Journal of Management & Entrepreneurship
ISSN 2229-5348

UGC Care Group I Journal
Vol-11 Issue-02 2022

The Capstone Design Project for the Bachelor of Science in Electrical and Electronic Engineering: Guidelines for Design, Supervision, Assessment, and Evaluation

DR.M.GANESH, MR.P.PRABHAKAR, MR.P.MADHUSHEKHAR
ASSOCIATE PROFESSOR, ASSISTANT PROFESSOR[2,3]
Department of EEE
TRINITY COLLEGE OF ENGINEERING AND TECHNOLOGY, PEDDAPALLY
mganeshtvm1719@gmail.com, prabhakar_3806@rediffmail.com, shajahan_vits@yahoo.co.in

Abstract **—** Numerous comments have been made at the Board of Accreditation for Engineering and Technical Education (BAETE) by mentors and visiting program evaluator teams from various public and private universities in Bangladesh on the importance of including any design project in an undergraduate electrical and electronic engineering curriculum and on producing creative ideas in the final year capstone design projects. The BSc in EEE curriculum at Southeast University in Dhaka, Bangladesh, has to undergo sweeping reforms in the Department of Electrical and Electronic Engineering (EEE) to address this shortcoming. We recommended renaming and reorganizing courses, putting more emphasis on capstone design projects, improving question setting and assessing students in other ways, hiring and retaining engineering faculty with an eye toward Outcome-Based Education (OBE), upgrading laboratories by purchasing new equipment and software and developing new experiments for each laboratory course, and exposing students to real-world design problems. The goals, results, mapping with program outcomes, learning domain, assessment methods, guidelines, ideas, and recommendations for supervising the capstone design project, assessment approach, and rubric setting, etc. are reported in this work. As a result, the undergraduate EEE department should be better equipped to provide, supervise, and evaluate capstone design projects in order to meet the rigorous standards of BAETE certification based on OBE.

Course evaluation, final design project, and grade all play a role in the field of electrical and electronics engineering.

INTRODUCTION

A Capstone Design Project (CDP) course, also known as a Senior Thesis, Senior Seminar, Final Year Design Project (FYDP), Senior Design Project (SDP), or simply Project, is the culmination and accumulation of information acquired during a program at the university level. In the United States, this is known as a senior seminar, while in the United Kingdom it is known as a dissertation or final year project. The word comes from the ornate coping or 'cap-stone' used at the very top of a structure or monument. The word has been in use in American higher education from the late 1800s and as recently as the middle of the twentieth century. As time progressed, it gained traction in other regions, especially those concerned with the success of their graduates in the job market. Southeast University, 251/1 & 252 Tejgaon Industrial cum Commercial Area, Dhaka 1208, Bangladesh; M. H. Bhuyan, Electrical and Electronic Engineering.. There was a strong focus on undergraduate education. The capstone experience has received more attention because to national funding programmes in Australia and the United Kingdom [1].

The primary goals of CDP are to provide students with the knowledge and skills necessary to successfully plan, develop, execute, manufacture, test, validate, manage workflow, deal with financial and ethical concerns, etc., in the course of completing design assignments. Each class works in small groups led by a member of the department's faculty to plan, create, and execute a real-world project with the goal of meeting a certain number of predetermined requirements. Students conclude their projects by reporting on and presenting their findings. Students are able to obtain expertise in any area of engineering practice via collaboration with professionals from industry and university professors during project work. In most circumstances, students may acquire knowledge of cutting-edge technology and/or generate original concepts that are not formally taught in the classroom. Therefore, students might benefit from this kind of intellectual endeavor while they adjust to life after college. Therefore, the CDPs create a one-of-a-kind and caring atmosphere for students, much as they would have when working in an industry, supervised by both teachers and professional engineers. Not only that, but the academics' advise and the students' actual works may help the industry solve some of its technical challenges. By fostering an environment where students can apply classroom knowledge to real-world industrial problems, and by ensuring the presence of a quality department with its vision, mission, and program educational objectives, this partnership mechanism helps achieve academic excellence. This helps the business sector meet with university professors and students to address issues. On the other side, the department benefits from this activity since it allows them to develop industry-level knowledge and skills while also reaping financial rewards from the sharing of their information, expertise, laboratory, and equipment. Furthermore, since students of this degree get more acquainted with industry personnel, they have a greater chance of being incorporated into the industrial workforce. Therefore, Capstone Research is essential for engineering students because it provides them with early, hands-on experience in the excitement and difficulties of the research and development sectors. or Design Project molds students into practicing engineers in preparation for the workforce. Undergraduates may find similar experiences in the research, design, development, and execution of prototype works during their capstone project. Undergraduate education in electrical engineering and electronics revolves on a research and design project that students work on and complete from start to finish. The BAETE requirement [2] states that the

capstone project must be taught in the fourth level and should last one year, but that laboratory courses may be begun at any

level or term in the EEE program. Creating a customized learning path (CDP) for graduating seniors has several positive outcomes. Here are just a few examples: First, it provides introductory engineering students with: • Valuable information and instruction in the right EEE subjects• Integrating what you've learned in EEE theory and lab with what you can do in the real world

Employers are becoming more discerning and demanding of students' resumes.

