American International University-Bangladesh (AIUB)
Faculty of Engineering
Department of CSE, EEE, and CoE

EEE4103 MICROPROCESSOR AND EMBEDDED SYSTEM
COURSE CAPSTONE PROJECT PROPOSAL FORM

SEMESTER: SPRING 2024-25

PROJECT TITLE: Development of an Arduino-Based Radar System for Object Detection and Distance Measurement.

SURVEY: Awareness and Interest in Embedded Radar Systems Using Arduino

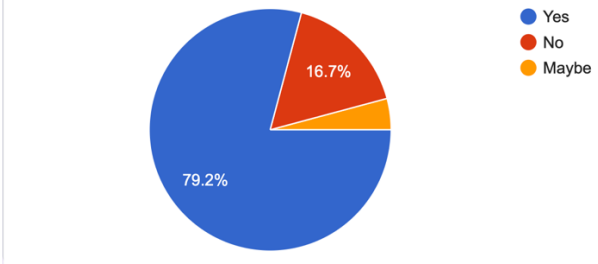
Objectives:

- To evaluate the awareness level of students regarding radar systems and their real-life applications.
- To assess interest in embedded systems and Arduino-based projects.
- To determine the feasibility and educational value of building radar systems for students.

Here is our survey report link: https://forms.gle/qnfs8zvBQWiAagUv5

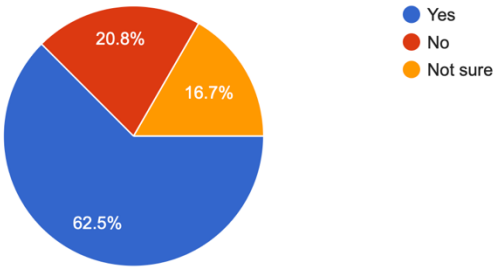
1.Are you familiar with radar technology?

24 responses



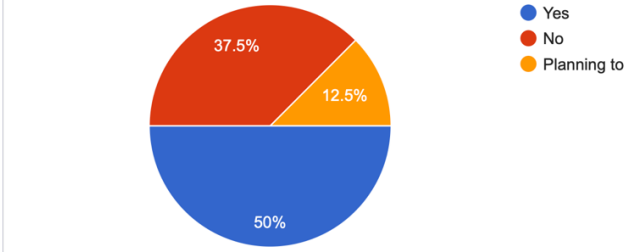
3. Do you think radar systems have applications in daily life?

24 responses



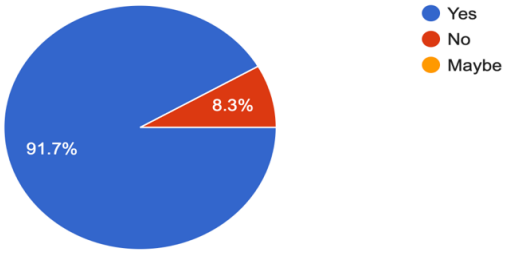
2.Have you ever worked on an embedded systems project?

24 responses



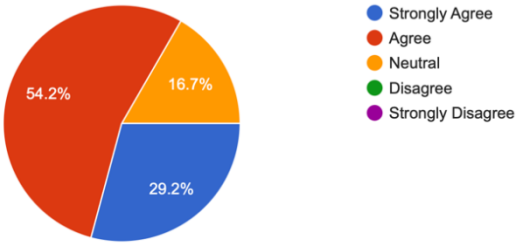
4. Would you be interested in learning more about radar systems?

24 responses



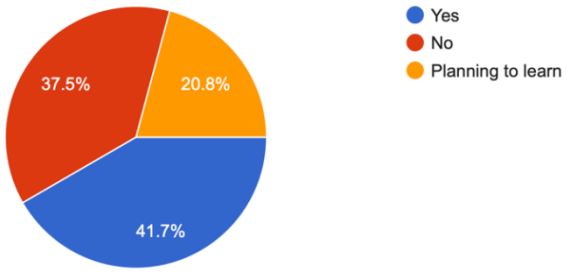
5. Do you believe integrating radar systems into vehicles can enhance safety?

