

## Prospects, challenges and evaluation of the BSc in EEE programme for diploma in engineering holders

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### Abstract

The acquisition of a BSc in EEE is a requirement for a successful career in engineering. However, not all students in Bangladesh have the opportunity to gain admission into degree programmes. The aim of this research is to report the challenges that the Department of Electrical and Electronic Engineering faced in attracting students to the BSc in EEE programme, as well as how they assessed and evaluated the students. The research was a case study conducted in the fall semester of 2020 during the period of online education due to the COVID-2019 pandemic. Various examination and assessment tools were used for the student performance evaluation. Some of the statistical parameters like average, maximum and median were used for the comparative analysis of the student performances on online quizzes, assignments and the obtained letter grades of the regular and evening programmes. It was found that in most of the cases evening programme students performed better in the same course.

**Keywords:** Diploma in Engineering, evening programme, online teaching–learning, performance assessment and evaluation.

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## 1. Introduction

The Diploma in Engineering studies or Diploma in Technical Education is a methodical way of obtaining a degree in any technology that is less than the undergraduate degree. The purposes of a technical degree are to provide students with some elementary knowledge of engineering courses but heavily emphasising on practical than theoretical in nature, basic sciences, computing tools and techniques, applied mathematical techniques for analysis, scientific and technical skills, all-inclusive English language, other soft skills to converse in the workplace and the capacity to relate the theory for solving broadly defined engineering and technical problems (ABET, 2021). It is a programme designed to develop practical skill sets and to provide enough training for the relevant job fields. It is an instruction-based academic package that makes an individual applying basic principles and skills to survive in the engineering project works (IES-NCES, 2021). Its duration is either 3 or 4 years varying from one country to another; the early engineering technology programmes were of 2 years duration (Land, 2012). In the world, numerous countries identify it as comparable to inter-science or pre-engineering courses for advanced studies at the tertiary level. However, in many countries, it was found from a survey that the current students and graduates of such programmes expect an engineering profession (Kelnhofer, Stangeway, Chandler & Peterson, 2010).

The diploma engineers mainly solve the broadly defined problems as per the Dublin Accord. They are also called engineering technologists who are trained professionals in certain aspects of development and implementation of a respective area of technology. They require engineering knowledge of fundamental principles and functional processes, technologies or approaches. The Dublin Accord was signed by its signatory countries in Dublin, Ireland, in May 2002. This Accord is specifically focused on the mutual recognition of academic programmes/qualifications that underpin the educational base for engineering technicians. The Accord acknowledges that the educational base is a key foundation for practice as an engineering technician, in each of the countries or territories covered by the Accord. At present, there are nine signatories under the Dublin Accord (DA, 2021). In most countries, a prospective student can enter into the Diploma in Engineering programme right after completing the 10th grade at school or vocational education institute or the secondary school certificate (SSC) examination.

In Bangladesh, most of the students have to carry on their studies struggling against hunger and poverty. Some of them have to bear the curse of unemployment even after finishing their studies due to inadequate technical knowledge and skills obtained during their course. In this situation, technical education is very much important in this country. As such, the government has also emphasised on the Diploma in Engineering education and has taken special efforts to build a skilled workforce. Therefore, the government formed the Bangladesh Technical Education Board (BTEB) through which a Diploma in Engineering degree can be obtained from any government or private polytechnic institute (BTEB, 2021). A student has to study for 4 years to get a degree. The polytechnic institutions conduct the first 2 years' examinations and then the final 2 years' examinations are conducted under the BTEB. A student can apply for admission to a Diploma in Engineering course to any BTEB-affiliated polytechnic institute after completion of the SSC or equivalent examination. After passing the Diploma in Engineering in Bangladesh, a student needs to study for 3.5–4 years to obtain a bachelor's degree in engineering; but universities in Australia and United Kingdom accept at least 1-year progression (recognition of prior learning) for Diploma in Engineering. The Diploma in Engineering degree is comparable to Business and Technology Education Council National Diploma by UK NARIC, now UK ENIC, which is the UK National Information Centre for the recognition and evaluation of international

qualifications and skills. After becoming BSc engineering graduates, they can apply for the membership of IEB and then can practice as BSc engineers who have to solve a multitude of complex engineering problems for which they need comprehensive knowledge and practical skills that allow fundamental and first-principles-based analytical approaches as per Washington Accord (WA, 2021).

Diploma holders can apply for the examination of becoming an Associate Member of the Institution of Engineers of the Institution of Engineers, Bangladesh (IEB), without any subject exemption, whereas in the IEI, diploma engineers can apply only for four subjects. However, if they obtain a BSc Engineering degree from an accredited programme by the Board of Accreditation for Engineering and Technical Education (BAETE), Bangladesh, then they can apply for full membership of the IEB directly (IEB, 2021).

In Bangladesh, there are over 50 government and over 100 private polytechnic institutes under the BTEB that offer a 4-year Diploma in Engineering in over 30 technical fields (BTEB-Syllabus, 2021). Each year, the student in-take of these polytechnic institutes is over 100,000.

After completion of the Diploma in Engineering course from BTEB, they can enter the job market. But a recent study showed that only slightly over 50% of diploma engineers can get a job in any private or public organisation (IER-DU, 2021). As a result, they are interested in getting a BSc engineering degree. However, a diploma engineer can apply for first-year undergraduate admission in a few public universities [(e.g., Dhaka University of Engineering and Technology (DUET) or Shahjalal University of Science and Technology (SUST) or Jessore University of Science and Technology (JUST)] and most of the private universities in Bangladesh. Besides, many jobholders with a Diploma in Engineering, passed out in the previous years, also want to get admission into the BSc Engineering programme at various public and private universities. However, in the public technical universities, the number of seats is limited, and they do not have evening programmes for jobholders. So, the rest of the admission seekers have to go to private universities to earn their BSc in engineering degrees. Many private universities do not maintain quality education due to their lack of quality laboratory, library, faculty and other staff, as well as limited resources and infrastructure facilities on the campus. So, the students suffer lower quality teaching and other services.

### **1.1. Purpose of the study**

Since the management of the Southeast University (SEU) is pledged to quality tertiary education, there is a chance for this university to open the doors for diploma holders to get quality tertiary level engineering education at an affordable cost. This article reports how the BSc in EEE evening programme for diploma holders was started in SEU. Then, it compares the performance of the evening programme students in a particular course conducted by the same faculty member in the same semester for two cohorts of students: one from the regular day shift and another from the evening shift students. The comparison shows that in most of the cases, the evening programme students are doing better. The aim of this research is to report the challenges that the Department of Electrical and Electronic Engineering faced in attracting students to the BSc in EEE programme, as well as how they assessed and evaluated the students.

