to be completed during the visit:

a. Meeting with senior administration of the institution;

b. Discussion with program as well as shared faculty from supporting departments to assess the program strength and its conduct;

c. Interaction meetings with students, alumni and other stakeholders including employers for obtaining their feedback;

d. Meeting with services and administrative officials of the institute in connection with provision of support regarding finance, infrastructure, examination, admission & registration etc.;

e. Review and analysis of all the documents furnished by the department / institution;

f. Visits to laboratories, library, computing facilities, auditorium, sports facilities, hostels, faculty offices, classrooms, career placement office, medical and such other facilities.

g. A concluding meeting with senior management of the program and institution to share observations of the visiting team.

2.6.6 Schedule of the Visiting Teams

The following is a normal schedule of the visiting team. Members are encouraged to have pre and post visit meetings among themselves in connection with evaluation of the program. First review meeting (pre-visit), preferably in the evening before the first day of evaluation, should be held for discussion and exchange of views on provided information, considering past observations and progress made so far.

The institution shall arrange an exhibit-room for displaying the following documents:

i. Samples of minutes of meetings; policy documents; faculty CVs; syllabi; research publications; project reports.
ii. Details pertaining to faculty members to verify their requisite qualifications and to ensure their continuity and effectiveness for teaching, learning & research pursuits.

iii. Program curriculum, evidence of regular review and consistency with PEC / HEC guidelines and adoption of Outcome Based Education (OBE) system.

iv. Course files for the subjects offered in the program.

v. Evidence for continuous assessment and improvement of the program and implementation plan.

vi. Random check of students’ work, question papers and answer sheets and student attendance record.

vii. Annual budgets for the period under review.

viii. Details of laboratories with equipment, its supporting staff and lab manuals.

ix. Measures taken for provision of general safety, health and environment.

x. Availability of training aids for imparting quality education.

xi. Mapping of Program Educational Objectives / Course Learning Outcomes (PEOs/CLOs) with Program Outcomes.

xii. Other additional document(s) required in support of the program.

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**Day One**

i. Opening meeting with senior administration of the institution;

ii. Presentation by the Head of the Department of program being evaluated and ensuing discussion;

iii. Assessment and analysis of documents displayed in the exhibit room;

iv. Visit of program laboratories and allied facilities;

v. Interaction with students;

vi. Visit to supporting and interdisciplinary departments and discussion with supporting staff;

vii. Visit to allied facilities such as library, computing, internet, medical, sports, hostels etc.;

viii. Discussion with alumni, employers and other stakeholders;

ix. Meeting with the faculty members;

x. Second review meeting of team members regarding assessment of the program.

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**Day Two**

xi. The evaluation team may request for any additional information / data or facts for clarifications to resolve issues or queries;

xii. Third review meeting of team members on overall assessment of
the program;

xiii. Sharing observations (strong and weak areas of the program) with the higher management of HEI;

xiv. Final meeting (post-visit) of the team members for compilation of draft visit report;

xv. Submission of final visit report to EAB.

2.6.7 Accreditation Fee Structure

Fee for various types of accreditation visit (i.e. Accreditation, Re-Accreditation, Confirmatory/Compliance, Zero, Interim, Change of Scope, and Appeal cases) shall be as prescribed by PEC EAB/EAQEC from time to time approved by competent authority of the Council.

Note: Please refer to PEC Secretariat / website (www.pec.org.pk) for the current fee structure / policy for various types of assessment visits.
CHAPTER – 3

CRITERIA FOR ACCREDITATION
3.1 Introduction

An engineering program shall be assessed by EAB to enable graduates of the program to register as graduate engineers with the PEC. As indicated in earlier paragraphs, the evaluation process is based on a set of broad-based criteria developed through a lengthy participatory process concerned with engineering education all over Pakistan and is compatible with international engineering standards. Each criterion serves to assess a principal feature of the institutional activities and program’s effectiveness as per its educational objectives. Hence, each of them is described in terms of quality attributes, amenable to a substantially objective and qualitative assessment.

The assessment involves a review of qualifying requirements (Sec. 1.7) and evaluation of an engineering program’s conformance to the following criteria.

Criterion 1 - Program Educational Objectives (PEOs)
Criterion 2 - Program Learning Outcomes (PLOs)
Criterion 3 - Curriculum and Learning Process
Criterion 4 - Students
Criterion 5 - Faculty and Support Staff
Criterion 6 - Facilities and Infrastructure
Criterion 7 - Institutional Support and Financial Resources
Criterion 8 - Continuous Quality Improvement
Criterion 9 - Industry Linkages

3.2 Accreditation Criteria

One of the objectives of PEC is to encourage the institutions to continually strive for the attainment of excellence. The EAB evaluation processes are designed to facilitate identification of strengths and weaknesses of the programs seeking accreditation.