2. The supervisors' responsibilities include: generating experimental and simulation data for ongoing research works or upcoming projects; speeding up the on-going research works in hand; completing time-bound project works on time; extending the existing projects; collecting funds for further research projects; implementing projects within a low budget; and mentoring students and interacting with colleagues and appropriate officials. Graduate engineering students benefit in three ways: • They gain invaluable experience in mentoring and interacting with their peers in the field; • They advance their own research projects; • They gain valuable teaching experience; and • They are given the chance to participate in hands-on projects and problem-solving. 4. For the Department—• Increasing the Intensity of Current Research Projects • Enhancing the Undergraduate Capstone Project • Broadening the Scope of Departmental Research • Applying to Financial Sponsors for Current and Future Departmental Research ProjectsHowever, there are constraints, such as the need for greater time and resources from teachers and researchers at all levels. Independent from the Institution of Engineers, Bangladesh (IEB), BAETE reviews engineering programs in Bangladesh to ensure that a baseline of quality is maintained as new courses are developed and existing ones are improved. BAETE claims that certified programs provide information useful to the general public, future students, guidance counselors, parents, schools, professional organizations, employers, government agencies, and certification bodies. accredited programs that go above and above what is required [2]. Students, program educational objectives, program outcomes and assessment, professional component, faculty, physical facilities, institutional support, industry linkage programs, and financial resources are just some of the areas that are evaluated by the BAETE criteria, which were established in 2017 and updated in 2019 [2]. The professional component of the BAETE standards identifies the topic areas that are important to the appropriate branch of engineering but does not recommend any particular programs of study. It further specifies that, at the end of the undergraduate engineering program, students will have participated in a culminating design project that puts their theoretical and practical training to use. It also recommends that the design process take into account authentic constraints like economic, environmental, financial, ethical, health and safety, social, political, sustainability, and manufacturability in addition to national and international engineering codes and standards and the United Nations' sustainable development goals. [2], [3]. Graduates of engineering programs should be prepared to apply what they've learned in the classroom to real-world problems including the analysis, formulation, interpretation of data, and design of engineering systems, sub-systems, or components. Students in engineering degree programs should be taught to think critically, operate ethically in interdisciplinary teams, and effectively communicate both orally and in writing [4, 6]. Employers in the engineering field often have high expectations that recent grads will be able to hit the ground running in their new roles, if not immediately upon hire. Therefore, students in engineering programs should be actively involved in projects-based activities that mimic real-world challenges [7]-[9]. After completing prerequisites, electives, experimental and simulation labs, mini-project tasks, etc., the CDP is the capstone course where such sequential engineering activities are conducted. The majority of BAETE's intended results for the program may be attained with the help of the CDP. Therefore, it is important to create course objectives and evaluate and quantify them in a manner that allows students to effectively show their achievement of these aims. The department's pedagogical practices may benefit from this as well. In this work, we propose a change to the CDP in the undergraduate EEE program based on OBE to better prepare students to meet the course and, ultimately, the program objectives. Course goals, learning outcomes, how they map to the program's overall goals, the cognitive domain of learning, assessment schemes, guidelines, ideas, and recommendations for supervision procedures, assessment strategy, and rubrics creation, etc. are also reported on in this article.

BSc in EEE Program of Southeast University Southeast University has an undergraduate electrical and electronic engineering (BSc in EEE) program. The faculty members have very limited specializations with terminal degrees in EEE. There are five faculty members with Master'sdegrees in power systems and renewable energies, two facultymembers who have the expertise and terminal degrees in semiconductor devices, and four faculty members who have terminal degrees in physics, mathematics, and chemistry. Butthis is not adequate to develop the students with specialties inEEE CDPs. It is required that the students enroll in core courses. The courses have analysis and design components and it is up to the course teachers whether or not to assign course level design projects. Besides, there are elective courses that are offered by rotation as per the needs of the students. The elective courses in the curriculum are divided into four major areas of specializations, viz. power, bio-energy, renewable energy, electronics, communications, and computer [10].

In the BSc in EEE program of SEU, the power and energy group includes power system, power system protection, high voltage engineering, power electronics, and associated laboratory courses. Besides, this group has non-laboratory courses like green power and energy, power system economics, power system reliability, power plant engineering, nuclear power engineering, power system operation and control, electrical energy conversion machines and power systems analysis, etc.

The electronics group includes VLSI II, optoelectronics, hardware design with VHDL, nano-electronic devices, etc. Besides, this group has non-laboratory courses like green electronics, analog integrated circuits, compound semiconductor, and heterojunction device, semiconductor device theory, semiconductor processing, and fabrication technology, etc.

The communication group includes digital signal processing II, optical fiber communications, digital communication,

microwave engineering, and associated laboratory courses. Besides, this group has non-laboratory courses like green

communication engineering, mobile cellular communication, telecommunication engineering, satellite communication, optical networks, random signals and processes, radio and television engineering, broadcast engineering, radar, and navigation, etc.

The computer group includes courses on microprocessor- based system design and computer networks and associated laboratories. Besides, this group also has few non-laboratory courses like real-time computer systems, multimedia communications, computer architecture, green computing,cryptography, and network security, etc.

In the Department of EEE, there are no faculty members who are specialized in communication and computer engineering. Communication and computer engineering related core and elective courses are taught by non-specialized faculty members having master degrees only. The elective courses are offered during the fourth year of their undergraduate study. Students must do their major in one

group and minor in only two groups out of those four options. Students pursuing a Bachelor of Science in EEE must complete a total of 120 credits, including a minimum of four 3-credit theory courses, two of which must include 1-credit laboratory if this group is a major group, and two 3-credit theory courses, one of which must include 1-credit laboratory if this group is a minor group. The number of credits needed to graduate will rise dependent on how many laboratory courses the student chooses to take. However, a student may only major in one course group at a time [10].