### **Nomenclature**

BAETE Board of Accreditation for Engineering and Technical Education

BTEB Bangladesh Technical Education Board

DA Dublin Accord

DUET Dhaka University of Engineering and Technology

EEE Electrical and Electronic Engineering Programme

JUST Jessore University of Science and Technology

PBL Project-Based Learning

SEU Southeast University

SUST Shahjalal University of Science and Technology

WA Washington Accord

## **2. Materials and methods**

### **2.1. Data collection tool**

The research made use of a case study. The results were collected using online quizzes, assignments and the obtained letter grades of the regular and evening programmes.

### **2.2. Participants**

This research was a comparative analysis research which collected data from students studying in the BSc in EEE programme, evening session, SEU, Bangladesh.

### **2.3. Data analysis**

Statistical parameters like average, maximum and median were used for the comparative analysis.

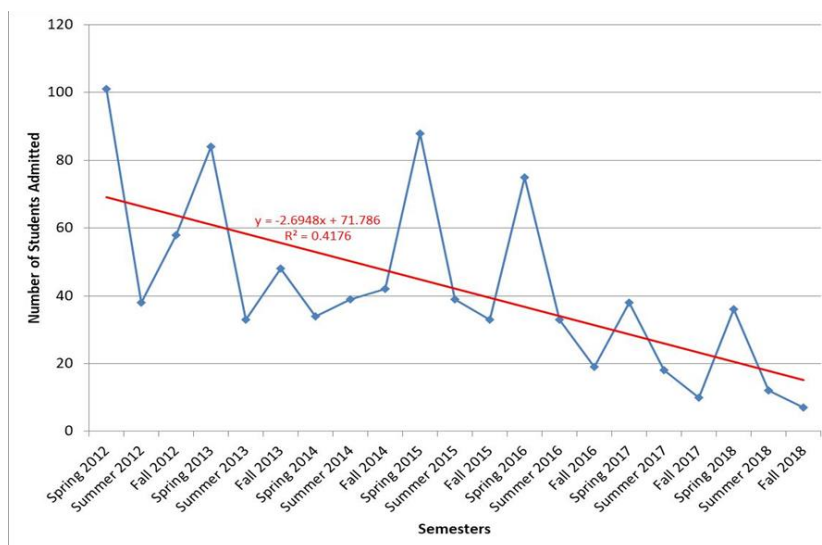
### **2.4. Data collection procedure**

In the 'EEE3305 Control Systems' course, there were 30 and 23 students in the day and evening programmes, respectively, offered in the fall semester of 2020. The course was conducted by the same faculty member who is an expert in his field for over 20 years of teaching and research. Based on the assessment policy, the students' performances in both programmes were analysed and evaluated. However, in the online quizzes, the questions were set only in the first three levels (remember, understand and apply) of Bloom's cognitive taxonomy of teaching and learning, because this domain is

effective in assessing course outcomes (Bhuyan, 2014; Bhuyan & Khan, 2014; Bhuyan & Khan, 2020; Bhuyan, Khan & Rahman, 2014; Bhuyan, Khan & Rahman, 2018). To study the necessity of opening up new programmes under the EEE department, at first, the admission and registration status of the university was studied.

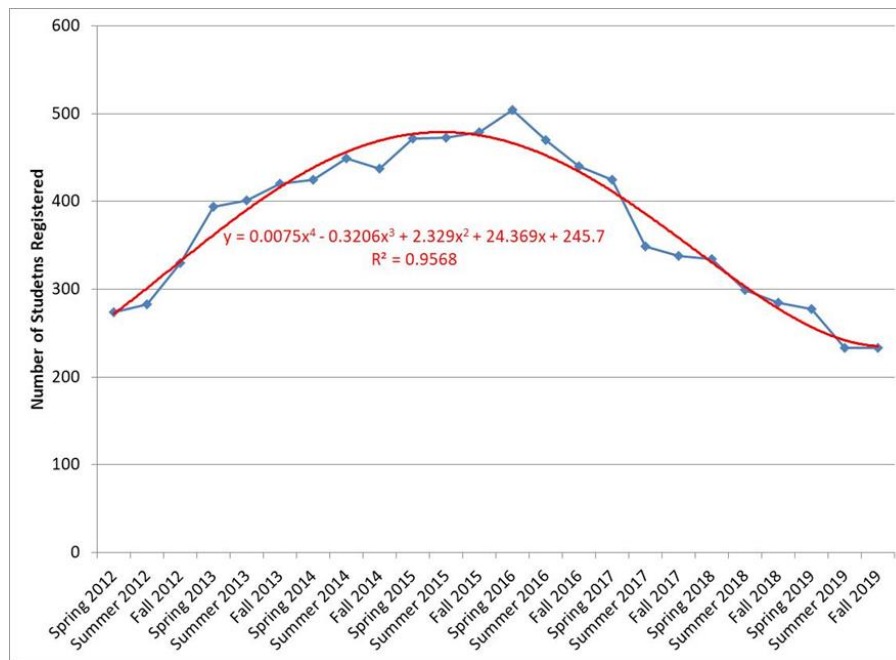
### 3. Results

Figure 1 shows that the student admission in various semesters of the regular programme is decreasing every year and the slope of the trend line of the actual curve is highly negative (around  $-2.7$ ).



**Figure 1. Number of students admitted in various semesters at the EEE department**

Besides, the semester-wise student registration status is analysed as shown in Figure 2, and it is observed that the registration trend started to decline from the Spring 2016 semester (in which the total registration was the highest in number = 504); after that, it started to decrease continuously. Therefore, in a bid to raise the student number and to survive in the EEE department, it became imperative to start a new programme to attract students



**Figure 2. Number of students registered in various semesters at the EEE department**

### 3.1. Need assessment

Since the day shift programme is under the EEE department, there was an important question as to why the same department would start a new programme at the evening shift. Therefore, a three-member committee was formed to identify the reasons behind the proposed new evening shift programme, headed by the Chairman of the EEE department. After several meetings and discussions, the committee identified the following reasons for opening up the evening shift of its BSc in EEE programme:

1. To increase the number of undergraduate students in the EEE department;
2. To help the diploma holders to get a university-level degree;
3. To support the jobholders–diploma engineers to get the university-level degree at an affordable cost in the evening after their job time;
4. To ensure maximum utilisation of the resources of the university at both day and evening;
5. To generate the revenue of the EEE department and hence invest it further by increasing the laboratory, library, research, training and infrastructure facilities of the department;
6. To avail benefits from the jobholders for the existing regular students of the undergraduate programme;
7. To enhance university–industry collaborations through the diploma holders who are also jobholders.

Upon achieving the Diploma in Engineering, diploma holders may either remain in engineering studies at the BSc engineering level or enter into jobs as supervisors, foremen, sales and marketing engineers, workshop engineers, technicians or superintendents, draftsman, service station engineers, automobile engineers, agricultural overseers, farm engineers, junior instructors in the polytechnics, workshop owners etc. But they are not offered a handsome salary and, as such, they are interested to enter into the BSc Engineering programmes. Since DUET is the only engineering university that offers a BSc Engineering degree only to the students from diploma backgrounds with an annual intake of 120 at the EEE department for the day shift and since UGC has set some guidelines for operating undergraduate engineering programmes for diploma holders, there is no hindrance from the government or the UGC to run this programme for diploma holders separately at SEU under the School of Science and Engineering. Besides, it is possible to produce quality graduates from the evening programmes if a minimum standard can be set through the establishment of adequate laboratories, library, teaching and other staff for the department and students do not take any course waiver instead of their diploma courses. Graduates of the evening programmes are expected to get a promotion or new job offers after earning their BSc Engineering degrees.