Institutions seeking accreditation of their programs are expected to satisfy each criterion. They are required to adhere to these criteria during the validity period of accreditation granted. They are also encouraged to periodically review the strengths and weaknesses of their programs and strive for their continuous improvement.

3.2.1 Criterion 1 - Program Educational Objectives (PEOs)

The institution applying for accreditation should have a mission statement and a set of goals. The program offered by the institution should also have well defined objectives. Program educational objectives (PEO) are broad statements that
describe what graduates are expected to achieve a few years after graduation. It should be ensured that the program mission and objectives are aligned with the vision of the institution. Program mission and objectives should be articulated and made known to everyone in the institution through institutional publications and websites.

The successful pursuit and realization of the mission and objectives, and the means adopted to accomplish them bring out the quality of the institution and its programs. Program educational objectives are based on the needs of the program’s constituencies and are linked to student outcomes and learning assessment process.

The objectives should be clear, concise, realistic and measurable within the context of the committed resources. A process should be developed to assess the level of attainment of the program objectives to evaluate effectiveness of the academic programs. It should include feedback from faculty, employers, alumni and other stakeholders. The evaluation results should be utilized for redefining/improving the program objectives.

The program seeking accreditation must demonstrate that following are in place:

a) Well-defined and published Program Mission
b) Program’s educational objectives defined and consistent with the mission
c) Program’s educational objectives based on the stakeholder’s needs
d) A process in place to evaluate the attainment of educational objectives
e) Demonstration of levels to which these objectives are attained
f) Evaluation results used for continual improvement of the program
g) Evidence of stakeholder’s involvement in the review and realignment of educational objectives

Note: Since the graduates of a program, which is being accredited for the first time, or the one which is in the initial phases of its accreditation (e.g. whose only one/two batches have graduated so far) the data related to the level of attainment of the program objectives is not required.

3.2.2 Criterion 2 - Program Learning Outcomes (PLOs)

Program outcomes are the narrower statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the knowledge, skills and attitude that the students acquire while progressing through the program.

The program must demonstrate that by the time of graduation the students have attained a certain set of knowledge, skills and behavioral traits, at-least to some
acceptable minimum level. Specifically, it is to be demonstrated that the students have acquired the following graduate attributes:

(i) **Engineering Knowledge**: An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

(ii) **Problem Analysis**: An ability to identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

(iii) **Design/Development of Solutions**: An ability to design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

(iv) **Investigation**: An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis, and interpretation of experimental data, and synthesis of information to derive valid conclusions.

(v) **Modern Tool Usage**: An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an understanding of the limitations.

(vi) **The Engineer and Society**: An ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solution to complex engineering problems.

(vii) **Environment and Sustainability**: An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

(viii) **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

(ix) **Individual and Team Work**: An ability to work effectively, as an individual or in a team, on multifaceted and/or multidisciplinary settings.
(x) **Communication:** An ability to communicate effectively, orally as well as in writing, on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

(xi) **Project Management:** An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.

(xii) **Lifelong Learning:** An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments.

In addition to incorporating the graduate attributes (i) to (xii) listed above as the program learning outcomes, the educational institution may also include any additional outcomes if adopted.

The range of complex problem solving and complex engineering activities is given in the tables *Definition of Complex Problem Solving* and *Definition of Complex Engineering Activities* given in Annex.

Specific details relating to the processes adopted for assessing, evaluating and reviewing the program outcomes should be provided. The institution can also present the internal quality assessment cycle adopted by its Quality Enhancement Cell (QEC).

In particular, the program must demonstrate the following:

- a) Well-defined and published Program Outcomes
- b) Program Outcomes linked to the Program Objectives
- c) Program Outcomes encompass desired outcomes listed above
- d) Mapping of Program Outcomes to Course Learning Outcomes (CLOs)
- e) Teaching-learning and assessment methods appropriate and supportive to the attainment of Course Learning Outcomes
- f) Quality of assessment mechanism to evaluate achievement levels for all the Program Outcomes by each student
- g) Process in place by which assessment results are applied to further refine the assessment mechanism and/or redefine the program / course outcomes, thus leading to continuous improvement of the program
3.2.3 Criterion 3 – Curriculum and Learning Process

The genesis of any engineering program is the fusion of its stakeholders’ perceptions. The academic curriculum of the program should be designed to facilitate / ensure the achievement of program outcomes by all students. This is achieved by offering a balanced combination of technical and non-technical contents coupled with appropriate assessment and evaluation methods. It should have a well-defined core of essential subjects which should be supported by requisite compulsory as well as elective courses. It should also invoke awareness and comprehension of societal problems amongst the students and should motivate them to seek solutions for improving the quality of life. The theory content of the curriculum has to be supplemented with appropriate experimentation in laboratories.

