Know your Graduate Attributes (GAs)

Mechanical Engineering

Student’s must demonstrate the following ECSA Graduate Attributes, to the satisfaction of both internal and external examiners in order to pass:

Graduate Attribute 1: Problem solving

Identify, formulate, analyse and solve complex engineering problems creatively and innovatively.

Level Descriptor: Complex engineering problems:

a) require in-depth fundamental and specialized engineering knowledge; and have one or more of the characteristics:
   i) are ill-posed, under- or over specified, or require identification and refinement;
   ii) are high-level problems including component parts or sub-problems;
   iii) are unfamiliar or involve infrequently encountered issues;

b) and their solutions have one or more of the characteristics:
   i. are not obvious, require originality or analysis based on fundamentals;
   ii. are outside the scope of standards and codes;
   iii. require information from variety of sources that is complex, abstract or incomplete;
   iv. involve wide-ranging or conflicting issues: technical, engineering and interested or affected parties.

Evaluated in: ENME4FP and ENME4MV

Graduate Attribute 2: Application of scientific and engineering knowledge

Apply knowledge of mathematics, natural sciences, engineering fundamentals and an engineering speciality to solve complex engineering problems.

Level descriptor: Knowledge of mathematics, natural sciences and engineering sciences is characterized by:

- A systematic, theory-based understanding of the natural sciences applicable to the discipline; • Conceptually-based mathematics, numerical analysis, statistics and formal aspects of computer and information science to support analysis and modelling applicable to the discipline;
- A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline; and
- Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

Range Statement: Mathematics, natural science and engineering sciences are applied in formal analysis and modelling of engineering situations, and for reasoning about and conceptualizing engineering problems.

Evaluated in: ENME4MT and ENME4AM

Graduate Attribute 3: Engineering design

Perform creative, procedural and non-procedural design and synthesis of components, systems, engineering works, products or processes. Range Statement: Design problems used in exit-level assessment must conform to the definition of a complex engineering problem. A major design problem should be used to provide evidence. The design knowledge base and components, systems, engineering works, products or processes to be designed are dependent on the discipline or practice area.

Evaluated in: ENME4PD, ENME4DP and ENME4FP

Graduate Attribute 4: Investigations, experiments and data analysis

Demonstrate competence to design and conduct investigations and experiments.

Range Statement: The balance of investigation and experiment should be appropriate to the discipline. Research methodology is to be applied in research or an investigation where the student engages with selected knowledge in the research literature of the discipline.

Note: An investigation differs from a design in that the objective is to produce knowledge and understanding of a phenomenon and a recommended course of action rather than specifying how an artefact could be produced.

Evaluated in: ENME4AM and ENME4DP

Graduate Attribute 5: Engineering methods, skills and tools, including information technology

Demonstrate competence to use appropriate engineering methods, skills and tools, including those based on information technology.

Range Statement: A range of methods, skills and tools appropriate to the disciplinary designation of the program including:

- Discipline-specific tools, processes or procedures;
- Computer packages for computation, modelling, simulation, and information handling;
- Computers and networks and information infrastructures for accessing, processing, managing, and storing information to enhance personal productivity and teamwork.

Evaluated in: ENME4CM and ENME4MT

Graduate Attribute 6: Professional and technical communication

Demonstrate competence to communicate effectively, both orally and in writing, with engineering audiences and the community at large. Range Statement: Material to be communicated is in an academic or simulated professional context. Audiences range from engineering peers, management and lay persons, using appropriate academic or professional discourse. Written reports range from short (300-1000 words plus tables diagrams) to long (10 000 to 15 000 words plus tables, diagrams and appendices), covering material at exit-level. Methods of providing information include the conventional methods of the discipline, for example engineering drawings, as well as subject specific methods.

Evaluated in: ENME4PD and ENME4DP

Graduate Attribute 7: Sustainability and impact of engineering activity

Demonstrate critical awareness of the sustainability and impact of engineering activity on the social, industrial and physical environment. Range Statement: The combination of social, workplace (industrial) and physical environmental factors must be appropriate to the discipline or other designation of the qualification. Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: health, safety and environmental protection; risk assessment and management and the impacts of engineering activity: economic, social, cultural, environmental and sustainability.

Evaluated in: ENME4EN and ENME4DP

Graduate Attribute 8: Individual, team and multidisciplinary working

Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments. Range Statement: Multidisciplinary tasks require co-operation across at least one disciplinary boundary. Co-operating disciplines may be engineering disciplines with different fundamental bases other than that of the programme or may be outside engineering.

Evaluated in: ENME4ML, ENME4PD and ENME4DP

Graduate Attribute 9: Independent learning ability

Demonstrate competence to engage in independent learning through well-developed learning skills. Range Statement: Operate independently in complex, ill-defined contexts requiring personal responsibility and initiative, accurately self-evaluate and take responsibility for learning requirements; be aware of social and ethical implications of applying knowledge in particular contexts.