### **3.2. Assessment of the pros and cons**

After that, the EEE department identified various pros and cons for opening up the same programme in the evening shift for the Diploma in Engineering holders; and after studying the pros and cons, the competent authority had come to a fruitful decision of opening the evening shift. Some of the pros and cons are mentioned as follows:

#### *Advantages:*

If the EEE department starts the evening programme for BSc in EEE, then it will be able to:

1. Raise the number of students in the department and hence the total number of students of SEU;
2. Raise the revenue of the department and hence the revenue of SEU;
3. Contribute to the less privileged segment of the society;
4. Utilise the classrooms, laboratory rooms and equipment and the other spaces of the university for the maximum amount of time;
5. Create opportunities for the staff of the university to get overtime payment;
6. Offer a Master's programme (i.e., MSc in EEE programme) without increasing any other facilities, such as evening programme coordinator, overtime and refreshment bill for evening staff and OSS.

*Disadvantages:*

If the EEE department starts the evening programme for BSc in EEE, then it may create some problems as well. These were identified as follows:

1. Since diploma engineers are mostly jobholders and come to the evening programme, they seek unwanted advantages and show several excuses for not attending the classes or examinations regularly;
2. Most students of the evening programmes are reluctant to study and seek grades/certificates only;
3. From the Tejgaon permanent campus, it is very difficult to get the bus and other communication facilities, so there is a need to create transport facilities for the faculty, students and staff of SEU;
4. For female students and faculty members, it is exceedingly difficult to stay till night as most of the roads do not have streetlights at Tejgaon;
5. During Ramadan, it is very difficult to adjust their classes, because of the need to arrange Iftar for the faculty and staff on behalf of the university authority;



6. Since the evening programme classes start from 6:00 pm and end at 09:00 pm and the office of the EEE department closes at 5:00 pm, the faculty members and staff are required to create evening refreshment facilities every day on humanitarian grounds.
7. It is required to increase the remuneration and refreshment bill for the chairman and coordinator for the evening shift of the department as they are to be in the evening shift as well.
8. The need to arrange rooms for additional faculty members due to the increased number of offered courses.
9. The need to increase the number of adjunct faculty members.
10. The need to increase the number of extra course load from 3 credits to 6 credits.
11. BAETE under IEB does not want to give accreditation to the evening programme. They are suspicious about the education quality in the evening programme. Of course, if the EEE department does not give any course waiver, maintain the academic discipline and provide quality education, then it will not be a problem.
12. Since top-grade universities do not offer these programmes, and only mid- and lower-grade universities offer evening programmes to the undergraduate students, then SEU may also fall into this category.

### **3.3. Identification of the objectives**

The EEE department had to identify some good objectives to open up the BSc in EEE programme in the evening shift. These are to:

1. Give opportunities to the deprived sectors of people in the country to make them capable of becoming dexterous engineers so that they can contribute to the societal and national needs, changes and development;
2. Meet the growing demand of engineers at home and abroad;
3. Create opportunities for diploma engineers for enhancing their knowledge and skills as per their merit and qualification according to the strategy set in the national education policy;
4. Utilise the capacity and resources of the university more efficiently without hampering the quality of education stretching the working hours till 9:30 pm.

### **3.4. Programme opening preparation**

To prepare for starting the evening shift of the BSc in EEE programme, it is required to initiate several operational strategies, such as curriculum setting, course waiver decision, class timing,

admission requirements, approval of the programme etc. Some of the basic operational strategies are provided in the following sub-sections.

### 3.4.1. Preparing operational strategy

The EEE department had to prepare the operational strategies and present them to the Board and University Management to open up the BSc in EEE programme in the evening shift. The summary of the proposed operational strategies is given in Table 1.

**Table 1. Proposed operational strategies**

Class days	Sunday to Thursday	Class time	06:00 –09:00 pm on each weekday
Who will take admission?	All 4-year Diploma in Engineering holders from BTEB, such as Architecture and Interior Design, Construction, Garments Design and Pattern Making, Footwear, Instrumentation and Process Control, Mechatronics, Mining and Mine Survey, Telecommunication, Civil, Wood, Computer, Computer Science, Electrical, Electronics, Food, Mechanical, Power, Refrigeration and Air-conditioning, Ceramic, Glass, Surveying, Marine, Tourism and Hospitality, Shipbuilding, Environmental, Aircraft Maintenance (Aerospace), Aircraft Maintenance (Avionics), Automobile, Chemical, Data Communication and Networking, Electro-Medical, Printing, Graphic Design etc. But no HSC student!		
Who will take the classes, guide research and internship students?	Existing Faculty Members and few Adjunct Faculty Members; full-time teachers will take one more extra course and a few more extra research and internship students to reduce the total expenses of the university		
Where will the programme run?	Existing EEE Department building after 05:00 pm, so no extra accommodation is required		
Who will run the programme?	Current Chairman and a new Coordinator for the evening shift		
Comply with Education Ministry and UGC policy/guidelines?	Yes	Require UGC approval?	No, only the Academic Council and Board of Trustee of SEU need to approve this proposal
Possible starting semester:	Spring 2018 Semester		

Then, the EEE department had to revise the curriculum structure also and present it to the Board and University Management to open up the BSc in EEE in the evening shift.

The undergraduate programme in Electrical and Electronic Engineering (BSc in EEE) comprises several categories of course groups, such as Core Courses, Capstone Design Project, Internship, Elective Courses, Inter-Disciplinary Engineering, Mathematics, Basic Sciences, English Language, General Education Courses and Professional Skill Course (SEU-EEE, 2020). Of them, we excluded a few courses of 21 credits from the regular curriculum structure of the BSc in EEE programme of the EEE department. The excluded courses are as follows: one 3-credit theory course from the Core Course group, one 1-credit laboratory course from the Inter-Disciplinary Engineering group, one 3-credit theory course from Mathematics group, two 3-credit theory courses, two 1-credit laboratory courses from the Basic Science group and two 3-credit theory courses from General Education Course group.

The list of waived courses is given in Table 2. Thus, the final curriculum structure for the students of BSc in EEE evening programme is given in Table 3.