The institution should ensure incorporating the inputs from all stakeholders, especially from the industry, in developing curriculum contents so as to keep the curriculum aligned with the program objectives and outcomes. The program structure should cover the essential fundamental principles at the initial stages, leading to integrated studies in the final year of the program, in consonance with the approach and levels defined in Bloom’s taxonomy.

Comprehensive pursuance of a curriculum necessitates that all of its related activities should be allocated time intervals as per a well-defined reference. In semester system of education, this reference is “Credit-Hour”. One credit hour is defined as:

(1) One contact hour per week for theory classes (it does not take into account any independent study time)
(2) Three contiguous contact hours per week of supervised lab work
(3) Three hours per week related to final year project, including meeting with the supervisor.

The program should be offered as a 4-year, 8-semester program. Minimum Fifteen (15) weeks of teaching, excluding time of examination(s), in a regular Fall / Spring semester is mandatory. However, for the optional Summer semester, minimum eight (8) weeks of teaching should be ensured.

The hallmark of a curriculum is to infuse original thinking, resourcefulness and entrepreneurial spirits among students. Each program should embody foundation courses as well as the general and specialized professional content of adequate breadth and depth, and should also include appropriate Humanities and Science components. The core of the program should concentrate on acquisition of knowledge and skills in the specific discipline and also ensure exposure to inter-disciplinary areas. There should also be an effective relationship between the curricular content and practice in the field of specialization. In addition, the graduates should demonstrate competence in oral communication, scientific & quantitative reasoning, critical analysis, system design, logical thinking, creativity and capacity for
life-long learning. The general framework pertaining to the knowledge profile for all engineering programs are defined, periodically reviewed and publicized by National Curriculum Review Committees (NCRC) of Higher Education Commission (HEC) in consultation with PEC. The contents of each constituent courses of the curriculum should be updated to absorb recent technological and knowledge developments. Evidence to this effect should be presented at the time of accreditation.

The delivery of subject matter and the assessment process employed should enable the students to develop intellectual and practical skills effectively, as deemed essential in program outcomes. Assessment of various learning outcomes should be carried out by employing direct / indirect methods appropriate for that outcome. Complex outcomes which are not easily quantifiable, e.g. communication skills (oral / written), critical thinking, etc. often require rubrics for their assessment. The assessment methods employed should be well understood by the students and the teaching / learning process should motivate them to develop a quest for life-long learning.

The academic calendar, number of instructional days, quality of faculty, contact hours per week, design and delivery of syllabi, student evaluation and feedback are the important aspects in reviewing the effectiveness of teaching-learning processes.

In addition to regular teaching / learning activities such as classroom interaction, lab experimentation and faculty consultation, other aspects of student learning such as tutorial system, research / design projects, seminar / workshops and exposure to industrial practice should form an integral part of curriculum. Internal reviews of quality assurance procedures should be carried out periodically.

An engineering program should also demonstrate the following essentials:

3.2.3.1 Internship Program

The program should facilitate and promote cooperative learning through supervised internship program of continuous 4-6 weeks duration in an engineering practice environment / organization. The training program should have been planned and agreed to between the institution and the host organization. The institution should receive report about each trainee indicating the training details, interest shown by the student; his/her work habits and punctuality.

3.2.3.2 Lab Work

The teaching / learning in each core engineering subject must be supported with sufficient practical work in the labs. For this purpose, lab manual containing all experiments for each course must be maintained. The labs should be well-equipped with the requisite equipment / machines such as basic components, modules, measuring instruments, etc. The students should be encouraged to develop practical skills. Also, they should be motivated to come up with their own design ideas and
demonstrate the ability to investigate, analyze and solve complex engineering problems.

3.2.3.3 Design Projects

In order to hone the practical skills and giving spark to their imagination, the students of an engineering program must be encouraged to undertake design projects as an integral part of every core subject. Such design projects should inculcate intuitiveness, resourcefulness and the spirit to compete. The students should also be motivated to participate in competitions which assign a theme and require the participants to use their ingenuity, creativity and innovation.

3.2.3.4 Final Year Project

A final year project is the confluence of an engineering program. Undertaking a final year project is a compulsory requirement. It should mainly comprise literature search, individual analysis, design and putting together various hardware, software and firmware modules to demonstrate a functional concept.

Design projects shall include complex engineering problems and design systems, components or processes integrating core areas and meeting specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. A project of this nature should invariably lead to an integration of the knowledge and practical skills as mandated in the program outcomes. In this context, project of interdisciplinary nature should be encouraged. The final-year project should span over two consecutive semesters, i.e. semester 7 & 8, totaling 6-credit hours.