II. BSC EEE CENTRALIZED DEVELOPMENT PLAN

Engineering standard codes, teamwork, ethical engineering issues, respect for safety, societal impact, environmental and sustainability, project management, finances, etc. are just some of the criteria that BAETE has pressed in the final year CDP, and both students and faculty supervisors should keep that in mind. The Community-Driven Project (CDP) should address societal issues, have a measurable economic effect both locally and globally, and include material covered in class.

Finding a real-world, multi-tiered, and equally time-consuming project that can be completed over the course of three semesters each year may be the most difficult part of the process. It has been suggested that the local industry, in cooperation with the university, provide a small number of industry-grade unsolved issues, and that the university's program, via the establishment of an industry advisory council, distribute these problems to the students for solution. As a result, establishing a design clinic allows for the collection of relevant, real-world projects. Projects of excellence and practical interest may also be proposed by the students. However, the relevant manager must authorize this before it can be implemented in the design clinic. The students' projects will next be divided up according to the previously established criteria [4].

CDP Elements A.

The two primary parts of CDP are the lecture and the laboratory. Students gain specific knowledge and skills in project design and implementation, as well as time and budget management, during the lecture portion of the course, while the laboratory portion of the course allows students to design, implement, and verify the design project through tests and measurements.

The testing and evaluation of students in the capstone design course, in particular, would need to be overhauled in order to successfully integrate the CDP into the undergraduate EEE program's curriculum. In order to introduce anything truly new and unique, teachers must first get the appropriate training. The students need to be educated about it and taught how to run the project from the ground up. Knowledge gained from both required and optional courses must be applied to real-world design challenges and reflected in final projects. Experts in academia and the business world from both university and partner industries must conduct the lecture andlaboratory classes. The cutting-edge engineering and technicalsoftware and modern tools must be purchased to do the simulation and verification work by the research students to embrace them with the new design tools and techniques so that they can grasp the concepts of real-time design works and become familiarized with such type of environment. In the second and third years, students must be given course level design problems that reflect efficacious real-world projects required for the industry. The curriculum breadth and depth of the undergraduate EEE program must reflect the latest engineering discoveries, innovations, and practices of the real- life cases. Any type of engineering design necessitates innovation for open-ended complex and multi-disciplinary problems. The latest versions of the high-tech software, viz. MATLAB, PSPICE, Cadence, Verilog, and VHDL must be made accessible in the research and working laboratories and the engineering students must be exhilarated to utilize that software to implement their design projects works in thelaboratories of the EEE department [3], [11]. This process requires a cluster of dedicated, dynamic, and qualified faculty members together with passionate and painstaking as well as committed students. However, to have such kind of effective manpower, the university must have an attractive salary package, incentive, and performance bonus system, reward policy, strategy to retain them in the department. Though, none of these factors were addressed in the EEE Department at Southeast University (SEU); therefore, this is now high timeto address these issues and take steps in the right direction to make a rigorous analysis of it and bring the necessary changes.

A. CDP Course Details

CDP should be offered over one year as a BAETE requirement in its manual since BSc in EEE program of SEU is being offered in 3 semesters in 1 year. As a result, the CDPcourse should be offered in three consecutive semesters in thefinal year of the program. As such, CDP has been split into 3codes and titles, such as EEE492 CDP I, EEE494 CDP II, andEEE496 CDP III with 2 credits in each semester. However, ifa student is in 4th year but he/she has not completed at least 120 credits then he or

she cannot register in this course. To advance to the next CDP course, a student has to pass the previous CDP course first [10].

Course contents of the 'Capstone Design Project' of the EEE Department involve a group of students who design, build, and test a system, component, or engineering process. CDPs are selected from the problems submitted by the facultymembers and local industries while industry projects are given preferences as they are well-matched to fulfill the course objectives and outcomes. The instructional phase includes (but not limited to) proposal preparation and reports writing methods, working methods, communication techniques with the group members, use of visual aids, design and development steps, etc. The performance phase includes (but not limited to) team formation and organization, design proposal submission, implementation of the design process, project scheduling, management and finance, design reviews, design simulation, and testing, preparation of documentation and presentation, drawings, and specifications, written report submission following the formatted template of the department, midterm oral presentation of partially completed projects and final poster presentation of the fully completed projects.

B. CDP Course Objectives

The objectives of this CDP course are to teach the students how to [10]-

1. Identify engineering problems, build an appropriate strategy to solve the problem systematically with given constraints of resources, budget, time, etc.
2. Analyze, design, build, and test engineering system/ subsystem within the given specifications, constraints and requirements, and engineering standards
3. Identify the impact of economic, environmental, social, political, ethical, health and safety considerations and constraints in the project and also validate it
4. Identify and assess the impact of usability, profitability, fabricability, and viability of a CDP
5. Apply the acquired knowledge and skills of the theory and laboratory courses completed in several semesters during the undergraduate engineering study
6. Use modern design tools in the design process and validation of a system/subsystem
7. Work in a multi-disciplinary team environment in the engineering profession
8. Demonstrate the development phases of EEE CDPs through the CDP proposal, time-line/Gantt chart of the project completion, requirement analysis, specifications list preparation, project design, final report, etc.
9. Exhibit the work through presentations using PowerPoint(midterm and online mode) or poster (on-campus)
10. Recognize the importance of life-long learning in the engineering profession
11. Demonstrate an understanding of ethical and professionalresponsibility in engineering project development phases.