**Table 2. The list of waived courses from the regular curriculum of the BSc in EEE day programme for the students of the BSc in EEE evening programme**

Course code	Title of the course	Credit
EEE111	Electrical circuit I	3
MAT111	Mathematics I	3
PHY115	Physics I	3
PHY122	Physics lab	1
CHE121	Chemistry	3
CHE122	Chemistry lab	1
MGT231	Industrial management	3
ECO315	Economics	3
CEN220	Engineering drawing lab	1
Total Waived credits		21

**Table 3. Course curriculum structure for the students of the BSc in EEE evening programme**

Category	No. of theory courses	No. of sessional/ laboratory courses	Total credits
Core courses	19	12	69
Capstone design project	-	-	6
Internship	-	-	0
Elective courses	6	3	21
Inter-disciplinary Engineering	2	0	6
Mathematics	4	-	12
Basic sciences	1	0	3
English language	4	-	12
General education courses	1	-	3
Professional skill course	-	-	0
Minimum requirement	37	15	132

So, there are 38 theories courses, and 15 laboratory courses are to be offered. So, a total of  $38 \times 3 \times 1$  (no. of theory sections) +  $15 \times 1 \times 2$  (no of lab sections) = 144 credits are to be offered when all batches of students get admitted within the next 10 semesters, assuming that at least one section in each batch will get admitted.

### 3.5. Comparing with the evening programmes of other universities

After that, the EEE department had to compare the curriculum structure, the number of waived credits, cost structure and prepare a plan accordingly to be placed before the Board and University Management to open up the BSc in EEE in the evening shift. This is shown in Table 4.

**Table 4. Comparing the proposed BSc in EEE evening programme with the other university's BSc in EEE evening programmes**

Comparative parameters	Universities offering evening programmes										
	SEU <sup>a</sup>	DUET <sup>b</sup>	DIU	GUB	PU	NUB	HUB	SU	UITS	EU	BUBT
TC <sub>min</sub>	153	163.5	143	144	140	160	143	144	155	149	154
TC <sub>exmp</sub>	21	20.5	13	13.5	13	29	14	-	22	13	0
TC <sub>eve</sub>	132	143.0	130	130.5	127	131	129	144	133	136	154
TC <sub>exmp</sub> (%)	9.0%	12.5%	9.1%	9.4%	9.3%	18.1%	9.8%	0%	14.2%	8.7%	0%
TS <sub>min</sub>	10	7 <sup>↑</sup>	10	10	10	9	10	10	10	10	12
CF (TK)	2,500	-	2,000	2,442	2,400	1,485	2,500	1,835	2,200	2,400	1,550
TF <sub>eve</sub> (TK)	259,000	-	364,900	355,000	382,900	261,000	404,500	405,000	327,300	398,400	344,415
TF <sub>reg</sub> (TK)	615,500	-	673,400	527,800	410,500	461,700	453,500	405,000	375,900	557,000	364,865
∆TF (TK)	356,500	-	308,500	172,800	27,600	200,000	49,000	0	48,600	158,600	20,450
OEP	-	-	CSE, ETE, CE, TE, NFE, SWE	CSE, TE	CSE, ETE, CE	CSE, TE	-	CE, ME, ECE, NAME, CSE	IT, TE	CSE, CE, CSE	CSE, CSIT, TE

<sup>a</sup> Proposed evening programme.

<sup>b</sup> First year, first semester courses are exempted because of the applicant's 3-year/4-year Diploma in Engineering background after 10 years of schooling. This is a day programme, but they take students having Diploma in Engineering only.

TC<sub>min</sub> = Total minimum credit requirements; TC<sub>exmp</sub> = Total number of exempted credits for the evening programme; TC<sub>eve</sub> = Remaining credits for the evening programme; TC<sub>exmp</sub> (%) = Percentage of waived credit; TS<sub>min</sub> = Minimum number of semesters required for the evening programme; CF = Per credit fee for evening programme (TK); TF<sub>eve</sub> = Total tuition fee after credit waiver (TK); TF<sub>reg</sub> = Total tuition fee for regular students (TK); ∆TF = Difference between regular and evening fee (TK); OEP = Other engineering programmes of the university that have an evening shift.

<sup>↑</sup> DUET programmes are bi-semester-based.

Since SEU will offer an evening programme for the first time, and to attract students from the existing market, SEU needs to waive the tuition fee more for the first few semesters.

### 3.6. Tuition fee structure

Then, the EEE department had proposed a tuition fee structure with a waiver policy for the BSc in EEE evening programme, as given in Table 5.

**Table 5. Tuition fee structure of the proposed BSc in EEE evening programme**

Items		Without any Waiver
Admission fee @TK15,000 per student	TK	15,000
Library fee @TK2,000 per student (one time)	TK	2,000
Tuition fee (126 credits theory and laboratory courses)	TK	189,000
Thesis fee (6 credits)	TK	9,000
Non-credit course fee (2 courses) @TK4,500 per course	TK	9,000
Laboratory fee (for 10 semesters) @TK2,000 per semester	TK	20,000
Extra-curricular activities fee (for 10 semesters) @TK1,000 per student	TK	10,000
Other fee (for 10 semesters) @TK500 per student	TK	5,000
Total fee	TK	259,000
Total cost reduction concerning day programme	TK	615,500–259,000 = 356,500

A scholarship policy was also suggested for the Diploma in Engineering holders based on their diploma results on a scale of 4.00, as shown in Table 6. Besides, a semester grade point average-based scholarship policy was also suggested for the Diploma in Engineering holders, as given in Table 7. But none of these proposals was approved by the university management due to a massive-scale flat tuition fee reduction from the tuition fee of the regular programme (around 65%) was given already to all students. However, admitted students are pressing their demands for further tuition reduction based on their merits or other grounds (such as freedom fighter quota, female student quota and semester results at SEU).

**Table 6. Proposed scholarship benefits from the proposed tuition fee structure of the evening programme based on diploma results**

SI #	Diploma results	Waiver rate	Minimum SGPA at SEU to be maintained to continue the waiver
1	CGPA 4.00 out of 4.00	100%	3.50 out of 4.00
2	CGPA 3.80–3.99 out of 4.00	50%	3.50 out of 4.00
3	CGPA 3.50–3.79 out of 4.00	30%	3.25 out of 4.00
4	CGPA 3.00–3.49 out of 4.00	20%	3.00 out of 4.00

**Table 7. Proposed scholarship benefits from the proposed tuition fee structure of the evening programme based on SGPA at SEU**

SI #	SGPA at SEU	Waiver rate	Minimum SGPA at SEU to be maintained to continue the waiver
1	SGPA 3.90–4.00 out of 4.00	50%	3.50 out of 4.00
2	SGPA 3.80–3.89 out of 4.00	30%	3.50 out of 4.00
3	SGPA 3.75–3.79 out of 4.00	20%	3.25 out of 4.00

#### 4.

##### 4.1. Performance evaluation method

The on-campus classes were stopped and only online classes were being conducted due to the COVID-2019 pandemic since 29 March, 2020, at SEU (Bhuyan, 2021) till now, and thus the teaching–learning, assessment and evaluation policies were changed a lot as per the guidelines set by the UGC, Bangladesh (UGC, 2020) and then subsequent resolutions were taken by the Academic Committee of the EEE department, and its approval was taken from the management of the university accordingly (Bhuyan, 2021). As per the new policy, the marks distribution that is followed in this course is shown in Table 8. This policy is followed across all the programmes under the EEE department. This policy uses two direct assessment tools, viz. Formative and Summative Assessments. Both of these tools have two more components each. The university follows the uniform grading policy of the UGC as shown in Table 9. However, withdrawal grades (W) and incomplete grades (I) may be awarded as per the university’s grading policy (Bhuyan & Tamir, 2020).