3.2.3.5 Assessment of Learning Outcomes

The program must ensure that each student has achieved all PLOs to acceptable level through assessment of CLOs. The appropriateness of the assessment methods along with the level of achievement against the targeted outcomes must be evaluated. Mapping of program outcomes to individual courses, nature of assessment tools (direct/ indirect/rubrics) and the process of evaluation to determine the attainment of PLOs should be demonstrated through reasonably convincing evidences.

3.2.4 Criterion 4 - Students

The quality of students admitted and their academic progression are important considerations in evaluating the success of a program in achieving its set objectives and outcomes. The institute must frame and enforce policies for admitting fresh as well as transfer students into the program.

The institute should devise mechanisms to guide students regarding academic and career matters. Policies should be made and implemented to maintain a manageable teaching load in all semesters. The institute must provide conducive teaching-
learning environment, and also monitor / evaluate students’ progression towards achieving program outcomes and objectives. The monitoring / evaluation processes should be adequate to ensure fulfillment of program requirements up to the required level of quality and standard by all the graduating students.

In order to inculcate ethical practices and inter-personal skills in program graduates, the institute should provide ample opportunities / facilities for extra- and co-curricular activities. Provision of in-door and out-door sports facilities for physical fitness and mental endurance should be ensured. The necessary administrative and financial support should be provided for establishing student clubs, societies, and chapters for various co-curricular activities. These activities are meant to transform the students / graduates into proficient engineers.

### 3.2.4.1 Admission Criteria

The entry requirement to the program shall be assessed to ensure that the students accepted are at the minimum qualifications required for training and education as an engineer. It is to be ascertained whether the students being admitted in the program qualify the minimum eligibility criteria prescribed by PEC for various programs (PEC’s Regulations for Engineering Education in Pakistan), and whether the merit is strictly being followed.

PEC has set the following minimum requirements for admission into any engineering program

- 60% marks in F.Sc (Pre-Engineering) / Equivalent Qualification
- Qualifying the Entry Test

Institutions are expected to have well laid-out and transparent procedure to compute overall merit for admission into an engineering program. Equivalence of the Examination passed by the candidate shall be determined by Inter Board Chairman’s Committee (IBCC) and eligibility by the concerned HEI.

### 3.2.4.2 Annual Intake

This aspect pertains to the number of students admitted considering the capacity of the program and its allied facilities through an assessment process. The program intake should be in-line with the maximum intake allowed by EAB (Sec. 1.7).

### 3.2.4.3 Admission Response

This aspect pertains to the number of applicants applying for admission into the program, and the ratio of the number of applicants offered admission and the number of students who finally joined the program.

### 3.2.4.4 Transfer Students

The institute shall develop a clear, documented and well publicized policy on transfer of students from other institutions. The policy shall take into account evaluation of
credit equivalence for the subjects studied in an accredited program of an institution and should be based on justifiable grounds. Not more than a maximum of 50% of the total credit hours required for the degree program should be transferred. All such cases of student transfer should be intimated to PEC for information and record at the time of acceptance by the institution.

3.2.4.5 Academic Counseling

This aspect pertains to the guidance available to students from teachers through dedicated office-hours beyond scheduled time-table. The office hours must be publicized by the instructors by posting them on the office doors/notice-boards. Tutorials, problem-solving and/or help sessions, when planned, should be scheduled and made a part of the time-table. RAs and TAs / GAs engaged to provide extra coaching and/or subject assistance, especially when assisting the main instructor with a larger class-size, should also maintain specific designated hours for off-class assistance/counseling. Individual student’s academic progress should be monitored and corrective measures taken on regular basis through well-defined mechanism.

3.2.4.6 Career and Student Wellness Counseling

In addition to the course specific guidance, the institute should have designated student counselors who would advise and counsel students regarding academic as well as career matters. A formal orientation session for the newly admitted students to apprise them about the salient requirements and policies/procedures of the program is highly desired. The student wellness counselor(s) should also provide assistance to students in managing their health, financial, stress, emotional and spiritual problems.

3.2.4.7 Class Size (Theory)

This aspect pertains to the number of students per section for the theory classes. For engineering subjects, average class size should be limited to 40-50 students per section. Where the main subject instructor is an experienced PhD faculty, and is being duly assisted by appropriate number of GAs/TAs/RAs for conducting scheduled Tutorials/Help-Sessions and/or with advertised office-hours for off-class guidance of the students, a bigger class size may be justified. For non-engineering subjects, a bigger class size of 70-80 students may be allowed.