C. Program Outcomes of BSc in EEE Program

The Bachelor of Science in EEE program offered at SEU requires that students earn the degree with minimum degree requirements of 153 credits following the guidelines set by theUGC, Bangladesh [12], and the BAETE, Bangladesh [2], [13].The curricula have been designed by the academic committee comprising all the Faculty Members of the Department and the curriculum committee comprising two external academicians, one industry expert, one alumni representative, one college-level science teacher. Besides, we took the opinions of local and regional requirements from the Industry Advisory Panel (IAP) comprising 10 external industry expert members, 3 departmental faculty members, 2 external academicians, and 2 alumni. There are twelve program outcomes of this program as suggested in the BAETE Manual [2], [13]. Graduates are expected to achieve the twelve attributes at the instant of their graduation from the EEE Department as mentioned in the manual provided by the BAETE [13] and adopted by the EEE

Department of SEU for its OBE-based curriculum of the BSc in EEE program [14].

TABLE I
COURSE OUTCOMES OF CDP AND ITS MAPPING WITH THE PROGRAM OUTCOMES OF BSC IN EEE PROGRAM

CO	CO Statement	Program Outcomes, Degree of Correlations: 3 = Strong, 2 = Moderate and 1 = Weak											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Identify an EEE problem which is complex and propose a solution by systematically writing proper planning within some given constraints		3										
CO2	Analyze the problem, review the relevant kinds of literature and articles to have necessary technical information, propose a methodology for the works, and investigate the available resources for designing the complete system and its sub-systems				3								
CO3	Implement the designed system within the budgetary and time constraints using technical knowledge and skills, tools and techniques, or any modern tools			3									
CO4	Simulate the system using any modern tools and find the experimental results as well as analyze and compare the results acquired to meet the expected specifications					3							
CO5	Estimate the impact of EEE solutions in a global, economic, environmental and sustainability, health, safety, and societal context						3	3					
CO6	Identify the ethical issues that may arise during the design stages of the system								3				
CO7	Function in a team as a group member or team leader									3			
CO8	Communicate with all members to complete the project in time, and be able to write technical reports, present the works in oral and poster formats										3		
CO9	Recognize the importance of engaging in life-long learning												3
CO10	Manage and control financial issues of the CDPs											3	

TABLE II
COURSE OUTCOMES OF CDP AND ITS MAPPING WITH THE PROGRAM OUTCOMES OF BSC IN EEE PROGRAM AS WELL AS BLOOM'S TAXONOMY (BT) DOMAIN, DELIVERY METHODS, AND ASSESSMENT TOOLS

CO Statement	PO	BT Domain/ Level	Delivery Methods and Activities	Assessment Tools
[CO1] Identify an EEE problem which is complex and propose a solution by systematically writing proper planning within some given constraints	PO2	Cognitive/ Apply	Discussion on the project proposal, question and answer session	Project proposal form
[CO2] Analyze the problem, review the relevant kinds of literature and articles to have necessary technical information, propose a methodology for the works, and investigate the available resources for designing the complete system and its sub-systems	PO4	Cognitive/ Analyze	Discussion on Chapters 1 & 2, question and answer (QA) session	Chapters 1 & 2 of the report
[CO3] Implement the designed system within the budgetary and time constraints using technical knowledge and skills, tools and techniques, or any modern tools	PO3	Psychomotor/ Naturalization	Discussion on demonstrated project work QA session	Demonstrated project + Chapters 3 & 4 of the report
[CO4] Simulate the system using any modern tools and find the experimental results as well as analyze and compare the results acquired to meet the expected specifications	PO5	Psychomotor/ Naturalization	Discussion on Chapters 3 & 4, QA session	Chapters 3 & 4 of the report
[CO5] Estimate the impact of EEE solutions in a global, economic, environmental and sustainability, health, safety, and societal context	PO6, PO7	Affective/ Characterization	Discussion on Chapter 5, question and answer session	Chapter 5 of the report
[CO6] Identify the ethical issues that may arise during the design stages of the system	PO8	Affective/ Valuing		
[CO7] Function in a team as a group member or team leader	PO9	Affective/ Valuing	Weekly Meeting and Group Discussion	FGD
[CO8] Communicate with all members to complete the project in time, and be able to write technical reports, present the works in oral and poster formats	PO10	Affective/ Organization		FGD Final Report PowerPoint Slide, Poster
[CO9] Recognize the importance of engaging in life-long learning	PO12	Affective/ Naturalization		FGD
[CO10] Manage and control financial issues of the CDPs	PO11	Affective/ Naturalization	Discussion on Chapter 5, QA session	Chapter 5 of the report

D.Mappings of COs with POs, Taxonomy Domain, DeliveryMethods, and Assessment Tools

There are three courses on the CDP, such as EEE492 CDPI, EEE494 CDP II, and EEE496 CDP III [10]. Mappings among COs and POs for each capstone design course of the program offered by the department of EEE at SEU are presented in the program outcome mapping matrix in Table I with the degree of correlations (3 is for highly correlated, 2 is for moderately correlated, and 1 is for weakly correlated). Besides, statements of the COs for the CDP course offered for the BSc in EEE program by the EEE department are shown in Table II including the relationship with POs, Bloom's Taxonomy domain and level, delivery methods as well as assessment tools. Levels of the cognitive domain are used for judging the knowledge [15] and 2 other domains of Bloom's Taxonomy are used for judging the skills and attitude levels.

