Preparing Outcome Based Questions, Assignments and Projects

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IUB INSTITUTIONAL QUALITY ASSURANCE CELL
A Center of Quality and Excellence

Outline & outcome

Outlines

- Program Outcome Tools (10 mins)
  - PO assessment tools
- OBE Based Assessment (50 mins)
  - Outcome base questions
  - Outcome based assignments
  - Outcome based projects

Outcomes

At the end of this seminar / workshop, the participants are expected to

- understand the good practice of OBE-based TLA
- write good course outcomes & proper matching with program outcomes
- design complex engineering projects, assignments & open-ended lab
- defining rubrics and addressing K-P-A for FYDP
- contribute in preparing SAR for BAETE accreditation

8. Program outcome (PO) - recall

Program Outcomes	NO	Learning Taxonomy
Engineering Knowledge (K1-K4)	PO1	Cognitive
Problem Analysis (K1-K4)	PO2	Cognitive
Design/development of Solutions (K5)	PO3	Cognitive
Investigation (K8)	PO4	Cognitive, Psychomotor
Modern Tool Usage (K6)	PO5	Cognitive, Psychomotor
The Engineer and Society (K7)	PO6	Cognitive, Affective
Environment and Sustainability (K7)	PO7	Cognitive, Affective
Ethics (K7)	PO8	Cognitive, Affective
Individual Work and Teamwork	PO9	Affective
Communication	PO10	Affective
Project Management and Finance	PO11	Cognitive, Affective
Life-Long Learning	PO12	Affective

Psychomotor & Affective domain – assessment

- **PO4: Investigation (lab, project/assignment, open-ended lab)**
  - ✓ **Conduct** investigations using relevant research methodology including literature review, design of experiments, analysis and interpretation of results to derive scientifically sound conclusions.

- **PO5: Modern Tools Usage (lab, project / assignment)**
  - ✓ **Utilize** systematic approach to select/create appropriate IT & engineering tools, with full understanding of their limitations, to model, simulate and solve complex engineering problem.

- **PO6: Engineer and Society (exam, assignment, presentation, report)**
  - ✓ **Assess** the Engineers' responsibility for safety and risk including the risk-benefit analysis considering practical issues of the society.
  - ✓ **Explain** the project outcome on the safety, health & legal issues.

Psychomotor & Affective domain – assessment

- **PO7: Environment & Sustainability (assignment, presentation, report)**
  - ✓ **Explain** the impact of project outcome on the environment & sustainability and addressing the SDG goals considering technical, economic, social & environmental issues.

- **PO8: Ethics (case studies, assignment, presentation, report)**
  - ✓ **Employ** ethical decisions considering professional code of ethics, rights and responsibilities of engineers.

- **PO9: Individual Work & Teamwork (project, lab)**
  - ✓ **Conduct** experiment (hardware / software / simulation) individually / in a group and report accordingly.
  - ✓ **Identify** a contemporary problem individually / in a group through literature review and solve the problem using appropriate method / technique.

Psychomotor & Affective domain – assessment

- **PO10: Communication (presentation, report)**
  - ✓ **Communicate** results clearly and professionally in oral and written form.

- **PO11: Project Management & Finance (assignment, project)**
  - ✓ **Plan** budgeting, procurement and financial management for implementing a project.
  - ✓ **Evaluate** the strategic issues and practical considerations to implement a project which includes conducting project meetings, prepare documents and report progress.

- **PO12: Life-Long Learning (assignment, project)**
  - ✓ **Identify** a contemporary problem through literature review whose solution will be designed, developed and verified using appropriate method / technique.

3. The laptop's touch pad is used to control the position of the pointer on the computer screen by providing a link between the position of a finger on the pad to a position on the screen as shown in Fig.3. The equivalent *RC* circuit of such a system is shown in Fig.4. Derive the expression of voltage across the capacitor if the switch is closed at time t = 0. Consider the capacitor is initially discharged. Calculate the time constant of the circuit when *R* and *C* is 5kΩ and 5μF, respectively. If the supply voltage is 50V, what will be the voltage across the capacitor after 100ms. [CO3-C4] (8+2+5)