3.2.4.8 Class Size (Practical)

For laboratory sessions, the number of students conducting experiments in the laboratory at one time should be such to ensure sufficient practical exposure and proper guidance / supervision by the Lab. Engineers. For hands-on type experiments, the number of students per workstation should be limited to 2-3 per workstation; whereas for labs which are demonstrative in nature, relatively larger number of students per workstation may be considered reasonable. Adequate number of Lab. Engineers and associated staff should be available for effective guidance and help to students during their practical sessions.
3.2.4.9 Semester Academic Load

This aspect pertains to the number of credit-hours taken by students in each semester, and the appropriateness of each subject’s workload in consideration of its credit-hours. Students should not be over-burdened with workload that may be beyond their ability to cope with, or may hamper their assimilation of the subject matter and optimal performance. Academic load in a semester should preferably be in the range of 15 ~18 Cr Hrs as prescribed by PEC/HEC.

3.2.4.10 Completion of Courses and Student Feedback

This aspect pertains to the completion of subject contents as published in the official program catalog and/or website. All the subject topics as well as the practical experiments meant to be covered for the particular course must be completed during the prescribed time. The information should be gathered from the official record, e.g. course-file as well as through feedback and interaction with students.

3.2.4.11 Participation in Competitions

Students’ participation in national / international engineering exhibitions and / or competitions not only provides an opportunity to display their projects, exchange ideas and compete with teams from other institutions. It helps to broaden their horizon and provides a platform to the program faculty and administrators to benchmark their program. Winning positions / prizes in such competitions serves to highlight the strong area of the program and builds confidence in the students. Thus, the program should encourage and facilitate participation in such competitions / exhibitions.

3.2.4.12 Student Performance Evaluation

This aspect pertains to the various mechanisms being used for evaluating students’ performance in the program courses, and their suitability and affectivity for assessment of the level of achievement of course learning outcomes. This may include a review of various class assignments, quizzes, research reports, examinations as well as lab projects and viva-voice. The number and variety of such assessment tools and their coverage of subject topics in a manner which ensures a reasonably accurate assessment of students’ level of achievement against various learning outcomes is the key to monitor students’ progress in a direct manner. It is expected that the program should demonstrate a minimum number of such class assignments, quizzes and examinations for assessment of PLOs.

3.2.5 Criterion 5 – Faculty and Support Staff

The faculty strength, qualifications, level of competencies, commitment and attitude play a vital role in the accomplishment of program objectives and outcomes. This in turn, depends upon the recruitment process, incentives, faculty development programs and workload of the faculty.
The program must have sufficient number of dedicated full-time faculty members to ensure adequate level of student-teacher interaction, and to provide necessary counseling to students. A viable engineering program is expected to comply with PEC’s criteria for the minimum number of dedicated program faculty members (Sec. 1.7). Each engineering program should strive for establishing itself independently; for this reason, faculty sharing with other engineering departments should be practiced essentially for the required inter-disciplinary courses. For the same reason, visiting faculty from other academic institutions and/or industry should only be engaged occasionally and that too for teaching specialized / advanced courses. However, the number of such visiting faculty members should be kept to a minimum.

The program faculty must have appropriate qualifications and competencies to cover all areas of the curriculum. The qualifications of the faculty are generally gauged by the advanced degrees held by them, practical experiences and their scholarship and research. It is expected that all teaching faculty shall have postgraduate qualifications, as per the criteria of eligibility set in PEC Regulation for Engineering Education. A teaching staff with BS level education but having vast industrial experience and proven specialized expertise may be considered as an exception.

The faculty is expected to act not only as instructors and researchers but also as student advisors, faculty mentors, academic planners, curriculum developers, internal auditors; and also occasionally assist in institutional administration. The faculty must demonstrate complete familiarity with Outcome-Based Educational (OBE) approach. They are expected to have the ability/authority required to ensure proper conduct of the program, and to develop/implement processes for evaluation, assessment and Continuous Quality Improvement (CQI) of the program. Their familiarity with the program objectives and outcomes, understanding of the outcome-based assessment cycle, and enthusiasm for developing more effective program are the key elements to ensure attainment of program objectives.

Employment and retention of qualified faculty and supporting staff is an indication of managements’ commitment and seriousness towards institute’s mission and program objective. Adequate employment security coupled with salaries and benefits commensurate with position, and periodic evaluation for vertical mobility should be ensured and made known. The institute should implement an effective mechanism for mentoring and academic/professional development of the faculty to ensure their continuity and retention. In addition, some sort of performance appraisal mechanism should also be in place to monitor the continued effectiveness of the faculty and their adherence to program’s objective and outcomes.