E. Guidelines for the Supervision and Execution Processesof the CDP

Pre-requisite theory and laboratory courses using the state of the art software and hardware must be offered to the students and they must pass all such courses before undertaking the CDP. Thus the students will be equipped with the necessary technical and non-technical skills that will help them complete the CDP course successfully. The design course spans over three semesters (i.e. over one year as per BAETE guidelines/manual [2]) from the commencement to the full-functional designed and implemented product. The students must look for an industrial sponsor, or a financial partner, or an entrepreneur to provide the project expenses with the cooperation of their supervisors.

Every group must provide a project proposal with objectives, methodology, financial and design constraints, design specifications, timing schedule, and possible outcomes of the product to be implemented. It is suggested that the design must be simulated and tested over and over again using any standard software before going for final implementation, viz., PSPICE, Cadence, MATLAB [16], VHDL, Verilog [17], SILVACO, etc. until the satisfactory outcome is achieved.

The CDP is offered at the beginning of the fourth year of undergraduate study. Students may take the 'Capstone Design Project' after completion of at least 120 credits of their course work as partial fulfillment of the requirements of their degree of BSc in EEE. Usually, the students enroll in both the design project and the elective courses in the fourth year. The knowledge and depth of the core and elective courses usually help the students complete the design projects successfully.

The students must complete this work within three consecutive semesters in the final year or at the fourth level of their academic degree program under the supervision of a Faculty Member of the EEE Department of SEU. The first, second, and third parts should be completed at Level IV, Terms I; II, and III respectively. The work has to be completed either separately or in a group comprising only 2- 3 students. Upon successful finishing of the assigned task, the students have to submit a CDP report on their findings and must present their works by appearing at an oral presentation in the

It's about halfway through the semester. The Chairperson of the EEE Department will choose four faculty members to serve as examiners for the semester-ending oral exam, poster presentation, and final project. The Chairperson may also solicit the participation of an External Member from outside the Department, such as a scholar or representative from a company active in the EEE sector [10]. The CDP should include the design and execution of a real-world, multi-disciplinary engineering system or sub-system, or the solution of a real-world engineering challenge.

Throughout the duration of each CDP, a Faculty Advisor will be present to provide oversight and direction. Furthermore, each group of students may have one or two mentors. During CDP I, student teams from later CDP courses (CDP II and CDP III) may act as advisors and mentors to those from earlier CDP courses. As a result, pupils are better able to communicate with one another and work together as a team. In addition to the professional BSc engineers working in the industry as collaborators, the students have access to faculty members of the department for consulting. Such off-the-cuff dialogue between students and teachers may sometimes provide useful insights and fresh perspectives that can speed up the design process. With the help of Department teaching members, the CDP is assigned to and supervised by the Coordinator of the Program [10].

If a student is enrolled in the EEE Program, the Program Coordinator will compile a list of potential CDPs from academics and industry and post it on the relevant bulletin boards. Each semester, a list of possible projects is made available to students. Three students work together on each CDP. The coursework for these three courses is ongoing, although students will be graded independently at the end of each semester.

Students are provided broad guidance on how to choose and select a CDP during the first semester of their senior year.

Students propose groups to the Program Coordinator, who must then get approval from the Department Chair. The first draft of the proposal is turned in by the students to the Program Coordinator. Someone takes charge of each group. The Faculty Advisor has to check in with the groups once a week to obtain an update on how things are doing and provide any required changes. The team's leader breaks down the work into manageable chunks and gives everyone on the team a certain number of modules to complete by a certain date. The team members' efforts, both successful and unsuccessful, must be meticulously recorded. The student should have all of the necessary project modules assembled by the second semester of their senior year and ready for testing and verification. During the final academic term, students are responsible for completing the project report, poster presentation, and implementing any changes or improvements recommended by the board of examiners. Students are encouraged to enter national design contests in the EEE sectors to showcase their original and creative concepts.

