77.5

Daffodil International University
Department of Electrical and Electronic Engineering
Faculty of Engineering
Final Examination, Summer-2026

Course Code: 0542-221 | Course Title: Probability and Statistics
Section: A, B, C, D | Level-Term: L2-T2 | Teacher's Initial: MAR, SS
Full Marks: 40 | Exam Date: August 22, 2026 | Time: 2 Hours

[Answer all the following questions]
[The second right-most column indicates the COs with the respective Bloom's level]
[The right-most column indicates the assigned marks]

Q1. An EEE engineer is testing 50 electronic components to assess their quality. The components are numbered from 1 to 50. One component is randomly selected for detailed testing. — CO-1 C(2) — 5

a) **Explain** why selecting one component randomly is a random experiment.
b) **Describe** an event and give one suitable event from this component-selection situation.
c) **Identify** the sample space for this experiment in terms of the components being tested.
d) If A is the event that component number 15 is selected, **explain** what A^c represents.
e) **Discuss** why the events "component number 15 is selected" and "component number 20 is selected" are mutually exclusive.

Q2. An EEE engineer is studying the relationship between the charging time of a battery and the amount of charge stored in it. The following observations were recorded during a laboratory experiment. — CO-2 C(4) — 10

Charging Time, X (min)	30	43	52	67	71	75	77
Stored Charge, Y (Ah)	42	48	55	61	68	73	89

a) **Analyze** the strength of the relationship between charging time and stored charge by calculating the Karl Pearson correlation coefficient.
b) **Identify** the regression equation of Y on X and estimate the stored charge when the charging time is 63 minutes.
c) **Explain** β_0 and β_1 in the context of the battery charging process.

Q3. An EEE department surveys 120 students from three specializations to study their preference for Battery Storage or Super capacitor-based Storage. The survey aims to examine whether students' specialization is associated with their energy-storage preference. The results are shown below: — CO-3 C(3) — 7

Specialization	Battery Storage	Super-capacitor	Total
Power Electronics	33	7	40
Control Systems	16	29	45
Communication Systems	16	19	35
Total	65	55	120

$\hat{\beta}_0 = \bar{Y}_i - \beta_1 \bar{X}_i$

a) **Determine** the probability that a randomly selected student prefers Super-capacitor.
b) **Calculate** the probability that a randomly selected student either belongs to Power Electronics or prefers Super-capacitor.
c) **Compute** the probability that a randomly selected student belongs to Power Electronics given that the student prefers Super-capacitor.
d) **Determine** whether the events "the student belongs to Power Electronics" and "the student prefers Battery Storage" are independent. Justify your answer.

Q4.a) An EEE engineer is monitoring the output voltage of a DC power supply. The output voltage is normally distributed with mean 220 V and standard deviation 5 V. For reliable operation, the voltage must remain between 215 V and 225 V. CO-3 C(3) 4

i) **Calculate** the probability that the output voltage lies between 215 V and 225 V.
ii) If 1000 voltage measurements are taken during the testing process, **predict** how many are expected to be unreliable?

Using the standard normal table,
$P(Z < 1) = 0.8413$
$P(Z < -1) = 0.1587.$

b) A semiconductor testing facility monitors the occurrence of defective chips as part of its daily quality-control process. Based on historical quality-control data, an average of 2 defective chips is detected per day, with a variance of 1.6 in the daily number of defective chips. Let X denote the number of defective chips detected on a randomly selected day. CO-3 C(3) 6

i) **Identify** the probability distribution of X and explain briefly why it is appropriate for this situation.
ii) **Compute** the probability that at most three chips are defective in a day.
iii) **Calculate** the probability that more than two chips are defective in a day.
iv) **Determine** the expected number of non-defective chips detected over a period of three days.

Q5. An EEE laboratory is evaluating the performance of two different battery-management systems. The average power consumption of each system is measured under similar operating conditions. CO-3 C(3) 8

The power consumption measurements (in W) from two independent samples are:

Battery Management System A: 48, 51, 49, 52, 50, 47

Battery Management System B: 44, 46, 43, 48, 45, 47, 42, 46, 44

The researcher assumes that the population variances are equal. **Apply** the appropriate test statistic to formulate and test the hypothesis, and decide whether there is a significant difference between the mean power consumption of the two battery-management systems at the 5% level of significance.

Using t-table
$t(0.025,13) = 2.160$

$$r = \frac{\sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n} (x_i - \bar{x})^2}}$$