The institute should encourage faculty for establishing linkages with industry for bringing in sponsored research projects and securing research grants from sponsoring agencies. Faculty workload should be such that it should not hinder their effective performance in both teaching and research.
Besides being adequate in number and qualifications, the faculty members should possess hands-on experience, communication skills, attitude and commitment to program’s objectives. There shall also be sufficient, qualified and experienced technical and administrative staff to provide support to meet the program objectives.

5.1 Faculty Strength

This aspect pertains to the faculty employed for the program. Faculty members employed on full-time basis and dedicated to the program are considered as Full-Time Dedicated Faculty members. Full-Time Faculty also means that the faculty member has served the program for a minimum of one semester.

Faculty members who are serving in the same institute as full-time regular faculty dedicated to some other program, and are being used to teach subjects related to their disciplines in the under-review program, are termed as Shared Faculty.

A program may occasionally invite qualified and experienced engineering professionals from industry as well as other academic institutions to impart state-of-the-art knowledge and applied skills/techniques to the program students. Such professionals are called Visiting Faculty members (attached as AnnexD - “Faculty Strength” and Annex E - “Faculty Summary”)

5.2 Full-Time Dedicated Faculty

This aspect pertains to the full-time program faculty members teaching core engineering subjects. The absolute minimum number of such faculty members for a program is given in Sec 1.7; however, the actual minimum number (MFS) of such faculty members required for the program is based on the number of sections (considering 35-40 students/section) admitted per year in the program, and is estimated as follows:

For each section admitted per year, there should be at-least 4 engineer faculty members holding post-graduate Engineering Qualifications (i.e. MS or PhD) and actively engaged in teaching core subjects. Active engagement in the program requires that the faculty member must be engaged in delivering the program curriculum (not being shared with other disciplines/department) and must have taught at-least 2 course-sections per year to the program’s degree students. The request for evaluation / accreditation of the program would not be entertained by PEC unless the program fulfills this minimum faculty requirement.

This minimum faculty requirement sets the bare minimum; however, the management should ensure that actual Full-Time Dedicated Faculty (FTDF) members be sufficient in number to ensure adequate level of student-teacher interaction, and to provide necessary student advising/counseling. To achieve this objective, the prescribed student-teacher ratio is 25:1 (maximum).
For this purpose, non-engineer faculty members having PhD in the relevant disciplines may also be employed to a maximum of 20% of MFS (which may be varied by EAB for each discipline). These non-engineering faculty members should; however, be engaged to teach only those subjects which are relevant to their areas of research and specialization.

In addition to the core teaching faculty, which must hold post-graduate qualifications, the institute/program is encouraged to employ Full-Time academic support staff, in the form of Teaching Assistants (TAs), Graduate Assistants (GAs), and/or Research Associates (RAs) to provide academic support/facilitation to students in the form of extra coaching for theory as well as Research/Lab. projects, and holding subject tutorials and/or problem-solving sessions. These TAs/GAs/RAs must be graduate engineers holding BS Engineering degrees. For the purpose of computing student-teacher ratio, these TAs/GAs/RAs would be counted as being equivalent to One-Half, up-to a maximum of 20% of FTDF.

Giving due consideration to the natural mobility of faculty members for various reasons, such as pursuing higher qualifications, availing Post-Doctoral research opportunities and/or seeking better career options, a faculty member who has contributed to teaching for more than a semester and whose timely replacement is made in the relevant field should also be considered in counting towards student-teacher ratio, up-to a maximum of 20% of FTDF.

Program faculty which is being shared with other disciplines/departments would be counted as One-Half while computing student-teacher ratio.

5.3 Shared Faculty

This aspect pertains to those faculty members who are serving in the same institution as a full-time faculty dedicated to some other programs and are being used to teach subjects related to their disciplines in the under-review program. This would include faculty from other engineering disciplines as well as faculty from departments of Mathematics, Humanities, and Physical and Management Sciences, etc. Shared faculty members engaged for the program must have post-graduate qualifications. For the purpose of computing student-teacher ratio, shared faculty members would be computed as One-Half, up-to a maximum of 25% of FTDF.

5.4 Visiting Faculty

A program may occasionally invite qualified and experienced engineering professionals from industry as well as other academic institutions to impart state-of-the-art knowledge and applied skills/techniques to the program students. However, each engineering program should strive for establishing itself independently; for this reason, the number of such visiting faculty members should be kept to a minimum and that too for teaching only specialized/advanced-level courses. This number
should not exceed 20% of FTDF, further, these visiting faculty members are not counted towards computation of student-teacher ratio.

5.5 Faculty Qualifications

This aspect pertains to the HEC/PEC recognized degrees held by the program faculty. The program faculty must have appropriate qualifications and competencies to cover all areas of the curriculum. The qualifications of the faculty are generally gauged by the advanced degrees held by them, practical experiences and their scholarship and research. It is expected that all teaching faculty must have postgraduate qualifications. A teaching staff with an engineering accredited degree but having vast industrial/field experience and proven specialized expertise may be considered as an exception.