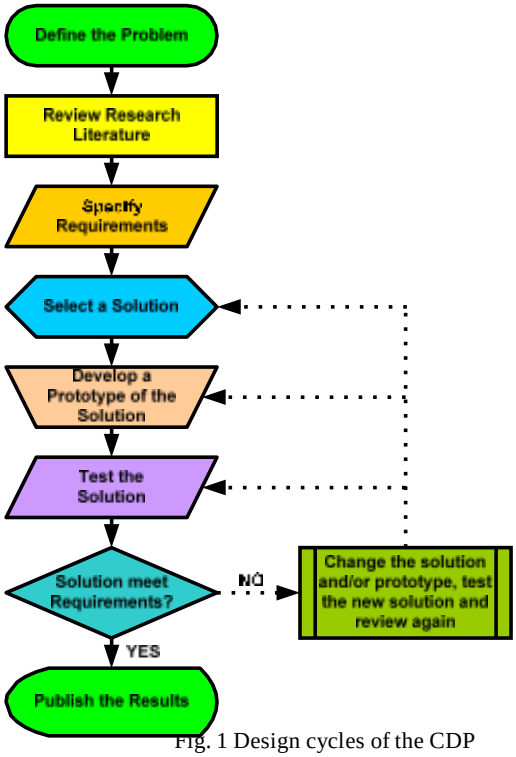

Fig. 1 Design cycles of the CDP

There is often a "standard model" of typical investigation into a project, including a design cycle with its many parts. The solution to every engineering design challenge requires everyone involved to follow a certain procedure. The solution sometimes comprises the design of a system or a subsystem (for instance, the design of a machine or its component, the production of a product, or the creation of a computer program) that satisfies particular criteria and standards in order to carry out one or more kinds of tasks. More engineering-focused projects may follow the engineering design process cycle shown in Fig. 1 for developing, deploying, testing, and confirming a product's conformance to specified criteria. Such a design cycle might be used by students for their projects. Currently, students in the EEE Department at SEU are not required to get funding, although doing so is essential for engineering-focused project design activities.

The following considerations are equally important for CDP management and implementation:

Each student must complete a Final Year/Capstone Design Project (FYDP/CDP) in their senior year, as stated by BAETE (Criteria 6, sub-criterion 3, in the second edition of the handbook). There has to be a 12-month commitment to this condition.

ii. The Capstone Design Project (CDP) serves as a culminating presentation of the program results at the level of addressing significant engineering issues using knowledge and skills obtained in previous course works that include relevant engineering standards/codes and various realistic restrictions. At the very least, CDP needs to address one of the 17

challenging technical problems in service of achieving the United Nations' Sustainable Development Goals (SDGs).

Each CDP has a designated Project Coordinator who is responsible for overseeing its implementation and reporting to the Department Academic Committee. All aspects of CDP oversight, documentation, monitoring, and assessment should be carried out by this group.

When soliciting subjects for the CDP from potential department heads, they must follow the rules outlined below:

The subject should a) be something about which the class is enthusiastic and invested.

The issue you choose should be grounded in reality and have real-world relevance and use.

b. The students' own knowledge, perspectives, and experiences may inspire the project.

Students are strongly encouraged to conduct surveys and analyses of community and business needs (point d).

It is important to provide faculty with example themes (option (e)).

f. Students may suggest a subject to any member of the faculty and ask to work under their guidance.

a. By the conclusion of the preceding semester (possibly the last week of the semester), the subject and the supervisor or mentor must be set.

The department manager checks in on the team once a week to see how things are doing with the project. Weekly progress

reports detailing the amount and quality of work completed must be sent to him or her. When finished, designs should be sent in to the head of the relevant department. After the design project is finished, a presentation (oral or poster) is scheduled. The initiatives will be reviewed by a panel of four experts. Both a digital and physical copy of the completed project report must meet the requirements of the Department of EEE. Students are required to present their work at the CDP Open House Exhibition once a year. This is a must-do step. A student will not be awarded a bachelor's degree until the CDP has been completed and all other requirements for graduating have been met.

II. EVALUATION STANDARDS AND COMMENTARY

When evaluating the CDP, it's important to think about how inventive and original the final product is. We cannot tolerate a simple design or execution. In addition, the difficult design is not approved if it has been completed by someone else. However, if new adjustments are made to enhance performance, extend longevity, or decrease implementation cost, then the extra labor may be tolerated. However, these standards for evaluation or CDP approval should be communicated to the students in advance. Students are expected to provide a PowerPoint or poster presentation of their work at the conclusion of each semester. To evaluate the presentation, a department chair's constituted examining committee. Students are expected to display their CDP and report using relevant test data in the form of tables, graphs, figures, etc. during the presentation. All issues, both technical and non-technical, that have arisen and been resolved must be covered in detail at the presentation and documented in the report sent to the relevant department. Because of this, theorganizations that are soon to take the CDP.

A. Evaluation of the Work So Far

In Fig. 2, we see a possible timeline for completing the CDP over the course of a year. The figure depicts the planned sequence of events while the job is carried out.

Fig. 2 Progress of work flow chart of the CDP

If the CDP can be implemented as shown in Fig. 2, the resulting work, including the proposed circuit or system diagram, experimental or simulation data, analysis, comments, etc., may be presented at a conference or published in a journal. The EEE Department Chair will appoint a Board of Examiners who will evaluate the student's work over the full year-long project. However, as there are three semesters each year in the EEE department at SEU, evaluation of completed projects occurs at least three times every academic year.

Publication in a peer-reviewed publication or in the proceedings of a relevant conference is required as evidence of completion of the required work. However, in the final semester, students must present a poster before the Board of Examiners in addition to giving multiple oral presentations throughout the year. Several guest lectures on a variety of subjects may be given to CDP students over the duration of the project.

a. Ownership of Ideas

b. Science, Technology, and the Law c. Technology Transfer d. The Characteristics of Small Businesses e. International Concerns

f. Ethics

Distinction Between a CDP and a Thesis g.