24 responses



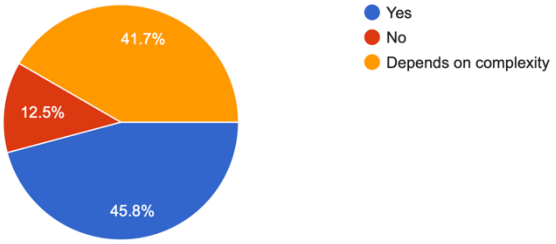
6. Have you used Arduino or similar microcontrollers before?

24 responses



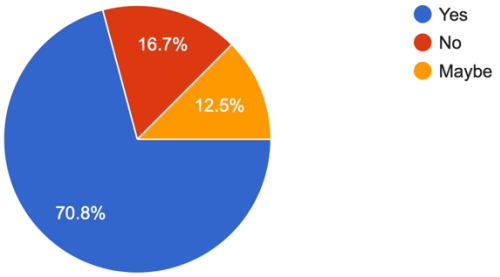
7. Do you think building a radar system is feasible for students?

24 responses



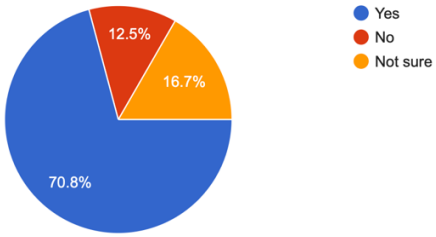
8. Would you participate in workshops on embedded systems?

24 responses



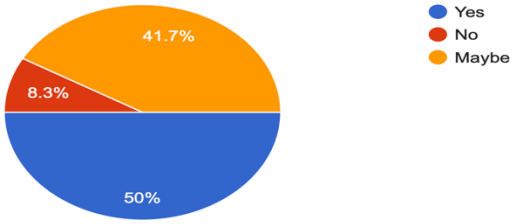
9. Do you see potential career opportunities in embedded systems?

24 responses



10. Would you recommend embedded systems projects to your peers?

24 responses



Sample Questions:

1. Are you familiar with radar technology?
2. Have you ever worked on an embedded systems project?
3. Do you think radar systems have applications in daily life?
4. Would you be interested in learning more about radar systems?
5. Do you believe integrating radar systems into vehicles can enhance safety?
6. Have you used Arduino or similar microcontrollers before?
7. Do you think building a radar system is feasible for students?
8. Would you participate in workshops on embedded systems?
9. Do you see potential career opportunities in embedded systems?
10. Would you recommend embedded systems projects to peers?

AIMS AND OBJECTIVES OF THE PROJECT:

Aim: To design and implement an embedded radar system using Arduino for real-time object detection and distance measurement.

Objectives:

1. **Design** the hardware setup integrating an ultrasonic sensor and servo motor with Arduino.
2. **Develop** the software algorithm to control the servo motor and process sensor data.
3. **Simulate** the radar system using appropriate simulation tools to validate functionality.
4. **Implement** the physical prototype and test its performance in real-world scenarios.
5. **Analyze** the system's accuracy and responsiveness in detecting objects at various distances.

LITERATURE REVIEW:

1. **Author(s): A. Smith, B. Johnson**
   Title: *Ultrasonic Sensors in Embedded Systems*
   Journal: International Journal of Embedded Systems
   Year: 2022
   Summary: Discusses the integration of ultrasonic sensors in embedded applications, highlighting challenges and solutions, particularly signal noise management and range accuracy.

2. **Author(s): C. Lee, D. Kim**
   Title: *Servo Motor Control in Microcontroller-Based Systems*
   Conference: IEEE Embedded Systems Conference
   Year: 2023
   Summary: Explores methods for precise control of servo motors using microcontrollers like Arduino, focusing on PWM (Pulse Width Modulation) techniques to enhance motor positioning accuracy.

3. **Author(s): E. Martinez**
   Title: *Real-Time Object Detection Using Embedded Radar Systems*
   Journal: Journal of Sensor Technology
   Year: 2021
   Summary: Presents techniques for implementing radar systems in embedded platforms for object detection, emphasizing real-time processing challenges and optimization methods.