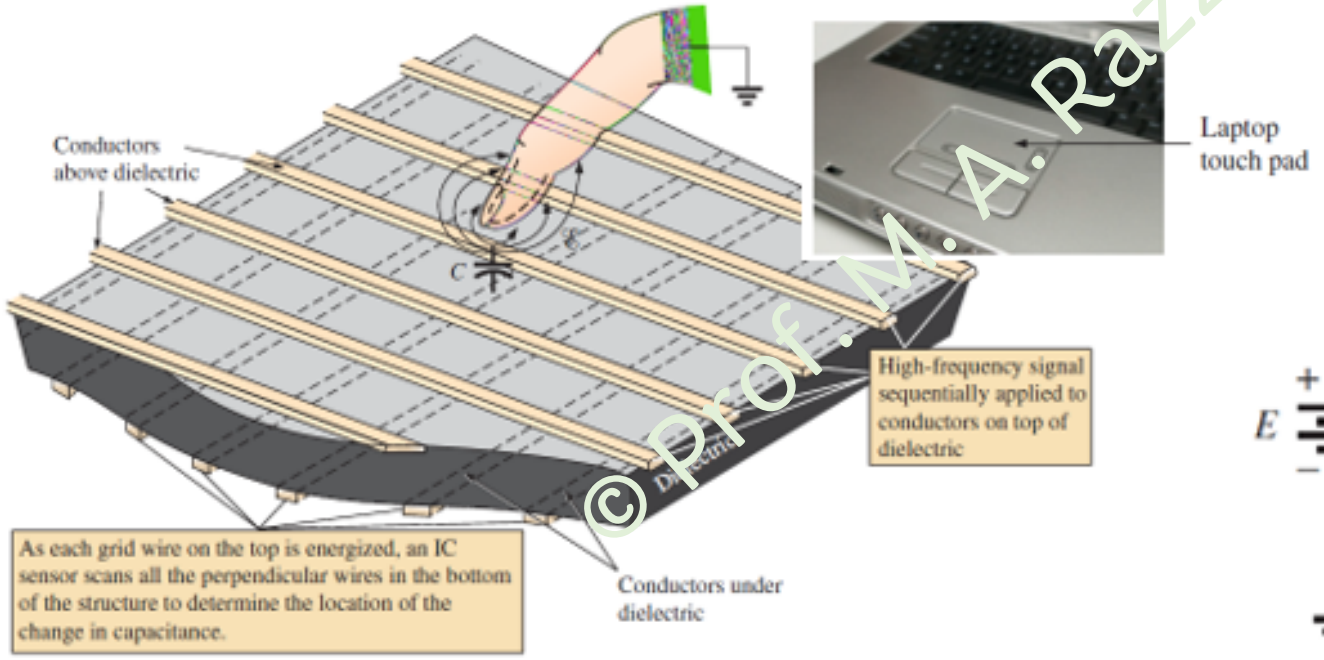


Fig.3

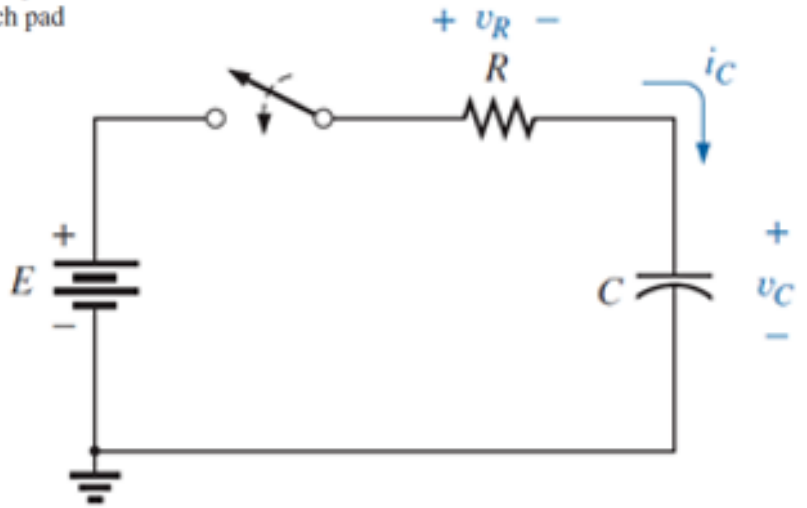


Fig.4

EEE101: Assessment – Exam (example)

4. In a magnetic resonance imaging (MRI) machine, the image is obtained by placing the patient in the tube to a precise depth depending on the cross section to be obtained and applying a strong magnetic field produced by a magnetic chamber. The equivalent magnetic circuit of such a magnetic chamber, which consists of cast steel, is shown in Fig.5. The B-H curve of magnetic materials is shown in Fig.6. Find the number of turns N_1 required to establish a flux $\Phi = 4.8 \times 10^{-4}$ Wb in the magnetic circuit. Also find the permeability μ of the material. [CO4-C3] (10+5)