Evaluated in: ENME4PD, ENME4DP and ENME4CM

Graduate Attribute 10: Engineering professionalism

Demonstrate critical awareness of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence. Range Statement: Evidence includes case studies typical of engineering practice situations in which the graduate is likely to participate. Ethics and the professional responsibility of an engineer and the contextual knowledge specified in the range statement of Graduate Attribute 7 is generally applicable here.

Evaluated in: ENME4PD

Graduate Attribute 11: Engineering management

Demonstrate knowledge and understanding of engineering management principles and economic decision-making.

Range Statement: Basic techniques from economics, business management; project management applied to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Evaluated in: ENME4PD, ENME4DP and ENME4ML

ASSESSMENT OF ECSA GRADUATE ATTRIBUTES

Relevant ECSA Graduate Attributes (GA) will be evaluated by means of reports, an oral presentation, and assignments. Graduate Attributes are individually assessed.

GA 1: A significant and complex problem is assigned to the project group. The group must decompose the 'global' problem into sub-problems. Each student will be responsible for solving a sub-problem, which is also complex. The student must redefine the problem in engineering terms, apply in-depth fundamental and specialized engineering knowledge during the problem solving process, and provide solutions that are original. Formal problem solving techniques and heuristics must be used to generate solutions. Final solutions must be in the form of engineering designs and prototyped technologies. Solutions proposed by the individual student must integrate with those proposed by the group, to solve the global problem and satisfy stakeholder requirements.

GA 2: When solving the complex problem, the student must apply knowledge of mathematics, natural sciences, engineering fundamentals and an engineering speciality. Types of knowledge that must be applied during problem solving and engineering design include, the application of natural science theory, fundamental engineering theory, specialist engineering theory, numerical analysis, statistical analysis and mathematical modelling.

GA 3: When developing solutions to the complex problem, the student must perform creative, procedural and non-procedural design and synthesis of components, systems, engineering works, products or processes. The student must apply formal design processes and tools for developing design requirements, design specifications, design concept generation, concept selection and product generation. The student must apply formal design methods when synthesizing parts and systems. Designs must be documented in written reports and engineering drawings. Solutions that have been developed into a final design must be prototyped and evaluated.

GA 4: The student must identify and apply suitable research methods for problem solving and engineering design. During problem solving, the student must conduct an investigation where s/he engages with selected knowledge in the literature of the discipline in order to develop solutions. The student must design and conduct experiments in order to validate simulations and theoretical models, and evaluate the solution to the complex problem and sub-problems. The student must collect and analyses data using appropriate engineering and scientific methods during experimentation. The results must be analysed and compared to existing research and designs.

GA 5: When performing problem solving and engineering design, the student must demonstrate the competence to use appropriate engineering methods, skills and tools. Computer packages must be used for computation, modelling, simulation, and information handling. Examples include, but are not limited to the use of CAD, FEA and CFD. The student must demonstrate the use of computers and networks to enhance his/her personal productivity. The students must use mechanical engineering tools, processes or procedures during problem solving and design.

GA 6: The student is required to effectively communicate the problem solving process, solution development and final results, both orally and in writing. The student will be assessed by internal and external examiners. Written and oral communications must be appropriately structured and delivered using professional and technical language. Written and oral communications must be fluent, coherent and meet acceptable academic standards. Graphical communication must be used to support written and oral communications where appropriate.

GA 7: The student must perform a reflective analysis on the sustainability and impact of engineering activities, when developing and reviewing design solutions. The student must demonstrate critical awareness of the sustainability and impact of the solutions that s/he generates, on the social, industrial and physical environment. Where relevant, the student must identify how negative impacts can be mitigated, managed or eliminated.

GA 8: The student must perform individual work and group work during problem solving and design. The student must identify and focus on a sub-problem in the project as an individual contribution to the solution. The student must demonstrate effective teamwork by supporting the work of their group members in order to achieve the solution to the global problem. Each student will be required to complete multidisciplinary tasks. When completing a multidisciplinary task, the student must establish multidisciplinary cooperation with individuals from other disciplines. Evidence of the multidisciplinary cooperation must be available in the form of meeting records and impactful insights being transferred to the problem solving and engineering design processes.

GA 9: A significant and complex problem is assigned to the project group that involves unfamiliar issues and knowledge that is not taught during the undergraduate degree. The student will be required to plan and conduct self-directed learning, in an ill-defined context, in order to become familiar with the problem and gain the knowledge required to provide appropriate solutions. The student must engage with new and specialized literature in the discipline in order to demonstrate responsibility for self-directed learning.

GA 10: The student is required to demonstrate engineering professionalism by applying the ECSA Rules of Conduct to his/her own conduct of engineering work. The student will be required to complete an assignment, documenting how his/her awareness of the need to act professionally and ethically was applied during the project. The student will also be required to research and evaluate case studies typical of engineering practice situations in which the graduate is likely to participate. The student must demonstrate an understanding of the role of the engineer in society and governing bodies that influence their professional development.

GA 11: The project must be managed using techniques from economics, business management and project management. The student must produce evidence of appropriate financial management, people management, project management and the communication of management decisions. At the termination of the project, the student is required to reflect on the success of the project in terms of meeting stakeholder expectations (quality management).