5.6 Student-Teacher Ratio

This aspect pertains to student-teacher ratio (20:1) generally prescribed as the best practice for the undergraduate programs. The actual number of required faculty will be worked out on this basis. For computing student-teacher ratio, total number of students will be taken as 4-times the number of admission seats per year. In addition to FTDF, TAs/RAs/Gas and shared faculty from other departments/disciplines would be counted as half.

5.7 Faculty Training and Mentoring

This aspect pertains to the training and mentoring of the faculty members for making them more effective in their role as instructors, student advisors, academic planners, and curriculum developers. Senior faculty is expected to undertake the responsibility to guide and help in providing mentoring support on regular basis. Not only there should be a systematic plan of activities for the training of newly inducted/young faculty members, the institute/program should also devise a strategy to conduct workshops/seminars as a refresher for the existing program faculty.

The faculty must be trained with Outcome-Based Education (OBE) system. Their familiarity with the program objectives and outcomes, understanding of the Outcome-Based Assessment (OBA) cycle, enthusiasm for developing more effective program, and the ability to become an active player in this regard are the keys to ensure the attainment of program objectives. They are expected to have the ability to ensure proper implementation of the program, and to develop processes for evaluation, assessment and CQI.

Following are some of the key points that should be covered during various phases of training.

- Teacher's training program
- Program objectives and outcomes
- Outcome-based assessment cycle and its implementation
• General aspects of lectures delivery
• Modes and means of effective student-teacher interaction
• Using quizzes/assignments/exams/projects/viva as effective assessment tools
• Evaluation of assessment results to gauge level of attainment of CLOs
• Preparing and maintaining course files

5.8 Faculty Retention, Development and Career Planning

Employment and retention of qualified faculty is an indication of managements’ commitment and seriousness towards institute’s mission and program objective. Faculty strength, qualifications, level of competencies, commitment and attitude play a vital role in the accomplishment of program objectives and outcomes.

To inculcate a sense of professional satisfaction and commitment to the program among faculty members, adequate employment security coupled with salaries and benefits commensurate with position, and periodic evaluation for vertical mobility should be ensured and made known to the faculty.

The institute should implement an effective planning for academic/professional development of the faculty to ensure their continuity and retention; in addition, some sort of performance appraisal mechanism should also be in place to monitor the continued effectiveness of the faculty and their adherence to program’s objective and outcomes. Institute should have adequate provisions for scholarships leading to PhD, training and sabbatical leave for Post-doc research to promote professional growth and development. Workload for young faculty enrolled in postgraduate programs should be reduced to compensate their pursuits in their research program.

5.9 Pyramid of Academic Structure

This aspect pertains to the number of faculty members on various professional ranks (i.e. Professors, Associate Professors, Assistant Professors and Lecturers) within the program. The institutions are encouraged to determine the number of faculty members on various ranks without a bar on the ratio among different ranks to encourage promotion to deserving candidates. The faculty pyramid provided by HEC should be treated as a guideline specifying the bare minimum number of higher rank positions. The adherence to this bare minimum, however, must be ensured on the least. While observing the mentioned pyramid, the program head of an engineering program should possess a PhD degree in relevant discipline coupled with required experience to lead an engineering program.

5.10 Faculty Workload

This aspect pertains to the extent and nature of workload assigned to faculty members. Faculty workload should be such that it should not hinder in their effective performance in teaching and research. The faculty workload should be as per the HEC guidelines, with an average not to exceed 9-12 hours per week (attach as Annex-F – “Faculty Loading”).
5.11 Faculty Research & Publications

The institute should foster research activities among its faculty members, by supporting participation in national/international conferences, workshops, etc. Faculty members, especially those holding PhDs degrees, should contribute actively in research, and are expected to publish 1-2 research papers each year in reputed national and international ISI indexed journals.

The institute should make provisions in the budget for allocations to participate and organize workshops, conferences, colloquia, etc. Policies for sabbatical leaves and short/summer leaves for the faculty to take-up post-doctoral research assignments at other national / international institutions / organizations should also be made.

The institute should encourage faculty members for establishing linkages with industry to provide consultancy, design services and to provide solutions to their developmental issues. Interaction with industry and sponsoring national/international agencies to attract R&D funding is one of the important factors indicating the dynamism of the program as well as its faculty members. The efforts of faculty members, who secure R&D funds from industry/donors, should be acknowledged in the form of reduced workload and/or financial incentives.