4. **Author(s): F. Zhang, G. Liu**
   Title: *Simulation Tools for Embedded System Design*
   Conference: International Conference on Embedded Systems
   Year: 2022
   Summary: Evaluates various simulation tools suitable for testing embedded system designs, identifying key features needed for accurate modeling and testing before hardware deployment.

5. **Author(s): H. Patel**
   Title: *Arduino-Based Radar System for Distance Measurement*
   Journal: Electronics and Communication Engineering Journal
   Year: 2023
   Summary: Details the development of a radar system using Arduino, focusing on hardware selection, interfacing ultrasonic modules, and programming aspects for accurate distance measurement

6. **Author(s): J. Chen, M. Wang**
   Title: *Enhancing Ultrasonic Sensor Accuracy in Noisy Environments*
   Journal: Sensors and Actuators A: Physical
   Year: 2022
   Summary: Investigates techniques such as digital signal processing and Kalman filtering to enhance ultrasonic sensor performance under environmental noise conditions, applicable to radar system design.

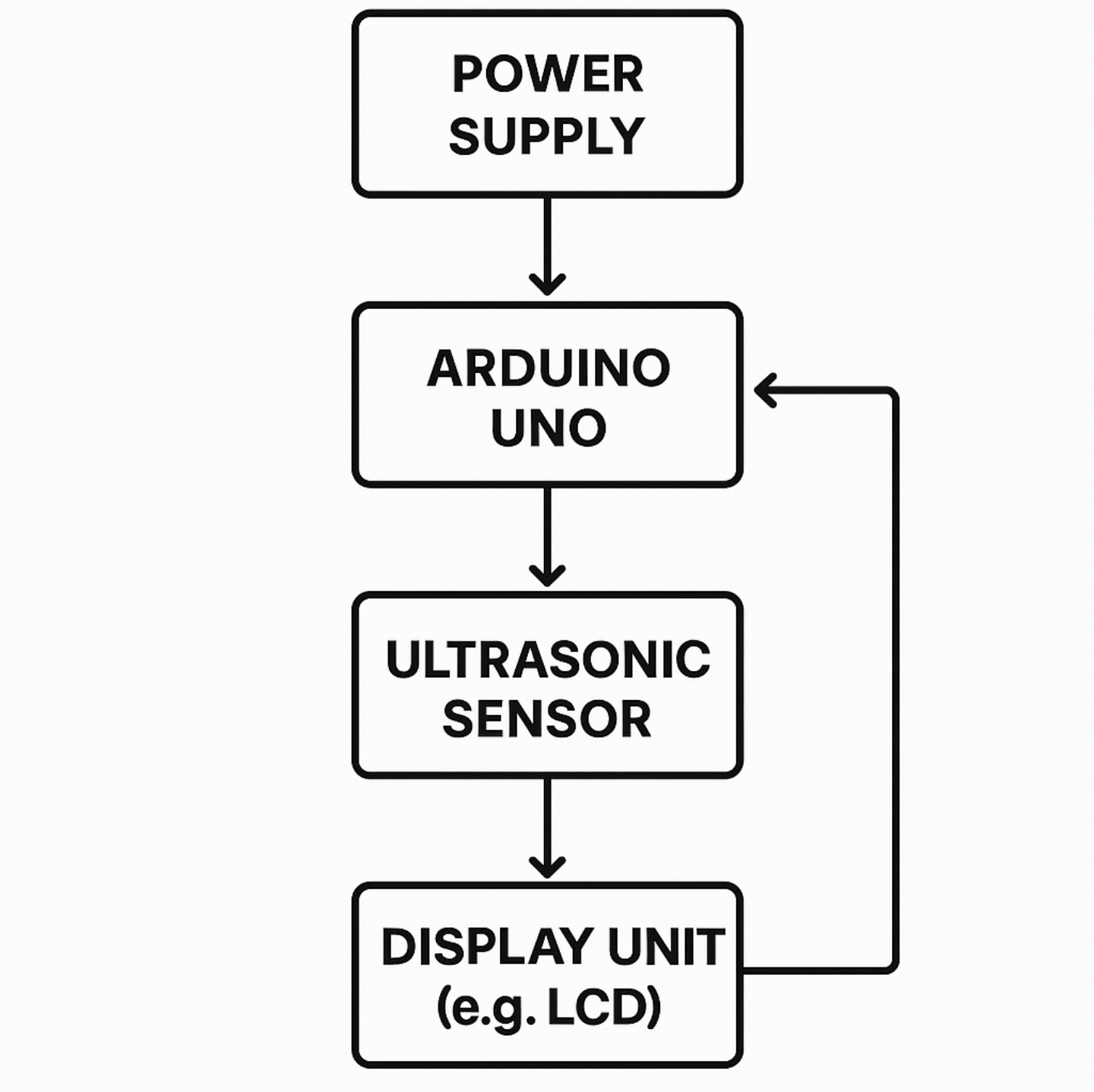
7. **Author(s): L. Anderson**
   Title: *Microcontroller-Based Embedded Systems for Object Tracking*
   Journal: Journal of Embedded Computing
   Year: 2021
   Summary: Discusses embedded system designs capable of dynamic object tracking, including sensor fusion strategies that combine ultrasonic and infrared sensors for improved detection accuracy.