A. Criteria and Evaluation Methods

Experts from BAETE have proposed guidelines for assessing students' results in terms of their skills, activities, criteria, methodologies, feedback, and assessments. Teachers are tasked with providing objective ratings of their pupils in accordance with the established criteria [18, 19]. The instructor may see the student in action to gauge his or her progress, including but not limited to logbook progress reports, thorough examination of all hardware modules, prototype assembly, module simulation, etc. In order to gather data for assessment, he may have one-on-one conversations with the team's mentor and other members. In addition, he should let the students show off the technical and non-technical talents they've gained via the project activities by presenting their work and answering questions about it [20]. The supervisor has to be able to suggest and

implement a system through which the students' progress may be tracked in relation to their assigned tasks. However, this should only be attempted by a seasoned professor. Otherwise, the department will provide criteria for the mentors and supervisors to use in assessing a student's performance and assigning a letter grade after the semester's culminating presentation. The instructor has to tell each student in the team how they're doing and provide suggestions for how they may do better moving forward with the assignment. When conducting, directing, monitoring, or evaluating CDP students, if any flaws are discovered, they must be reported promptly to the department chair or coordinator so that the problem may be fixed. Each project should keep detailed records, updating their supervisor or adviser on a weekly or biweekly schedule (depending on department policy) with information such as the project's title, type, literature reviewed, components used, cost and its break down, prototypes, project timeline, etc. The leader of the team is responsible for keeping track of [18], [19] the development of each subordinate. This will allow the supervisor to provide a fair mark to each team member at the conclusion of the semester. The project presentation must be followed by a survey. done on each student individually before they leave the lab in complete anonymity. Three to five years after the class of the group has graduated, they should be surveyed again.

CDP_RUB_1: Rubric for Assessment of Capstone Design Project Proposal
Target Course and Program Outcome: CO1 and PO2

Southeast University

Serial #		Capstone Design Project Title	Semester:
Poster ID			

Project Member's Name and ID #	1.
	2.
	3.

Objectives	Very Poor (1)	Poor (2)	Average (3)	Very Good (4)	Excellent (5)	Marks (5) 1	2	3
Project Description	*It is unclear what is being proposed.*	*Only few aspects of the proposal are clear but most of them are unclear*	*The description is adequate but need further clarity and it does not explain project concisely with a clear picture*	*Description is clear, concise, and easy to understand but still few grey areas are there.*	*Description is fully clear, concise, and easy to understand.*			
Adequacy and Feasibility of Design	*Processes and procedures are omitted, impractical design.*	*Processes and procedures are vaguely stated, design is seemingly impractical.*	*Processes and procedures for executing the project appear manageable, but there is some uncertainty.*	*Processes and procedures are not well-stated but seem manageable.*	*Processes and procedures are well-stated, manageable and appropriate.*			
Components of the Proposal	*The report misses many important components*	*The report misses few important components*	*The report has important components but lacks many important description*	*The report has important components but lacks few important description*	*The report has all important components with proper description*			
Budget (Appropriateness and Justification)	*Budget is unreasonable in all areas. Costs are not justified in the budget narrative. Many costs are not relevant and essential to this project.*	*Budget is unreasonable in most of the areas. Costs are not justified in the budget narrative. Most costs are not relevant and essential.*	*Budget is comprehensive and reasonable but not explained clearly. Most costs are justified, relevant and essential to this project.*	*Budget is comprehensive, clearly explained, and appropriate for the activities proposal. Few costs are not justified/relevant/essential.*	*Budget is comprehensive, clearly explained, and appropriate for the activities proposal. All costs are justified/relevant/essential.*			
Objectives and Goals	*The objectives and goals of the project are not clearly stated or are nonexistent.*	*The objectives and goals are not clearly stated and most of them don't exist*	*The objectives and goals are not clearly stated but most of them exists*	*The objectives and goals are clearly stated but few of them don't exist*	*The objectives and goals of the project are clearly stated and all of them exist*			
Comments of the Supervisor:				Assessed by (Name, Sign & Date)	Total (Out of 25)			

Fig. 4 Rubric for assessment of CDP proposal

I. Figure 3 depicts the grading scale used to evaluate the submission. After having students work in groups of no more than three, a supervisor will assign points for each rubric target to the students in the right-hand column. The sum of all targets is then divided by 2

CONCLUSION

The primary goal of any engineering curriculum is to provide students with the skills they'll need to succeed in the workplace, where they'll be expected to contribute across a wide range of disciplines. Employers in the business seek for those with "ready-made" experience in the field; that is, those who can hit the ground running after receiving their degree from an accredited institution. They must keep the university updated on the engineering issues and challenges they face on a daily basis, as well as the knowledge and abilities they seek in order to solve those issues with the help of university graduates. The curriculum and assessment/evaluation methods should be refined based on the CDPs' assessment/evaluation results and feedback reports. By evaluating and responding to student comments, we can maintain high standards and keep them satisfied with the department. However, they need to be given the correct information. The CDP requires students to learn about a wide range of constraints not typically covered in engineering courses, including but not limited to: time, money, social, management, administrative, reliability, manufacturability, health and safety issues, environment and sustainability, ethical issues, standards and codes in engineering, etc.

In order to conform to BAETE standards, guidelines, and manuals, several adjustments were made to the EEE program's capstone design course in the fourth year. The faculty of SEU's BSc in EEE program have had access to some of the aforementioned thoughts and proposals. Students, teachers, recent grads, alumni, employers, parents, and anybody else who could have an opinion are all being polled. The department head and supervisor may learn a lot from this sort of survey and make adjustments to the CDP conducting and supervising procedures that will lead to future quality improvements. For the sake of future quality enhancement of CDP monitoring and guiding procedures, it is crucial to hear from the working engineers who graduated from the department. Supervising the CDP for undergraduate EEE students requires a significant time commitment and sustained effort on the part of faculty. Therefore, it is only fair that they get payment for all of the hard work and oversight they put in.