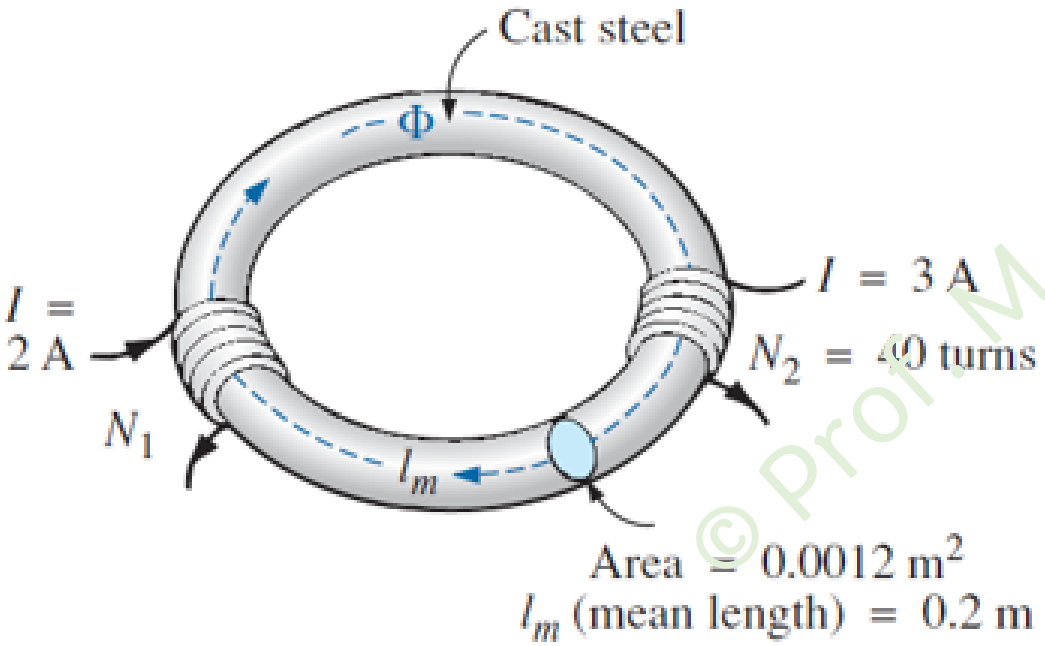


Fig.5

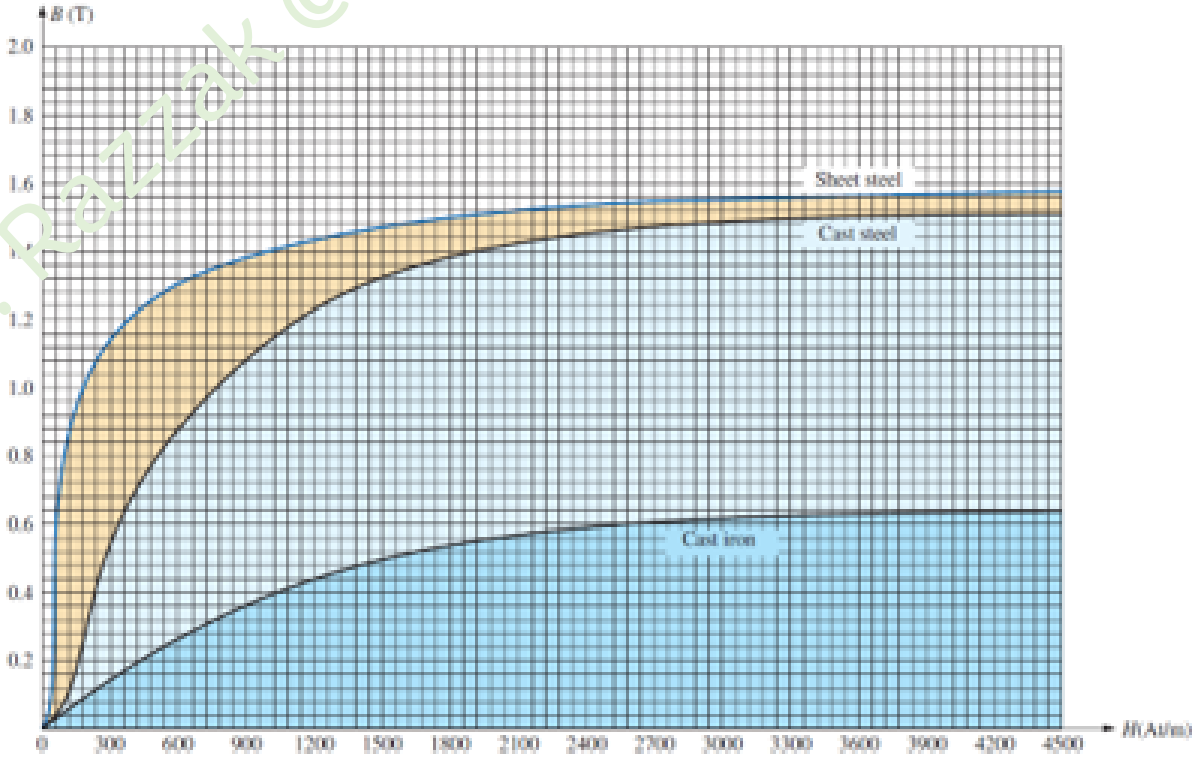


Fig.6

Cognitive domain assessment (exam) - example

Course: Control Systems (Final Exam)

You are required to design an electric vehicle number plate recognition system consisting of a motor, camera and an amplifier as shown in Fig.3. The system can also be used to detect any number plate following the moving objects automatically. The root locus technique can be used to analyze and design the effect of loop gain upon the system's transient response and stability. Determine the following design parameters:

(i) Natural frequency and amplifier gain, K, for which the root locus crosses the imaginary axis. (15+10)

(ii) Range of amplifier gain, K, for which the system will be stable. (5)

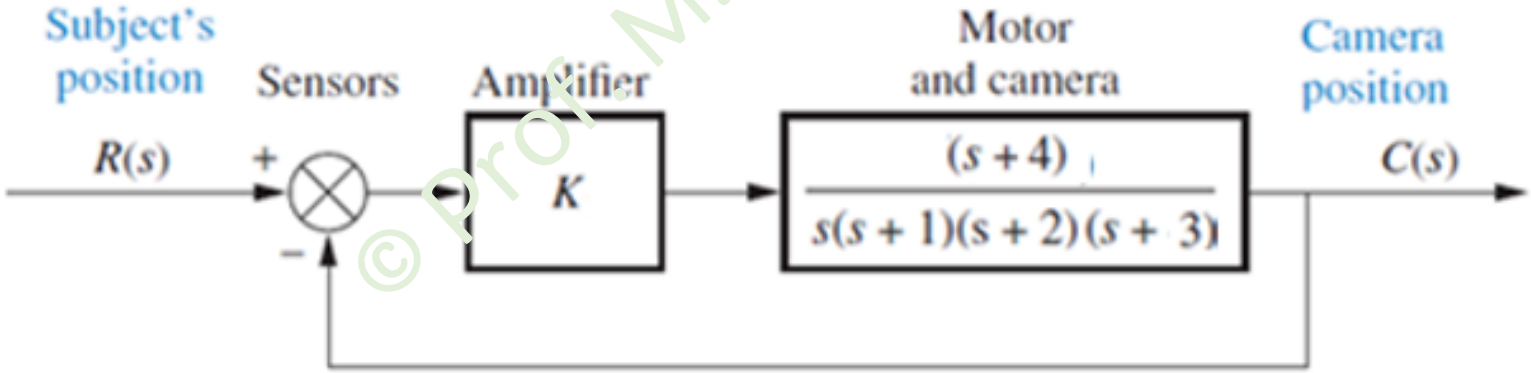


Fig.3

Cognitive domain assessment (exam) - example

Final Examination (Spring 2018)

EEE 402: Power Transmission & Distribution

Full Marks: 90 **Time:** 120 Mins

Instructions:
1. Answer ALL questions.
2. Mobile phone / other electronic gadgets are not allowed as calculator.
3. Partial grading is available.

Q1. Suppose you are recruited by Power Grid Company Bangladesh (PGCB) limited where you are assigned to design a transmission line for installing in Rangamati Hill Tracts district. A prototype of such a transmission line is shown in Fig.1, where the tension in the conductor is 1600Kg and weight of conductor is 1.5kg/m. Determine (i) the minimum clearance of the conductor and hill (ii) clearance mid-way between the support to solve your assignment. [CO2-C3] (6+6)

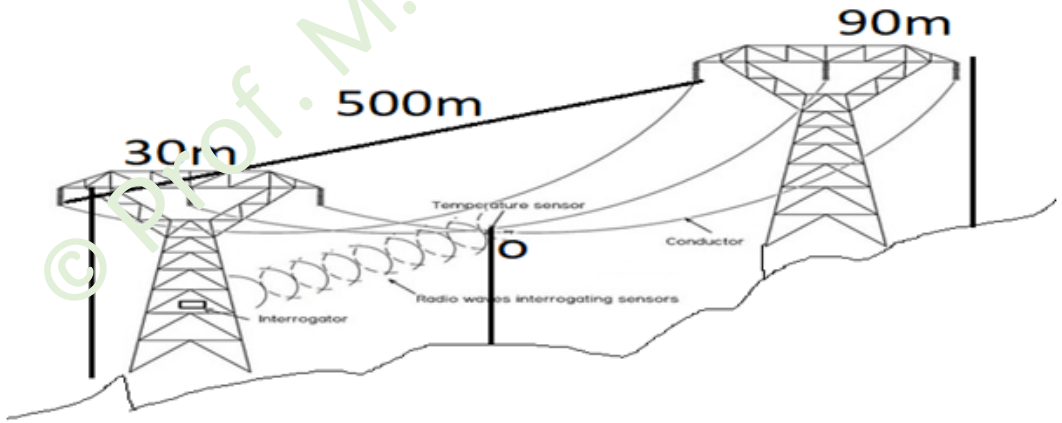


Fig.1 Prototype transmission line to install at Rangamati

Cognitive domain assessment (exam) - example

Course: Digital Image Processing (Final Exam)

1. **Histogram Equalization** is a computer image processing technique used to improve contrast in images. ***Perform*** histogram equalization to the following images having 8 discrete pixel levels (0-7) to transforming it into a histogram equalized image with 8 discrete grey levels. [CO3-C3]