3.2.6 Criterion 6 – Facilities and Infrastructure

The candidate institution shall ensure availability of needed infrastructure, not limited to the availability of land, buildings, equipment, library, laboratories, workshops, computing facilities, seminar hall, auditorium, playgrounds, hostels, recreational and healthcare facilities, etc. In addition, cafeteria, transport, consulting and career placement services should be provided as per requirement for the program. The intention is to make the institution fully aware of present and future needs of the program.. An evidence of strong financial commitment and availability of the needed finances for the project has to be ensured.

Similarly the classrooms, offices, laboratories, and associated equipment must be adequate to provide conducive atmosphere to attain PLOs. Modern tools, equipment, computing resources, and laboratories appropriate to the program must be available and accessible to faculty and students, and should be systematically maintained and upgraded.

Following documentary evidences should be furnished with clear description in self-assessment report by candidate institution for the accreditation / re-accreditation of engineering program(s).

i. The adequacy of teaching and learning facilities such as classrooms, learning-support facilities, study areas, information resources (library),
computing and information-technology systems, laboratories, workshops, and associated equipment to cater for multi-delivery modes.

ii. Describe the adequacy of support facilities such as hostels, sports and recreational centers, healthcare centers, student centers, and transport in facilitating students’ life on campus and enhancing character building.

The information required in items i. and ii. should be provided in the supporting documents but is not limited to the following:

- Master plan of physical facilities.
- A summary, in tabulated form, of the lecture hall facilities (give number, capacity, and audio video facilities available).
- Details of the Program laboratories as per Annex C.
- A summary of recreational, and sports facilities, and other amenities.
- A summary of information on recent / continuous improvements and planned improvements in these facilities.

3.2.7 Criterion 7 – Institutional Support and Financial Resources

This criterion deals with the financial resources and their commitment to support an engineering program. The main objective is to glean and assess the adequacy of these resources in sustaining the program, with a view to its up-gradation and future enhancements. Hiring and retaining qualified faculty members in sufficient numbers is a pre-requisite for a vibrant program. Obviously, this needs continued financial commitment in addition to creating conducive environment. The availability of infrastructure in terms of classrooms, well-equipped labs and well stocked library are also essential requirements. In addition to teaching and learning, the program must demonstrate avenues of R&D pursuits to enable students and faculty transform their innovative and original thinking into practice. All these activities demand availability of sufficient financial resources and their proficient management.

Needless to say, a sound engineering program must be economically viable to ensure its sustainability and future enhancements. Therefore, it is essential that an institution requesting accreditation of an engineering program should provide the requisite information and data to the PEC for evaluating its fiscal details. The clarity and accuracy of the information will facilitate an objective assessment of adherence to this criterion.

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The required information comprises income and expenditure details which can be extracted from the approved budgets for the current as well as two previous, but consecutive, financial years. In case of new programs, only one or two budgetary figures will suffice (attached as Annex G - “Financial Health”). Institution is required to provide copies of the approved budgets and last-year audited accounts.

3.2.8 Criterion 8 – Continuous Quality Improvement

As stated in earlier paragraphs, the concept of accreditation of an engineering program is the demonstration of adherence to the laid down criteria of PEC. The weaknesses and non-conformance observed during the last accreditation and evaluation visit must be addressed to remove the deficiencies. Obviously, the subsequent compliance report from the institution should be based on verifiable remedial measures. Prior to its submission to PEC, it is desired that the internal Quality Enhancement Cell (QEC) of the institution should have already confirmed the veracity of the actions taken for CQI.

Continuous improvements are assured only if a proficient closed-loop system is in place. The institution should have well defined process for quality improvement. This aspect deals with the steps taken for improvement of program quality and in particular steps taken in the light of the observations of last accreditation visit.

The institution should also provide details of the procedure of internal assessment which is part of the internal quality assessment as part of QEC program. The institutions should demonstrate and provide information and reports that are prepared for continuous quality improvement related to different accreditation criteria described in this manual. The institution should also provide following documents:

i. Self-assessment reports based on Surveys and feedback from the stakeholders

ii. Report of implementation plan based on the observations of last accreditation visit and the remedial actions taken by the institute.

3.2.9 Criterion 9 – Industrial Linkages

This aspect relates to industrial collaboration and linkages program of the institution in order to provide opportunity to students for training, consultancy, R&D and exposure to professional practices. Students are expected to undertake assignments from industry to provide solutions to complex engineering problems. Students and faculty should be encouraged to establish collaboration for R&D and product development related projects, with due regard to environmental and societal impact. Feedback from the industry and employers is crucial and an essential part of curriculum review process used to evaluate attainment of the program objectives.
Annexures

Annex-A
Annex-B
Annex-C
Annex-D
Annex-E
Annex-F
Annex-G
Annex-H