**Table 8. Student performance assessment method of the EEE Department at SEU**

SI #	Assessment tool	Percentage of total marks	Remarks
1	Formative assessment: Attendance	05%	Based on the number of online classes, quizzes, viva-voce attendance, and number of assignment submission
	Continuous assessment	25%	Based on six online quizzes, the best three quizzes are counted
2	Summative assessment: Midterm examination	30%	Based on three assignments <sup>a</sup> and one online viva-voce, the ratio of marks is 50:50
	Final examination	40%	Based on four assignments <sup>a</sup> and one online viva-voce, the ratio of marks is 50:50

<sup>a</sup> Assignments must be handwritten on A4/letter-sized offset paper with a top sheet that includes student name, student ID, section, course code, the course title, assignment topics, date of submission etc.

**Table 9. The uniform grading policy by UGC followed at SEU**

Marks out of 100	Letter grade	Grade point
80–100	A+	4.00
75–79	A	3.75
70–74	A–	3.50
65–69	B+	3.25
60–64	B	3.00
55–59	B–	2.75
50–54	C+	2.50
45–49	C	2.25
40–44	D	2.00
00–39	F	0.00

## 5.

### 5.1. Outcome analysis and evaluation

#### 5.1.1. Analysis of net profit and financial viability

The EEE department analysed the financial viability of the programme taking into consideration extra costs that would incur due to teachers' and staff salaries, stationery costs, utility bills and some miscellaneous costs. Salaries of full-time teachers are counted based on their one 3-credit extra course load bill for the evening shift and an average of 12 credits of teaching load per full-time teacher. If an average salary of TK80,000/- per month is assumed, and the other operating costs are considered as TK20,000/- per month, as such, the total cost becomes TK100,000/- per month. Therefore, the gross total expenditures become TK400,000/- per semester.

Each newly enrolled student was also offered 4 courses of 12 credits. Initially, it was estimated that 30 students would take admission in the first batch. However, it was finally observed that 40 students got admitted in the first batch of the evening programme that commenced in the spring semester of 2018, and hence the revenue earned from the first batch was TK1,120,000/- per semester. The detailed breakdown of the total revenue is shown in Table 10. So, the net profit from the first batch becomes TK (1,120,000–400,000 = 720,000)/- per semester.

**Table 10. The revenue earning breakdown from the first batch comprising 40 students**

Cost component and rate per student	Per unit rate × number of admitted students	Cost unit	Total revenue
Admission fee @TK7,500 per student	7,500 × 40	TK	300,000
Admission form @TK500 per student	500 × 40	TK	20,000
Library fee @TK2,000 per student	2,000 × 40	TK	80,000
Tuition fee (12 credits enrolled) @TK1,250 per credit per student	1,250 × 12 × 40	TK	600,000
Laboratory fee @TK2,000 per student	2,000 × 40	TK	80,000
Extra-curricular Activities Fee @TK500 per student	500 × 40	TK	20,000
Other fee @TK500 per student	500 × 40	TK	20,000
	Total fee	TK	1,120,000

During this 4-year journey, the EEE department will offer a total of 132 credits considering 21 credits of course waiver from the regular structure; therefore, the department needs  $132/12 = 11$  additional faculty members. If an average salary of TK80,000/- per month is assumed, so a total of TK880,000/- per month salaries are required. If the other operating costs are considered as TK120,000/- per month, as such, the total cost becomes TK1,000,000/- per month. Therefore, the gross total expenditures become TK4,000,000/- per semester. However, the students will get their degrees in 11 semesters. Therefore, on average, they will take  $132/11 = 12$  per semester. By this time, the department has 400 students up to the final semester. Hence, on the whole, the EEE department can earn a total of TK4,000,000/- per semester from the evening programme only. The detailed breakdown of the total revenue from all students in a semester is shown in Table 11. The tuition fee per credit was raised to the students who enrolled in the evening programme from the spring semester of 2019. However, when the pandemic started, all students are getting a flat 25% tuition fee

waiver in three semesters, summer 2020, fall 2020 and spring 2021 Semesters, and a flat 20% tuition fee waiver in the summer semester of 2021. So, on average, a flat rate of TK1,250/- per credit is assumed for the overall revenue calculation. Therefore, the net profit from all batches of evening students becomes TK (7,200,000–4,000,000 = 3,200,000)/- per semester. Therefore, in a 4-year cycle, the net profit becomes  $TK3,200,000 \times 11 = 35,200,000/-$  (35.2 million of Bangladeshi Taka).

**Table 11. The revenue earning breakdown from the first batch comprising 40 students**

Cost component and rate per student	Per unit rate × number of admitted students	Cost unit	Total revenue
Tuition fee (12 credits enrolled) @TK1,250 per credit per student	$1,250 \times 12 \times 400$	TK	6,000,000
Laboratory fee @TK2,000 per student	$2,000 \times 400$	TK	800,000
Extra-curricular activities fee @TK500 per student	$500 \times 400$	TK	200,000
Other fee @TK500 per student	$500 \times 400$	TK	200,000
	Total fee	TK	7,200,000

From this expenditure versus revenue analysis, it is observed that this programme is very much helpful for the income generation of the department to meet the various expenses of the department, such as establishing quality laboratory and purchasing library books, journal papers etc. for further development; upgrading the existing laboratories by purchasing continuously quality test and measurement equipment, electrical and electronic engineering training kits and modules as well as necessary accessories; creating more infrastructure facilities in the department, e.g., multimedia and Internet-based classrooms, laboratory rooms, faculty rooms, office rooms etc.; recruiting more senior faculty members for the department; arranging various training programmes and workshops for the faculty members; organising various extra- and co-curricular activities in the department in gorgeous ways.