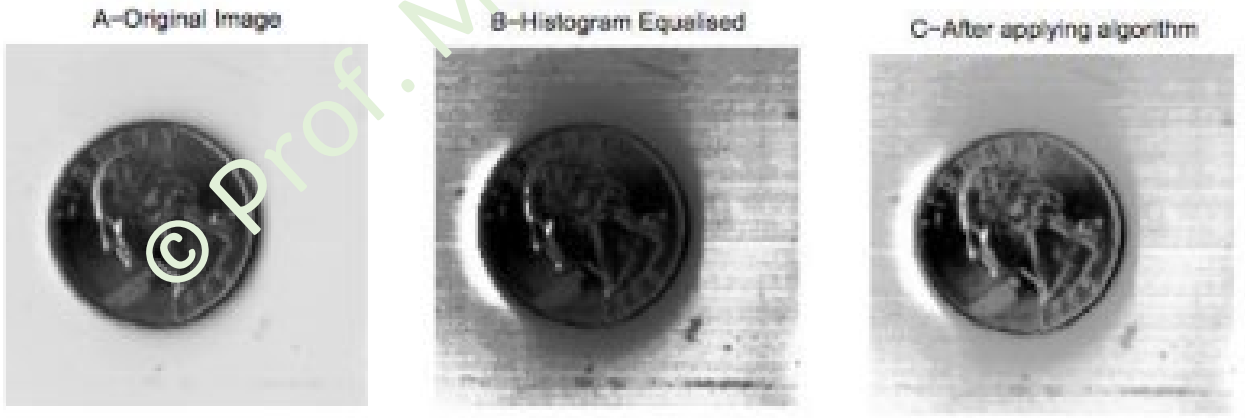
1	1	1	1	1	1	1	1
0	2	5	5	5	5	2	0
0	3	2	6	7	2	3	0
0	3	3	2	2	3	3	0
0	2	3	2	2	3	3	0
0	3	2	4	4	2	4	0
0	2	6	4	4	4	2	0
1	1	1	1	1	1	1	1

Cognitive domain assessment (exam) - example

Course: Digital Image Processing (Final Exam)

2. Histogram Equalization is applied to the coin in image A and the result is the image B. Figure 4 Image Enhancement of Coin Image. [CO3, C3]

a) Explain what do you understand by Histogram Equalization.
b) Why does image B look bad with few visible details on the coin?
c) A different algorithm is applied to image A and produces image C above, which enhances both the background and the coin. Describe a possible concept of the algorithm.



Cognitive domain assessment (exam) - example

Course: Digital Image Processing (Final Exam)

3. In Digital Image Processing, **noise removal** is one of the preprocessing techniques. There are various types of image noise. In the MATLAB program below, **Median Filtering** is used to remove '**salt and pepper noise**'

```
A=imread('zebra.jpg');
title('IMAGE WITH SALT AND PEPPER NOISE');
figure,imshow(A);
modifyA=zeros(size(A)+2);
B=zeros(size(A));
for x=1:size(A,1)
  for y=1:size(A,2)
        modifyA(x+1,y+1)=A(x,y);
  end
end
for i= 1:size(modifyA,1)-2
  for j=1:size(modifyA,2)-2
        window=zeros(9,1);
        inc=1;
        for x=1:3
              for y=1:3
                    window(inc)=modifyA(i+x-1,j+y-1); inc=inc+1;
              end
        end
med=sort(window);
B(i,j)=med(5);
  end
end
B=uint8(B);
title('IMAGE AFTER MEDIAN FILTERING');
figure,imshow(B);
```


a) ***Describe*** the different steps in 2D Median Filtering. [CO2-C2]

b) ***Show*** how the MATLAB code above implement the steps mentioned in part (a)

c) ***Explain*** why Median Filtering is appropriate for 'salt and pepper' noise removal.

Cognitive domain assessment (exam) - example

Course: Digital Image Processing (Final Exam)

4. Image Filtering is useful in image extraction and feature enhancement. This is often achieved through the **detection of edges** within images.

i) **Explain** Edge Detection with examples.
ii) **Explain** how Edge Detection is achieved?
iii) **Distinguish** among the Roberts Cross Edge, Sobel Edge Detector and Canny Edge Detector. [CO2-C2]

Cognitive domain assessment (exam) - example

Course: Sensor and Instrumentation (Class Test / Final Exam)

1. A **transducer** is an electronic device that converts energy from one form to another. Common examples include microphones, speakers, thermometers, position and pressure sensors, antenna etc.

a) ***List*** three common types of transducer used in the industry. [CO2-C1]

b) ***Explain*** different methods of measuring liquid levels using capacitive transducer. [CO2-C2]

Cognitive domain assessment (exam) - example

Course: Sensor and Instrumentation (Class Test / Final Exam)

1. **Pressure sensors** are used for many automotive, medical, industrial, consumer and building devices, which depend on **accurate** and **stable pressure measurements** in order to operate reliably. A pressure sensor has a span of 25 to 150 psi. ***Specify*** the error when measuring 107 psi, if the accuracy of the gauge is ±1.5% of span, of reading. [CO2-C3]

Cognitive domain assessment (exam) - example

Course: Robotics (Mid Term Exam)

1. The end-effector mounted on the wrist enables the robot to perform specified tasks. Various types of end-effectors are designed for the same robot to make it more flexible and versatile. **Classify** different types of end effectors based on their structure and usage. (CO1-C2)

2. A rotation matrix is a collection of equations expressed in matrix form and used to change the perspective associated with spatial data. **Obtain** the rotational matrix for Figure A and Figure B, which show positive rotations about the Y-axis and X-axis. [CO2-C3]

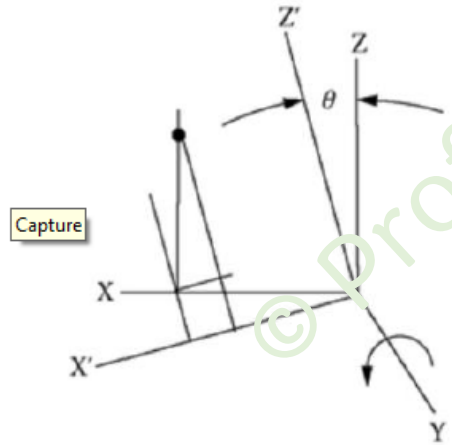


Figure A: Rotation about the Y-Axis

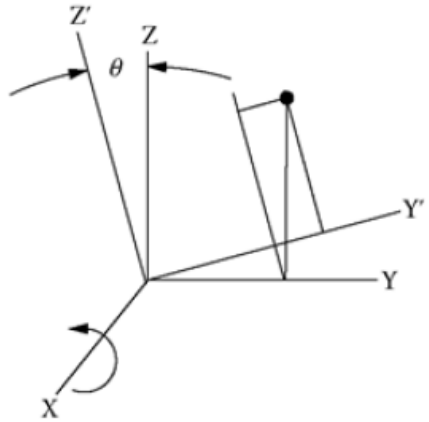


Figure B: Rotation about the X-Axis

Cognitive domain assessment (exam) - example

Suppose you are appointed at the Rooppur Nuclear Power Plant as a Plant Operation Engineer. At some point of the operation, you observe a sudden abnormal increase in steam production and the rate of U-235 fission goes up. What do you think the primary reason would be? What measure would you take to address the issue? [CO1-C2] (10)