8. **Author(s): P. Roy, S. Gupta**
   Title: *Real-Time Data Processing for Arduino Applications*
   Conference: International Symposium on Arduino and IoT Innovations
   Year: 2023
   Summary: Highlights real-time data acquisition and processing strategies for Arduino-based systems, ensuring minimal latency during object detection and distance calculations.

9. **Author(s): R. Thomas**
   Title: *Low-Power Design Techniques for Embedded Radar Systems*
   Journal: International Journal of Low Power Electronics
   Year: 2022
   Summary: Focuses on reducing power consumption in embedded radar systems by optimizing sensor activation cycles and microcontroller sleep modes, important for portable radar applications.

10. **Author(s): S. Banerjee**
    Title: *Integration of Servo and Ultrasonic Modules for Autonomous Systems*
    Conference: IEEE Conference on Robotics and Automation
    Year: 2022
    Summary: Discusses the coordinated control of servo motors and ultrasonic modules to enable scanning and mapping in embedded robotic systems, which is highly relevant for radar-based object detection.

EXPERIMENTAL BLOCK DIAGRAM:



Power Supply: Provides necessary voltage to the system.

- **Arduino UNO:** Central microcontroller that processes inputs and controls outputs.
- **Servo Motor:** Rotates the ultrasonic sensor to scan the environment.
- **Ultrasonic Sensor:** Detects objects by emitting and receiving ultrasonic waves.
- **Display Unit:** Shows the distance measurements to the user.

POSSIBLE OUTCOMES OF THE PROJECT:

- **Educational Impact:** Enhances understanding of embedded systems among students.
- **Practical Application:** Provides a foundation for developing more complex radar systems.
- **Community Engagement:** Can be showcased in workshops and seminars to inspire interest in embedded technologies.
- **Safety Enhancement:** Potentially adaptable for obstacle detection in vehicles or robotics, contributing to safety measures.

PROJECT TIMELINE (GANTT CHART):

The following timeline represents the proposed duration and order of the project tasks. The project is designed to be completed in **8 weeks**.

Task No	Task Description	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
1	Problem Identification & Survey	■	■						
2	Literature Review & Component Selection		■	■					
3	Circuit Design & Hardware Implementation			■	■				
4	Software Development (Arduino +				■	■			

	Processing)								
5	Testing and Debugging					[redacted]	[redacted]		
6	Data Analysis & Visualization Output						[redacted]	[redacted]	
7	Final Report Writing and Presentation								

REFERENCES:

Sample for the conference paper

REFERENCES

[1] S. Ghosh, A. Gupta, A. Roy and S. Banerjee, "Development of a Low-Cost Sonar Based Object Detection System Using Arduino and Ultrasonic Sensor," *Proceedings of the 2018 IEEE Applied Signal Processing Conference (ASPCON)*, Kolkata, India, 2018, pp. 194-198. doi: 10.1109/ASPCON.2018.8748649.