REFERENCES

[1] Toward a Constructive Postmodern University," by M. Ford, M. P. Ford, and Greenwood, Information Age Publishing, p. 44, 2006, ISBN 978-1-59311-405-3.

[2] [3] BAETE (2019). Society for Engineering and Technology Accreditation

[3] Retrieved on 6/20/20: Education, "Accreditation Manual for Undergraduate Engineering Programs," 2nd Edition, March 2019, from http://www.baetebangladesh.org.

[4] Copyright 2002, American Society for Engineering Education. Session 2793, pp. 7.280.1-7.280.6. [4] E. H. Shaban, "Capstone Design Projects in Undergraduate Electrical Engineering Education," Proceedings of the 2002 American Society for Engineering Education, Annual Conference and Exposition.

[5] "A New Theory for the Assignment of Members of Engineering Design Teams," ASEE/GSW, Texas A&M University, College Station, Texas, USA, 2001, T. L. Chambers, A. D. Manning, and L. J. Theriot.

[6] According to E. Koehn's "Educational Criteria for Engineering Design and Practice," published in 1998 by the ASEE/GSW at the University of New Orleans in New Orleans, Louisiana, USA.

[7] For example, see [7] E. L. Wang and J. A. Kleppe's "Teaching Invention, Innovation, and Entrepreneurship in Engineering," Journal of Engineering Education, volume 90, issue 2001, page 565.

[8] [8] "University Industry Design Clinic -A Decade of Experience with an Innovative Capstone Design Course," Intertech International Conference, University of Cincinnati, Cincinnati, OH, USA, 2000. Authors: R. L. Huston, S. Anand, and G. E. Seldman.

[9] In their 1991 book "Electronic Design," Savant, Roden, and Carpenter cited the work of Benjamin/Cummings Publishing Company.

[10] In their paper "Achieving the Objectives of a Two-Semester Senior Design Sequence in Mechanical Engineering: Faculty Goals and Student Perception," authors J. A. Caton, R. Chona, and M. McDermott discuss the goals of the instructors and how students see their progress during the course of the two semesters. New Orleans, LA, USA: ASEE/GSW, University of New Orleans, 1998.

[11] Course Outline for a Bachelor of Science Degree in Electrical and Electronic Engineering [11]. Curriculum for the Bachelor of Science degree in Electrical and Electronics Engineering at Southeast University, Dhaka, Bangladesh, as revised at their third annual Curriculum Committee Meeting on January 30, 2019: Course curriculum of EEE 3 at SEU, downloaded 10 July 2020 from http://www.seu.edu.bd/dept/eee/downloads/Course_Curriculum_of_EEE _Department_3.pdf.

[12] According to [12] S. R. Eisenbarth's "Introducing Top-Down Design Principles in an Undergraduate Computer Systems Design Course," New Orleans, LA, USA: ASEE/GSW, University of New Orleans, 1998.

[13] [13] UGC (2018). The Bangladeshi government's University Grants Commission. This document serves as "Guidelines for Preparing Standard Curriculum of Four Year Degree in Engineering Program," Accessed on the 15th of April, 2020 from http://www.ugc.gov.bd/site/view/policies/-.

[14] Board of Accreditation for Engineering and Technical Education (2017), cited in [14] BAETE. Accessible at http://www.baetebangladesh.org/ download.php as of 15 April 2020 is the first edition of the "Accreditation Manual for Undergraduate Engineering Programs," published in April 2017.

[15] As of the 20th of October, 2020, you may view [15] EEE-PO's Program Outcomes of the BSc in EEE Program at https://seu.edu.bd/dept/eee.php?id=poutcomes.

[16] Reference: Bhuyan, M. H., and Khan, S. S. A., "Teaching a Numerical Analysis Course for Electrical Engineering Students in the Cognitive Domain," International Journal of Electrical Engineering Education, Manchester University Press, UK, e: 2050-4578, p: 0020-7209, vol. 51, no. 1, pp. 82-92, 2014.

[17] "Teaching Numerical Analysis Course for Electrical Engineering Students using MATLAB," by M. H. Bhuyan and S. S. A. Khan, published in the Southeast University Journal of Science and Engineering (SEUJSE), 1999-1630, volume 10, issue 2, pages 38-46, 2016.

[18] Based on the work of M. H. Bhuyan and R. A. Nabi, "Design and Implementation of FPGA based 32-bit Carry Look Ahead Adder using Verilog HDL in Xilinx Environment," Journal of Bangladesh Electronics Society, 1816-1510, volume 9, issues 1-2, pages 161-167, 2009.

[19] "How to Configure and Assess Engineering Capstone Design Course," by J. E. Cross and A. Singh, presented at the 1998 ASEE/GSW conference and published by the University of New Orleans in New Orleans, Louisiana, USA.

[20] For example, see [20] "Implementation of Academic Assessment in Engineering Capstone Design," ASEE/GSW, New Mexico State University, Las Cruces, NM, USA, 2000 by H. P. Mohamadian, S. I. Ibekwe, and C. L. Burris.

[21] As cited in [21] B. H. Swaile, "Professional Ethics and Critical Thinking -A case Study Approach," Intertech International Conference, University of Cincinnati, Cincinnati, OH, USA, 2000.