Cognitive domain assessment (exam) - example

Course: Control Systems (Class Test)

Consider the operation of the biological control system consisting of a human being reaching for an object as shown in Fig.2. Draw the equivalent block diagram of this control system by naming each block. Specify whether this is a closed loop or open loop system. (6+2)

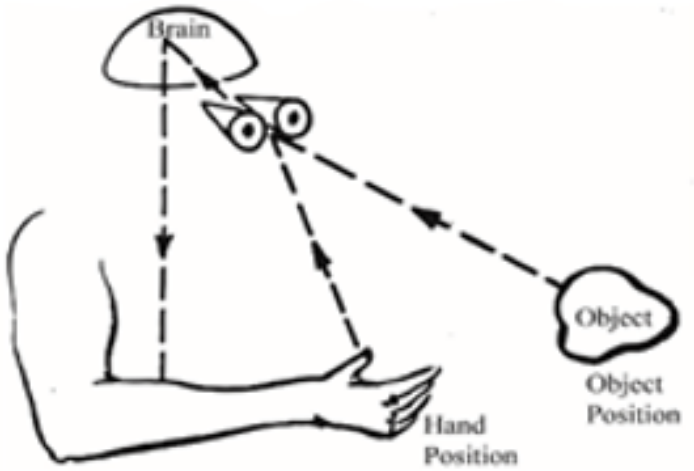


Fig.2

Cognitive domain assessment (exam) - example

Course: Control Systems (Class Test)

Consider a car is moving along the road as shown in Fig.2. The vertical displacements at the tires act as the motion excitation to the automobile suspension system. The motion of this system consists of a translational motion of the center of mass and a rotational motion about the center of mass. Draw a schematic diagram of this automobile suspension system and determine the transfer function by simplifying it. [CO1] (2+8)

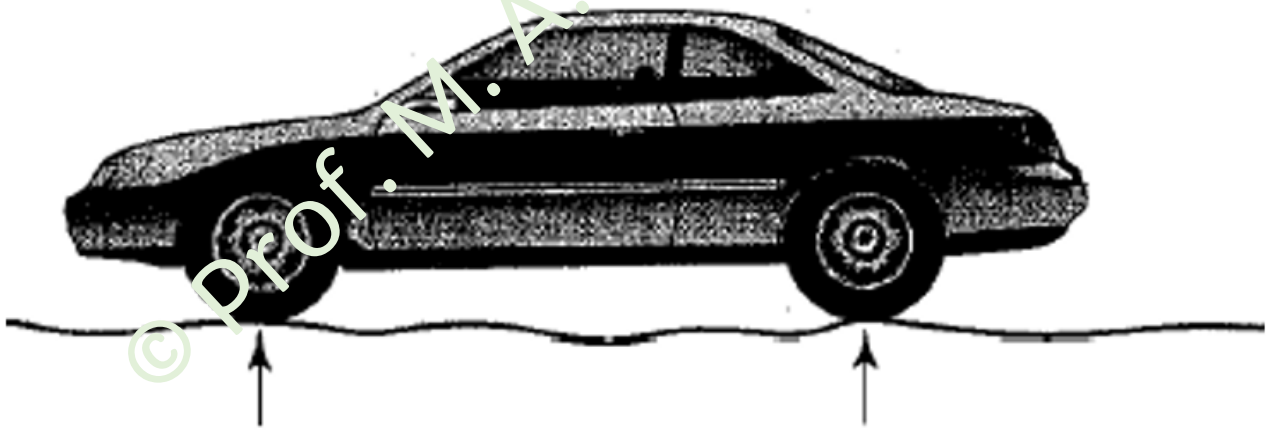


Fig. 2

Cognitive domain assessment (exam) - example

1. Suppose you are recruited by Solshare, a leading PV solution provider in the country, where your task is to design the DC-DC boost converter for photovoltaic system as shown in Fig.4, using computer simulation. (1) **Derive** the necessary expressions needed for your design. (2) **Design** the circuit components of the boost converter for the required specifications shown in Table-I. (3) If you increase the switching frequency from 25 kHz to 30kHz, how it will affect your design considering the size and cost for your analysis. [CO2] (6+10+4)

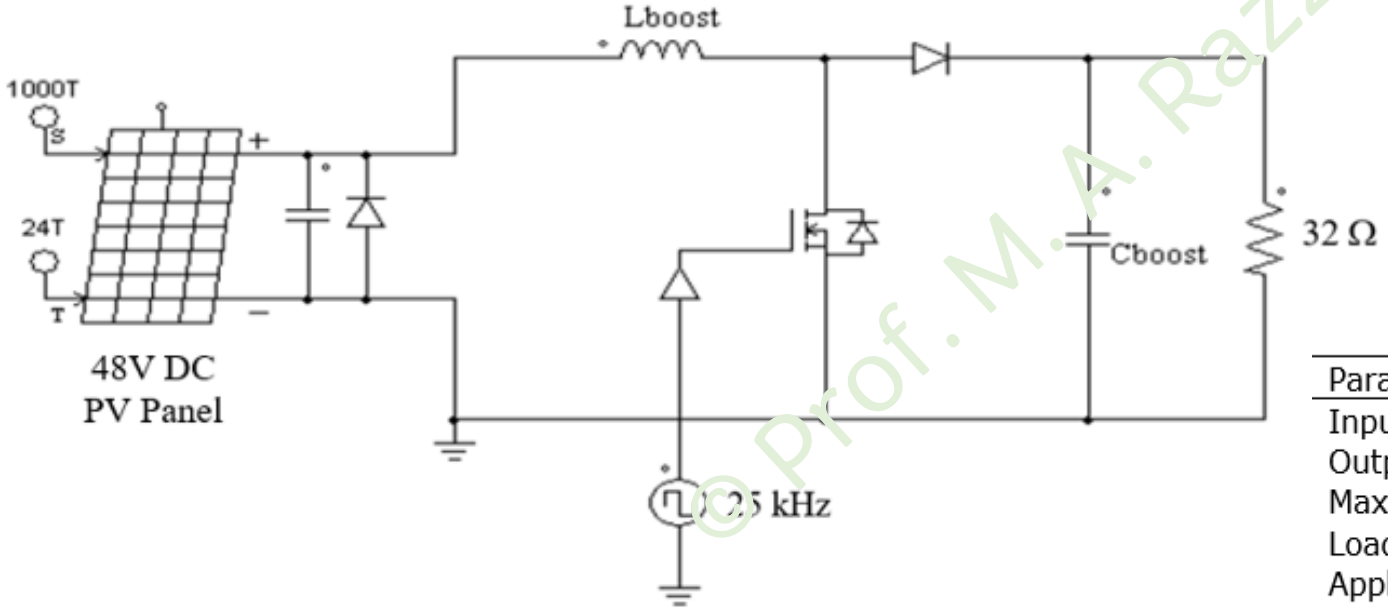


Fig. 4

Table-I Design requirements for DC-DC boost converter

Parameters	Value
Input DC Voltage	(30 + sum of all digits of your ID) V
Output DC Voltage	312 V
Maximum Inductor Current	500 A
Load impedance	6.24 Ohm
Applied Switching Frequency	25 kHz
Inductor current ripple	5%
Output voltage ripple	0.5%
Converter efficiency	95%