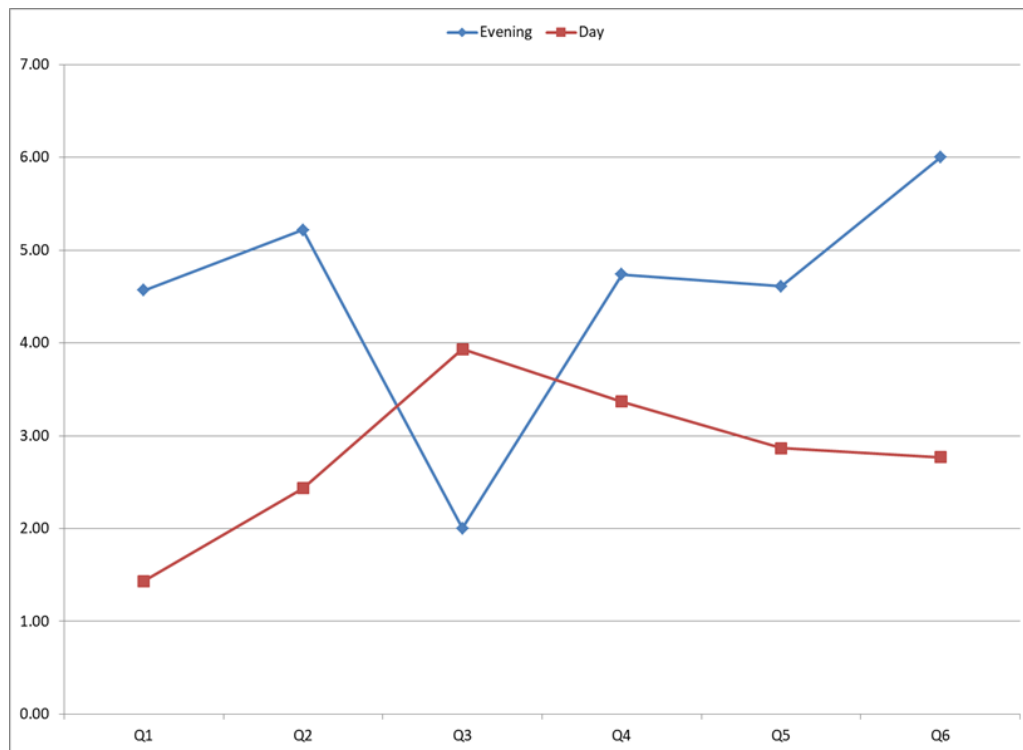
Now, the EEE department needs to do the break-even analysis. It was found that the total gross expenditures per semester when there is only one batch of students were TK400,000/- and the department can earn  $TK(1,120,000 \div 40 = 28,000)/-$  by admitting one student in the first semester. So, at least  $TK(400,000 \div 28,000)$  15 students in the first semester to come out of break-even point. Through this crude analysis, we have to consider other factors. For example, if a full-time teacher takes this course, then the extra-load is around half of his full-time salary, as such his income level would reduce, and hence the cost of the department. Hence, it can be inferred that the evening programme is financially viable, too.

## 5.2. Student performance evaluation

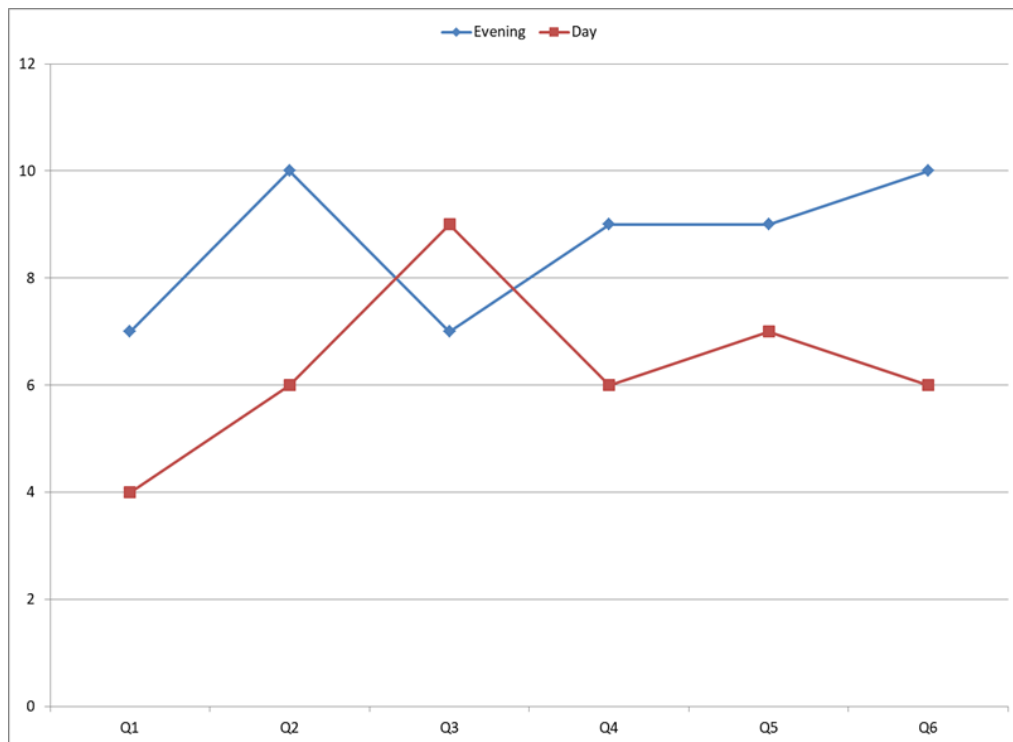
To analyse the student performance of the evening programme concerning the students of the day programme, two sections of the same course in the same semester were conducted by the same faculty member having experience and expertise in the subject matter of the course. The selected course was EEE3305 control systems with 3-credits offered in the fall semester of 2020. The obtained overall grades, total marks, each quiz marks, each assignment marks, attendance rates etc., of that course were compared for the students of two programmes, viz. day and evening shifts. It has been observed that in Figure 3, the higher average marks are obtained by the students of the evening programme in five online quizzes out of the six online quizzes taken. Besides, in Figure 4, it has been



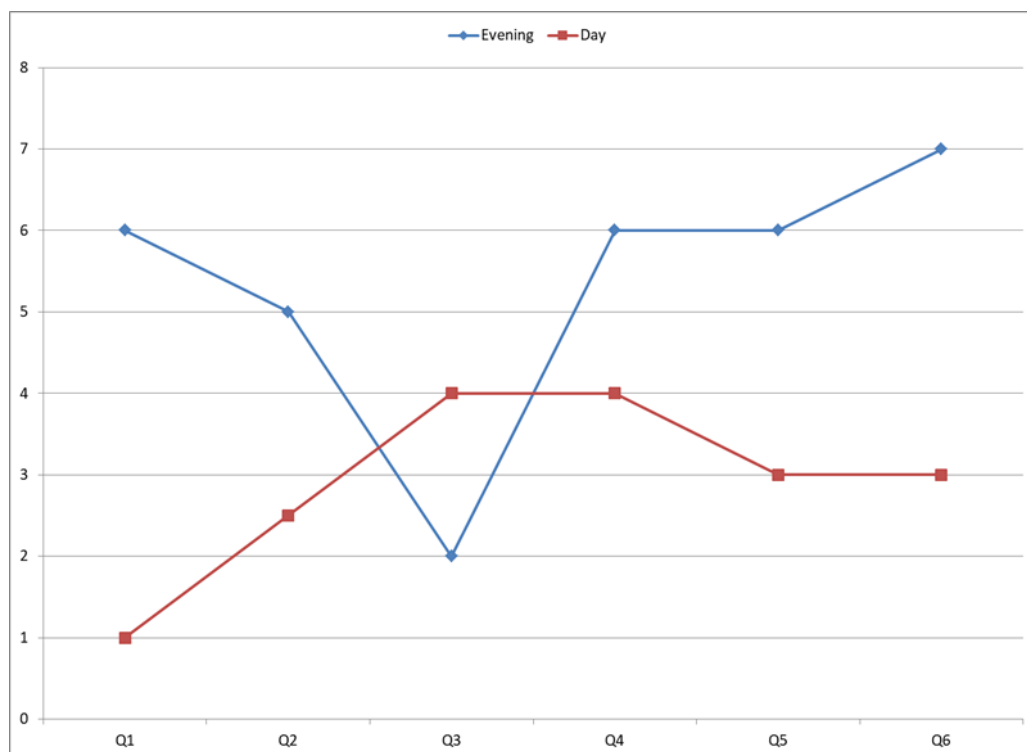
observed that the higher maximum marks are obtained by the students of the evening programme in five online quizzes out of the six online quizzes taken. It has been observed that, in Figure 5, the higher median marks are obtained by the students of the evening programme in five online quizzes out of the six online quizzes taken.