[2] A. Kumar, R. P. Dwivedi and S. Sharma, "Ultrasonic Radar System Using Arduino and Processing Software," *International Journal of Computer Applications*, vol. 162, no. 7, pp. 11-14, Mar. 2017. doi: 10.5120/ijca2017913276.

[3] J. Chen and M. Wang, "Enhancing Ultrasonic Sensor Accuracy in Noisy Environments," *Sensors and Actuators A: Physical*, vol. 320, pp. 112579, 2022. doi: 10.1016/j.sna.2020.112579.

[4] L. Anderson, "Microcontroller-Based Embedded Systems for Object Tracking," *Journal of Embedded Computing*, vol. 14, no. 3, pp. 210-217, 2021. doi: 10.3233/EC-210027.

[5] P. Roy and S. Gupta, "Real-Time Data Processing for Arduino Applications," in *Proceedings of the 2023 International Symposium on Arduino and IoT Innovations (ISAII)*, Singapore, 2023, pp. 88-92. doi: 10.1109/ISAII57890.2023.1012345.

[6] R. Thomas, "Low-Power Design Techniques for Embedded Radar Systems," *International Journal of Low Power Electronics*, vol. 18, no. 1, pp. 45-52, 2022. doi: 10.1166/ijlp.2022.1904.

[7] S. Banerjee, "Integration of Servo and Ultrasonic Modules for Autonomous Systems," in *Proceedings of the 2022 IEEE Conference on Robotics and Automation (ICRA)*, Philadelphia, USA, 2022, pp. 1405-1410. doi: 10.1109/ICRA.2022.9812273.

[8] HC-SR04 Ultrasonic Sensor Datasheet, Elecfreaks, Accessed: Apr. 15, 2025. [Online]. Available: https://cdn.sparkfun.com/datasheets/Sensors/Proximity/HCSR04.pdf

[9] Servo Motor (SG90) Datasheet, Tower Pro, Accessed: Apr. 15, 2025. [Online]. Available: https://cdn.sparkfun.com/datasheets/Robotics/Servos/SG90%20servo.pdf

[10] Arduino UNO Datasheet, Arduino.cc, Accessed: Apr. 15, 2025. [Online]. Available:

https://docs.arduino.cc/resources/datasheets/UNO-Rev3-datasheet.pdf

Instructions:

1. There is no definite format to write the proposal, but students must follow the mentioned instructions properly.
2. Fill in the form accurately with all necessary information.
3. Make a color print on this form.
4. Figures, tables, charts, circuit diagrams, block diagrams, and wave shapes must be color printed.
5. The survey form links with the answers must be provided in the proposal form.

FOR FACULTY USE ONLY

COMMENTS BY COURSE TEACHER:

COURSE TEACHER'S NAME **COURSE TEACHER'S SIGNATURE** **DATE**

GROUP MEMBERS

(Maximum 6 students are permitted to carry out a single Project. However, depending on the capability of the students, 4 students may be allowed but not less than that)

NAME: Abul Bashar Saurov **ID #:** 22-48823-3 **PROGRAM:** CSE **EMAIL: abulbasharsaurov00@gmail.com**	**NAME**: Lubna Akter **ID #:** 22-47066-1 **PROGRAM:** CSE **EMAIL:**
NAME: MD. Abdullah Anas **ID #:** 22-49814-3 **PROGRAM:** CSE **EMAIL:abdullahanas100200300@gmail.com**	**NAME**: Osama Mobin Zuhar **ID #:** 22-49938-3 **PROGRAM:** CSE **EMAIL:**
NAME: MD. Samiul Alam Safayet **ID #:** 23-50151-1 **PROGRAM:** CSE **EMAIL:**	**NAME**: …… **ID #:**…… **PROGRAM:** EEE/CoE/CSE **EMAIL:**

REMARKS (for OFFICE use only)

Course Name:	Microprocessor and Embedded System	**Course Code:**	EEE 4103
Semester:	Spring 2024-2025	**Sec:**	C
Faculty Member:	**Prof. Dr. Engr. Muhibul Haque Bhuyan**		

Capstone Project Title:	**Development of an Arduino-Based Radar System for Object Detection and Distance Measurement.**
Project Group No.	07

Sl #	Student ID #	Student Name	Obtained Marks
1.	22-48823-3	Abul Bashar Saurov	
2.	22-47066-1	Lubna Akter	
3.	22-49814-3	MD. Abdullah Anas	
4.	23-50151-1	MD. Samiul Alam Safayet	
5.	22-49938-3	Osama Mobin Zuhar	
6.			