Assessment (Assignment) - Affective domain

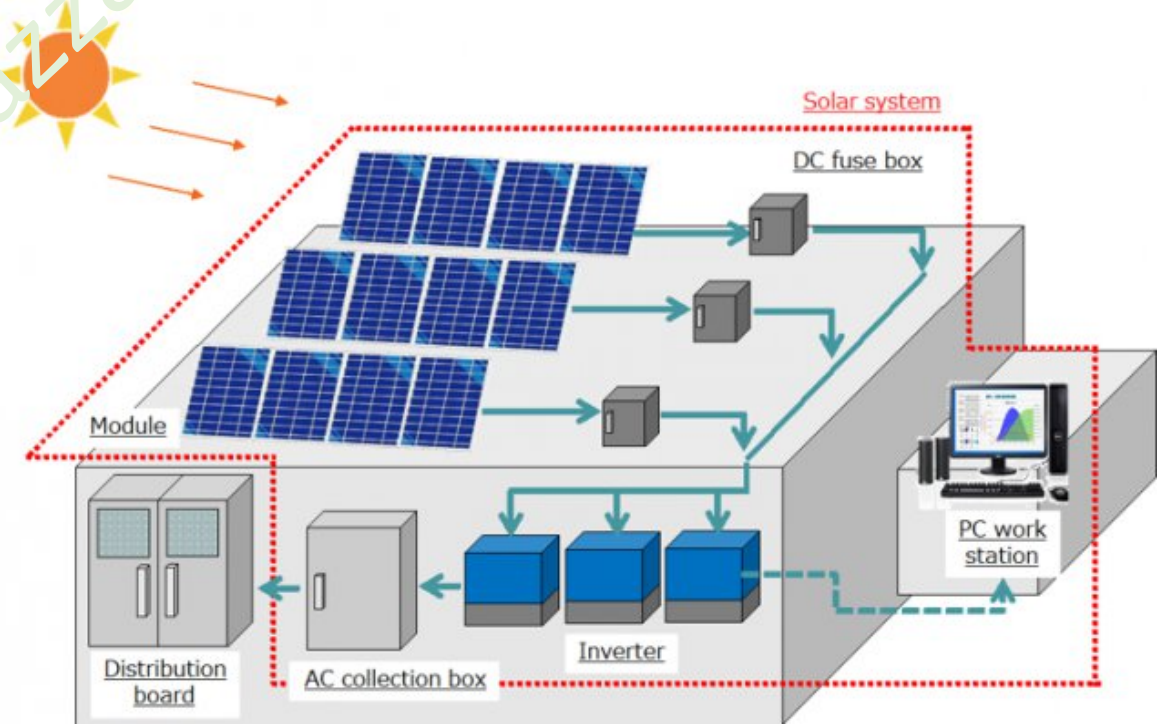
- Course assignment addressing complex engineering problems
- Course: Power Electronics and Drives

Problem: (1) Design a solar-powered 12/325V, 500W MOSFET-based dual-stage DC-DC boost converter for a purely resistive load of 50Ω. Use 12V, 500W single solar panel for your design. Consider the same duty cycle for each stage, minimum switching frequency as 20kHz, and inductor current ripple and output voltage ripple by your choice. (2) Verify your design using simulation. (3) Also investigate the performance of the converter for different types of loads.

Affective domain – PO9, Project Management & Finance

- **Project [CO4-A5]:** Suppose you are recruited in a new solar PV project where you are required to plan, design and install a 100 kW rooftop solar PV system in a garments industry where there is a guava garden located in the suburb of Dhaka city near Savar. The 100 kW solar power plant includes 200 panels with 500 wP capacity, 10 grid-tie inverters with 10 kW each, distribution board, 2 energy meters including 1 net meter, wiring cables, mechanical structure and 1000 Wh battery-bank as emergency backup system. Taka 5.5M is initially allocated for the project. Rest of the money needs to be taken loan from a commercial bank.

  a) Prepare a budget and procurement plan considering allocated amount & bank loan.
  b) What engineering ethical conduct and issues are needed to be taken care of?
  c) Calculate NPV and payback period.
  d) Explain the impact of project on the environment, society, safety, health and legal issues.



Affective domain, PO8 – Ethics (case studies)

Q1 [CO2-A4]. Abdul Baten has been named Project Manager of the General Sensor Company's new sensor manufacturing process project. Sensors are extremely price sensitive. Basundhara has done a great deal of quantitative work to be able to accurately forecast changes in sales volume relative to changes in pricing. The company president, Selim Chowdhury, has faith in the sensitivity model that the company uses. He insists that all projects affecting the manufacturing costs of sensors be run against the sensitivity model to generate data to calculate the return on investment. The net result is that project managers, like Baten, are under a great deal of pressure to submit realistic budgets so go/no-go project decisions can be made quickly. Company President has canceled several projects that appeared marginal during their feasibility stages and recently fired a project manager for overestimating project costs on a new model sensor. The project was killed early in the design stages, and six months later a competitor introduced a similar sensor that proved to be highly successful.

Affective domain, PO8 – Ethics (case studies)

PM Baten's dilemma is how to construct a budget that accurately reflects the costs of the proposed new process. He is an experienced executive engineer and feels comfortable with his ability in estimating costs of projects. However, the recent firing of his colleague has made him a little nervous. Only one stage of the four-stage sensor manufacturing process is being changed. Baten has detailed cost information about the majority of the process. Unfortunately, the costs and tasks involved in the new modified process stage are unclear at this point. Baten also believes that the new modifications will cause some minor changes in the other three stages, but these potential changes have not yet been clearly identified. The stage being addressed by the project represents almost 50 percent of the manufacturing cost.

a) What are the probable Professional Engineering Ethical Issues in the above mini-Case? Please use your unique imagination here, beyond the story given above! (14)

b) How should the Project Manager Abdul Baten handle the Professional Engineering Ehical Issues in this mini-Case? (6)

Assignment / Project (theory / lab)

- Design circuit lab consisting of a series parallel network using the following open-ended features where you are required to (1) measure the total circuit current and voltage across any one resistor, (2) compare the calculated and measured results and (3) observe the effect of the open circuit & short-circuit fault.