**Figure 3. Performance analysis of the students based on obtained class average marks on various online quizzes of the control systems course**



**Figure 4. Performance analysis of the students based on obtained class maximum marks on various online quizzes of the control systems course**



**Figure 5. Performance analysis of the students based on obtained class median marks on various online quizzes of the control systems course**

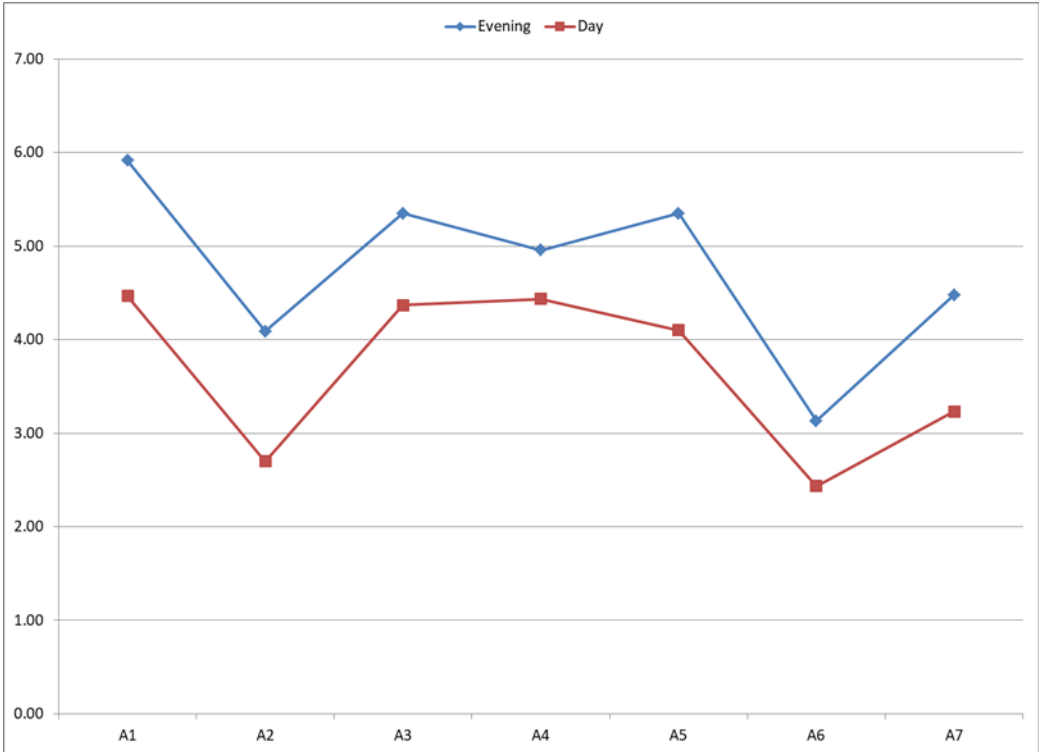


Figure 6. Performance analysis of the students based on obtained class average marks on various assignments of the control systems course



Figure 7. Performance analysis of the students based on obtained class maximum marks on various assignments of the control systems course

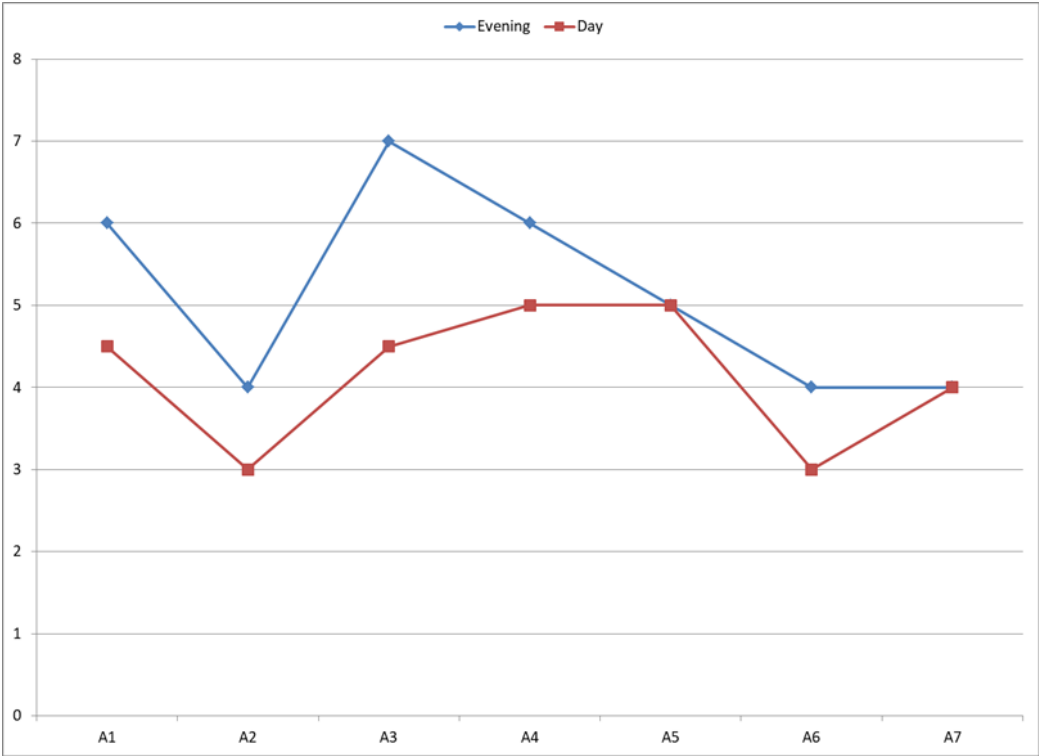


Figure 8. Performance analysis of the students based on obtained class median marks on various assignments of the control systems course