Assessment Materials and Marks Allocation:

COs	Assessment Materials	POIs	Marks
CO3	Course Capstone Proposal Form	P.c.2.C6	30

Assessment Rubrics:

KPIs	Excellent [2]	Proficient [1.5]	Good [1]	Acceptable [0.5]	Unacceptable [0]	No Response [0]	Secured Marks
Project Title	The title reflects an issue related to complex engineering problems showing targets and methods with possible outcomes.	The title reflects an issue related to complex engineering problems showing targets and methods but some missing issues.	The title reflects an issue related to the course capstone project but there may be some missing issues.	The title reflects an issue related to the course capstone project but is not complete or specific.	The title does not reflect any issues related to the course capstone project.	No Response at all/ copied from others /identical submissions with gross errors/ image file printed	
Comments						**Total Marks (2)**	

KPIs	Excellent [6-7]	Proficient [4-5]	Good [3]	Acceptable [2]	Unacceptable [1]	No Response [0]	Secured Marks
Survey	The survey developed as a process for complex engineering problems considering cultural and societal factors have superior variables, targets, measures, and the implementation process is clear and challenging for future	The survey developed as a process for complex engineering problems considering cultural and societal factors has good variables, targets, measures, and The implementation process is clear and	The survey developed as a process for complex engineering problems considering cultural and societal factors has moderate variables, targets, measures, and The implementation process is clear and	The survey developed as a process for complex engineering problems considering cultural and societal factors has good variables, targets, measures, and The implementation process is somewhat	The survey developed as a process for complex engineering problems considering cultural and societal factors has poor variables, targets, measures, and the implementation process is very unclear	No Response at all/ copied from others /identical submissions with gross	

	project implementation with several possible outcomes having good impacts.	challenging for future project implementation, with some possible outcomes and little impact.	challenging for future project implementation, with a few possible outcomes and impacts.	clear for future project implementation, with very few possible outcomes and little impact.	for future project implementation with a few possible outcomes but no impacts.	errors/ image file printed	
Comments						**Total Marks (7)**	

KPIs	Excellent [4]	Proficient [3]	Good [2]	Acceptable [1]	Unacceptable [0.5]	No Response [0]	Secured Marks
Aims and Objectives	Aims and objectives are written to solve complex engineering problems considering cultural and societal factors with specific targets, measurement, and implementation processes that are clear and challenging and have several possible outcomes having very good impacts.	Aims and objectives are written to solve complex engineering problems considering cultural and societal factors with general targets, measurement, and implementation processes that are not clear and challenging and have some possible outcomes having good impacts.	Aims and objectives are written to solve complex engineering problems considering a few cultural and societal factors with narrow targets; measurement, and implementation processes are clear and challenging and have a few possible outcomes having some impacts.	Aims and objectives are written to solve complex engineering problems considering cultural or societal factors with a very target; measurement and implementation processes are not clear or challenging and have little possible outcome having no impact.	Aims and objectives are written to solve complex engineering problems but do not consider cultural and societal factors with any targets; measurement, and implementation processes are not clear and challenging, and no possible outcomes have no impacts.	No Response at all/ copied from others /identical submissions with gross errors/ image file printed	
Comments						**Total Marks (4)**	