Open-ended features:

- ✓ Build circuit using at least 6 resistors having only one resistor in each branch.
- ✓ In your lab you have resistors having resistance values between 1Ω to 10kΩ and you can choose 6 resistors values by your choice.
- ✓ Consider the input voltage, V = sum of all digits of your student ID in volt.
- ✓ You may consider any network theorem to solve the problem.

Results & Analysis:

- ➢ Verify deign using simulation. Compare the calculated and simulated results.
- ➢ Did you observe any discrepancies between calculated and experimental results? Explain.
- ➢ What will be the impact on the total circuit current if any one branch is (1) open (2) short circuited?

Assignment / Project (theory / lab)

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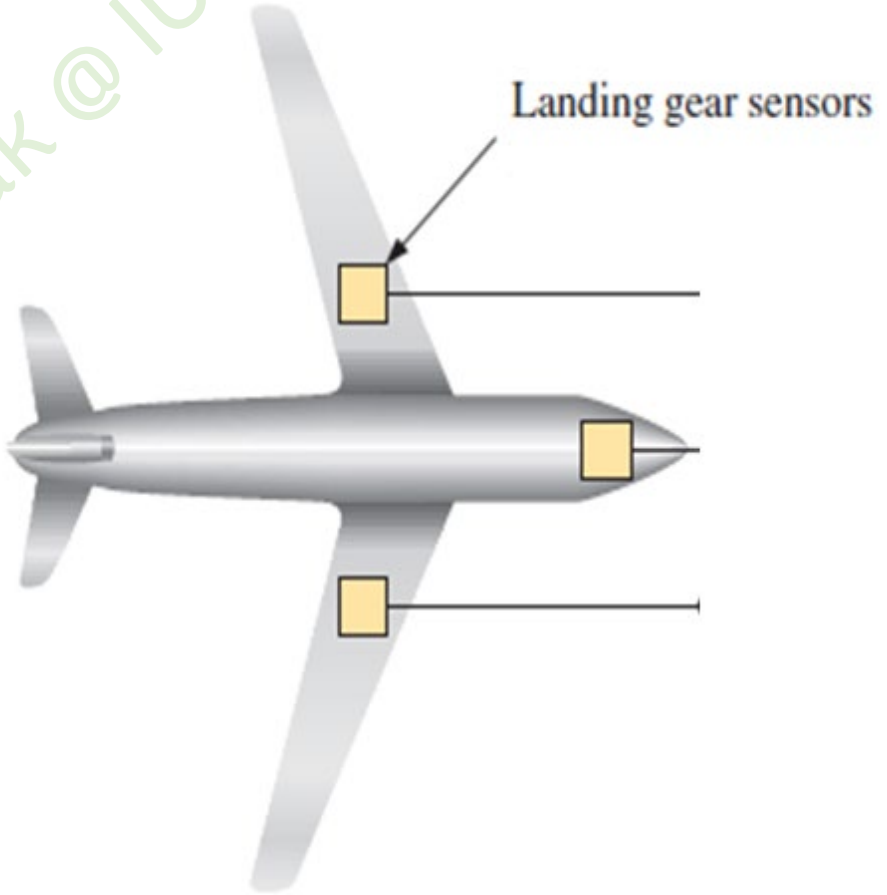
- ➢ Did you observe any discrepancies between calculated and experimental results? Explain.
- ➢ What will be the impact on the total circuit current if any one branch is (1) open (2) short circuited?

Assignment / Project (theory / lab)

Course: CSE231/EEE211 Digital Logic Design

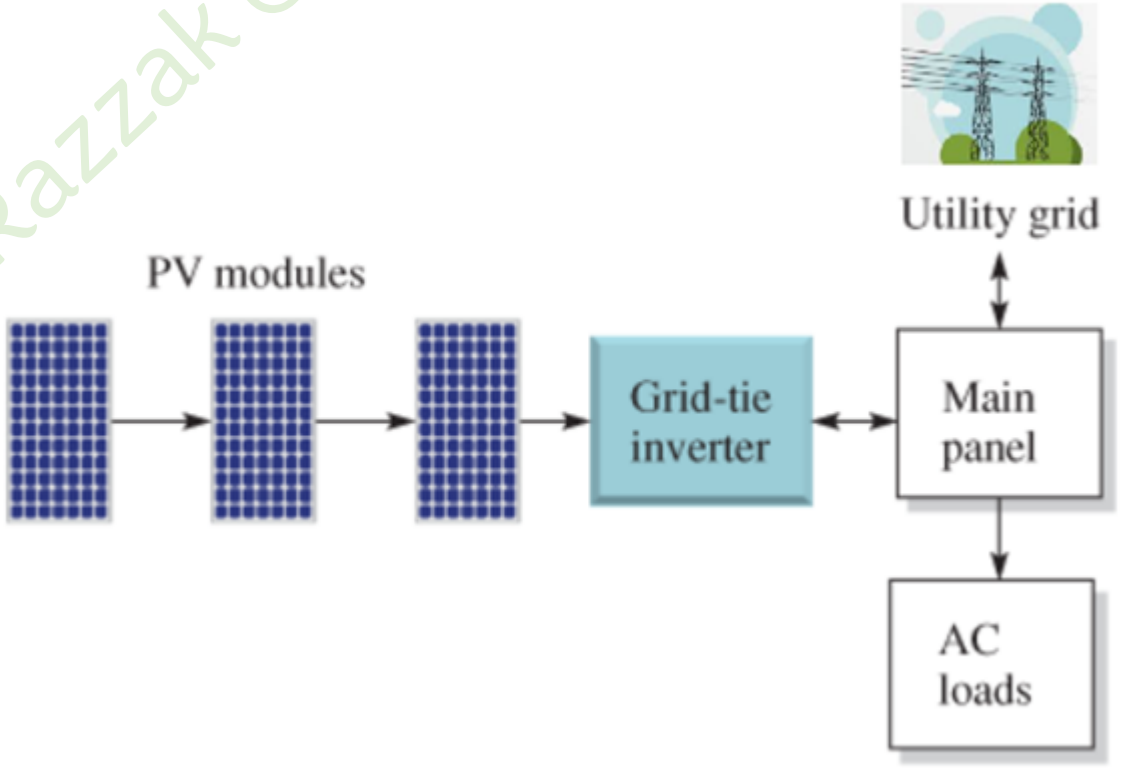
1. (a) As part of an aircraft's functional monitoring system (Fig.1), a circuit is required to indicate the status of the landing gears prior to landing. A **green** LED display turns on if all three gears are properly extended when the "gear down" switch has been activated in preparation for landing. A **red** LED display turns on if any of the gears fail to extend properly prior to landing. Implement a logic circuit and connect with three sensors as shown in Fig.1 to meet this requirement. [CO3-P5] (6)