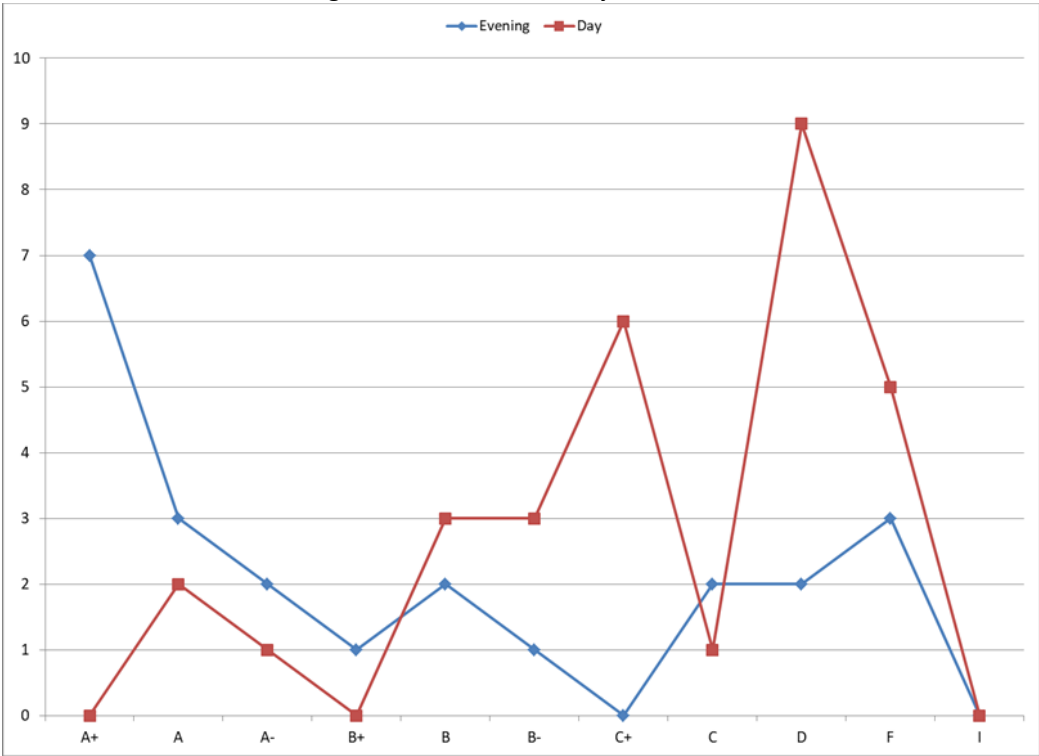


Figure 9. Performance analysis of the students based on the number of obtained letter grades in the control systems course

It has been observed that in Figure 6, the higher average marks are obtained by the students of the evening programme in all seven assignments given to them. Not only that, but they also achieved the higher maximum and median marks in all seven assignments given to them, as shown in Figures 7 and 8, respectively. In Figure 9, it is observed that the upper grades (i.e., A+, A, A–, and B+) are mostly achieved by the students of the evening programme concerning the students of the day programme. Therefore, it is concluded that the evening programme is an effective programme for any engineering department for diploma holders who are in a job at daytime and want to work hard to obtain a BSc engineering degree from a quality tertiary education provider. Achievement of higher grades by the higher number of students may be attributed to the fact that the students of the evening programme are more serious than that of the day programme, because the former being in the jobs understands better the necessity of obtaining a BSc Engineering degree than the latter.

## 6. Discussion

After analysing the issues of opening an evening programme for the BSc in EEE programme for the Diploma in Engineering holders and subsequent assessment and evaluation of the academic performances of the evening programme students by an expert faculty member of a particular course, the following recommendations were made for further quality improvement of the programme and to make it more fruitful and attractive to the students:

The evening programme should be continued by the EEE department of SEU since it is attracting students and generating a huge amount of revenue without increasing overhead costs. Since the students attend the class after performing their duties in the jobs, there should be a less amount of time for lectures; class should be more interactive than the day programme, so that the students do not get bored with continuous lecturing.

To make the best use of the class duration, e-flipped classroom technique must be used. It has been found that the e-flipped classroom model may be developed based on the technology-driven active learning technique for the students and may be an effective alternative method to teach a large number of contents from the theory courses of the curriculum during the lockdown period due to the COVID-2019 epidemic (Guraya, 2020; Rubio-Fernandez, Munoz-Merino & Kloos, 2019). This would assist the students to engage themselves effectively in out-of-class studies as per their suitable schedules and hence grasp the course learning contents assigned by the course instructor before coming to the class (Lai & Hwang, 2016).

Online assessment policies need to be refined more so that the teaching-learning, assessment, and evaluation is possible to conduct at the higher levels of Bloom's taxonomy's cognitive domain as well as other domains, viz. affective and psychomotor domains (Bhuyan, 2021; Bhuyan & Khan, 2014).

Since this programme is making a profit, the profit must be invested further to enhance the quality of each programme continuously by recruiting more qualified faculty members having PhD degrees, upgrading the curriculum, hiring qualified technical and office support staff for the laboratories and offices of the EEE Department, purchasing cutting-edge laboratory equipment, establishing good research laboratories, engaging faculty members and students, both regular and evening students, into the research projects, publishing research papers in the journals and conferences at the national and international levels, allocating more funds as research grants, encouraging students to be involved

in the capstone design projects etc. This will, in turn, help the BSc in EEE day programme to be enhanced further and attract students in that stream as well.

To improve teaching quality in the online version, faculty members need to be trained regularly. Taking student feedback is an essential method to get a proper reflection about how to pay full attention to the students for their proper learning and to utilise the advantages of this online teaching mode during the pandemic period. Arranging seminars and webinars with the industry leaders so that the regular programme students become familiar with job demands and engineering skill sets. All programmes' final year students need to be offered skill set development programmes,

## 7. Conclusion

This article explained the importance of opening an evening programme for the BSc in EEE programme and evaluated and compared the student performances in both regular and evening shifts based on their online courses during the pandemic. Besides, the profit level and break-even analysis were also made.

In the job field, a few positions are available above the rank of a technician that has the term 'technologist' in the job advertisement. That is, qualified engineering graduates are heavily needed to fill up those gaps to solve the technological problems and technical communication so that the teamwork becomes much better. If a 4-year engineering technology graduate can satisfy most of these skill sets, then he/she can avail those positions that are currently being offered to the graduates of the BSc engineering programmes. Since due to some technical limitations, the diploma engineers or engineering technology graduates cannot enter into those jobs with their knowledge, skills and experiences; therefore, if they can obtain a BSc engineering degree from any suitable programme, then they can serve better with dignity and pride and reduce demand gap of the job market of professionally qualified engineers.

Finally, it can be concluded that the decision of opening the evening programme for the diploma holders was justified and done right at the time. It generated revenue, increased student intake and registration and made it possible to make a new investment to the department for further quality improvement and revitalise the day programme as well.

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