KPIs	Excellent [5]	Proficient [4]	Good [3]	Acceptable [2]	Unacceptable [1]	No Response [0]	Secured Marks
Literature Review	Specific formats are maintained to review and cite the literature with recent publications. Identified and analyzed the problem correctly.	Specific formats are maintained to review and cite the literature with recent publications. Identified and analyzed the problem correctly, but all issues were not addressed with relevant or intended work.	Specific formats are maintained to review and cite the literature with recent and past publications. Identified and analyzed the problem correctly, but all issues were not addressed with relevant or intended work.	Specific formats are maintained to review and cite the literature with recent and past publications. Identified but could not analyze all the problems correctly, and all issues were not addressed with relevant or intended work.	No specific formats are maintained to review and cite the literature with recent publications. Could not identify and analyze all the problems correctly, and all issues are not addressed with relevant or intended work at all.	No Response at all/ copied from others/ identical submissions with gross errors/ image file printed	
Comments						**Total Marks (5)**	

KPIs	Excellent [5]	Proficient [4]	Good [3]	Acceptable [2]	Unacceptable [1]	No Response [0]	Secured Marks
Experimental Block Diagram	The block diagram is drawn to show the connections of all the possible components or sub-systems to show their interdependence with all possible flows of signals from inputs to outputs.	The block diagram is drawn to show the connections of all of the possible components or sub-systems to show their interdependence with a few missing flows of signals from inputs to outputs.	The block diagram is drawn to show the connections of most of the possible components or sub-systems to show their interdependence with a few missing flows of signals from inputs to outputs.	The block diagram is drawn to show the connections of a few possible components or sub-systems to show their interdependence with some missing flow of signals from inputs to outputs.	The block diagram is not drawn to show the connections of all possible components or sub-systems to show their interdependence and flow of signals from inputs to outputs.	No Response at all/ copied from others /identical submissions with gross errors/ image file printed	
Comments						**Total Marks (5)**	

KPIs	Excellent [4]	Proficient [3]	Good [2]	Acceptable [1]	Unacceptable [0.5]	No Response [0]	Secured Marks

Possible Outcomes	Outcomes are written to achieve complex engineering problems' solutions considering cultural and societal factors and showing measurement, and implementation processes to attain the outcomes with all possible impacts.	Outcomes are written to achieve complex engineering problems' solutions considering cultural and societal factors and showing measurement, and implementation processes to attain the outcomes with some impacts.	Outcomes are written to achieve complex engineering problems' solutions considering cultural and societal factors and do not show measurement, and implementation processes to attain the outcomes without showing any impacts.	Outcomes are written to achieve complex engineering problems' solutions but do not consider cultural and societal factors and do not show measurement, and implementation processes to attain the outcomes without showing any impacts.	Outcomes are not written to achieve complex engineering problems' solutions do not consider cultural and societal factors and do not show measurement, and implementation processes to attain the outcomes without showing any impacts.	No Response at all/ copied from others /identical submissions with gross errors/ image file printed	
Comments						**Total Marks (4)**	

KPIs	Excellent [5]	Proficient [4]	Good [3]	Acceptable [2]	Unacceptable [1]	No Response [0]	Secured Marks
Gantt Chart	Specific formats are maintained to draw the Gantt chart and there is the order of workflow with all work to be done.	Specific formats are maintained to draw the Gantt chart and there is the order of workflow with a few works missing.	Specific formats are maintained to draw the Gantt chart and there is the order of workflow with some works missing.	No specific formats are maintained to draw the Gantt chart and there is little order of workflow with some works missing.	No specific formats are maintained to draw the Gantt chart and there is no order of workflow with the most important works missing.	No Response at all/ copied from others/ identical submissions with gross errors/ image file printed	
Comments						**Total Marks (5)**	

KPIs	Excellent [3]	Proficient [2.5]	Good [2]	Acceptable [1]	Unacceptable [0.5]	No Response [0]	Secured Marks
References	Specific formats are maintained to write references, and all are recently published journal and conference papers having no missing information.	Specific formats are maintained to write the references, and all are journal and conference papers, but some old papers have missing information.	No specific formats are maintained to write the references, and many are internet sources with several missing information and very old references.	No specific formats are maintained to write the references and most of them are internet sources with missing information.	No specific formats are maintained to write the references, and all are internet sources with missing information.	No Response at all/ copied from others /identical submissions with gross errors/ image file printed	
Comments						**Total Marks (3)**	