Course project

- Course: Renewable Energy Technology

Problem: Design a solar-powered 24/230V, 1kW MOSFET-based single-phase grid-tie inverter which can feed power to utility grid when electrical loads are not consumed any power or less power than what is produced by solar panels. Use two 500W solar panels for your design. Consider switching frequency either less than 5kHz or greater than 20kHz, and inductor current ripple and output voltage ripple by your choice (say, between 2% to 10%). You can consider fly-back converter or transformer or buck and boost converters for your design. (2) Verify your design using simulation. (3) Now for analyzing the performance, the same converter is connected to a 100Ω load instead of grid. Investigate the efficiency of the converter using simulation by changing the load from 5Ω to 100Ω with an increment of 5Ω. (4) Propose a solution using block diagram to monitor the solar energy remotely using mobile app and/or web, and measure the solar energy supplied to the grid using net metering system. (5) Discuss the impact of project outcome on the environment and sustainability.



Question moderation - documents

- Course outline
- Question paper
- Moderation FORM

Question moderation form

QUESTION MODERATION REPORT (INITIAL MODERATION)

Course Title	Electrical Circuit – I				Course Code	EEE 131	
Term	☐ Spring	☑ Summer	☐ Autumn	2020	Exam Type	☐ Mid	☑ Final

A. Evaluation of questions

Sl No	Evaluation Item	Accepted as it is	Minor correction	Major correction
1	Reflection of learning outcomes (COs) in the questions	☐	☑	☐
2	Relevance of questions according to six levels of cognitive domain in Bloom's Taxonomy	☐	☑	☐
3	Breadth of the course material supposed to be covered during the semester	☑	☐	☐
4	Clarity of the questions	☐	☑	☐
5	Distribution of marks allocated for each question	☐	☑	☐
6	Correctness of the grammar and spelling	☐	☑	☐
7	Question format followed as prescribed by the department	☑	☐	☐

Question moderation form

B. Suggestive modification of questions, if any			
Question No.	**Moderator's Suggestions**	**Responses of the Examiner**	**Moderator's Remarks**
1	According to course outline there should be no question from CO1. Omit this.		
2 (b)	Use the word "transfer" for maximum power transfer to the load and find the maximum power transfer to the load.		
3 (b)	This is an incomplete question. You can use "Draw the Norton's equivalent circuit……". Use "…the last two digit…"		
4	It's a very long question. Give 30 marks and analyze only v_c. Add "…how the time constant and transient response of v_c will affect by increasing C from 5 to 10μF."		

C. Overall Acceptance

☐ Accepted as it is ☐ Accepted with minor revisions ☑ Accepted with major revisions

D. Any other comments

Use the word "circuit" instead of "network" in all questions.

Name of Moderator	Prof. Dr. Md. Abdur Razzak	**Designation**	Professor
Signature of Moderator	Abdur Razzak	**Date**	22/09/2020

Question moderation form

QUESTION MODERATION REPORT (FINAL MODERATION)

Course Title	Electrical Circuit – I				Course Code	EEE 131	
Term	☐ Spring	☑ Summer	☐ Autumn	2020	Exam Type	☐ Mid	☑ Final

A. Evaluation of questions

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1	Reflection of learning outcomes (COs) in the questions	☑	☐	☐
2	Relevance of questions according to six levels of cognitive domain in Bloom's Taxonomy	☑	☐	☐
3	Breadth of the course material supposed to be covered during the semester	☑	☐	☐
4	Clarity of the questions	☐	☑	☐
5	Distribution of marks allocated for each question	☑	☐	☐
6	Correctness of the grammar and spelling	☐	☑	☐
7	Question format followed as prescribed by the department	☑	☐	☐

Question moderation form

B. Suggestive modification of questions, if any			
Question No.	**Moderator's Suggestions**	**Response of the examiner**	**Moderator's Remarks**
1	According to course outline there should be no question from CO1. Omit this.	CO1 is included in Final examination, there was a typing mistake in the course outline provided for moderation, which has been corrected.	I think course outline is OK. From next term no need to add CO1 questions in the final.
2 (b)	Use the word "transfer"…for maximum power transfer to the load and find the maximum power transfer to the load.	Comment applied in the revised question paper	Modification accepted.
3 (b)	Incomplete question. You can use "Draw the Norton's equivalent circuit……". Use "…the last two digit…."	Comment applied in the revised question paper	Use "…the last two digit…."
4	It's a very long question. Give 30 marks and analyze only v_c. Add "…how the time constant and transient response of v_c will affect by increasing C from 5 to 10μF."	Comment applied in the revised question paper and marks allocation modified accordingly	Modification accepted.
C. Overall Acceptance			
☐ Accepted as it is ☑ Accepted with minor revisions ☐ Accepted with major revisions			
D. Any other comments			
Use the word "circuit" instead of "network" in all questions.			

Question moderation form

Course Title	Electrical Circuit - I				Course Code	EEE 131	
Term and Year	○ Spring	◉ Summer	○ Autumn	2023	Exam Type	◉ Mid	○ Final

A. Evaluation of questions

Sl No	Evaluation Item	Accepted as it is	Minor correction	Major correction
1	Reflection of learning outcomes (COs) in the questions	☑	☐	☐
2	Relevance of questions according to six levels of cognitive domain in Bloom's Taxonomy	☑	☐	☐
3	Breadth of the course material supposed to be covered during the semester	☑	☐	☐
4	Clarity of the questions	☑	☐	☐
5	Distribution of marks allocated for each question	☐	☑	☐
6	Correctness of the grammar and spelling	☑	☐	☐
7	Question format followed as prescribed by the department	☑	☐	☐

Question moderation form

B. Suggestive modification of questions, if any			
Question No.	**Suggestions**	**Responses of the examiner**	**Moderator's Remarks**
1	Show distribution of the marks, such as, (2+4+4)		
2	Show distribution of the marks, such as, (4+3+3)		
3	Show distribution of the marks, such as, (4+3+3)		
4 (a)			
4(b)			

C. Overall Acceptance

○ Accepted as it is ◉ Accepted with minor revisions ○ Accepted with major revisions

D. Any other comments

Exam time should be 90 minutes

Response of the examiner			
Name of Moderator	Dr. Md. Abdur Razzak	**Designation**	Professor
Signature of Moderator	Abdur Razzak	**Date**	04/08/2021

Any questions or comments?