Total No. of Questions: 21

Enrollment No : _____

MEDICAPS UNIVERSITY

Faculty of Engineering

End Semester Examination May 2025

RA3EL18 Autonomous Vehicles

Programme	:	B.Tech.	**Branch/Specialisation**	:	RA
Duration	:	3 hours	**Maximum Marks**	:	60

Note: *All questions are compulsory. Internal choices, if any, are indicated. Assume suitable data if necessary. Notations and symbols have their usual meaning.*

Section 1 (Answer all question(s))

		Marks	CO	BL
Q1.	What is the primary purpose of a safety framework in autonomous vehicles? ○ Enhancing speed ○ Reducing cost ◉ Ensuring safe operations ○ Simplifying design	1	1	1
Q2.	Which method is commonly used to minimize errors in localization algorithms? ○ Mean subtraction ◉ Least squares method ○ Speed optimization ○ Torque adjustment	1	1	3
Q3.	What is the primary purpose of the Extended Kalman Filter (EKF)? ○ Estimating linear system states ◉ Processing non-linear measurements for state estimation ○ Enhancing vehicle speed ○ Minimizing fuel consumption	1	2	1
Q4.	Which method enhances accuracy by combining data from multiple sensors? ○ Feedforward neural networks ◉ Sensor fusion ○ Speed optimization ○ Distance mapping	1	2	4
Q5.	Which layer in a CNN is responsible for detecting patterns such as edges and textures? ○ Fully connected layer ○ Pooling layer ◉ Convolutional layer ○ Output layer	1	3	2
Q6.	Which optimization algorithm is commonly used to minimize the loss function in deep learning models? ◉ Stochastic Gradient Descent (SGD) ○ Random search ○ Linear regression ○ Principal Component Analysis (PCA)	1	3	3
Q7.	What is the main purpose of intrinsic camera calibration? ○ Determine the camera's position in space ◉ Measure the internal characteristics of the camera, like focal length and lens distortion ○ Detect objects in an image ○ Align multiple cameras for stereo vision	1	4	1
Q8.	Which vision system uses two cameras to perceive depth information? ○ Monocular vision ◉ Stereo vision ○ Pinhole vision ○ Projective geometry	1	4	2
Q9.	Which algorithm guarantees the shortest path if the heuristic is admissible? ○ Random walk ◉ A* search ○ Gradient descent ○ Backpropagation	1	5	2

Q10. Which term describes the predicted time remaining before a collision occurs if the current motion continues? | 1 | 5 | 4

- ○ Path cost
- ◉ Time to Collision (TTC)
- ○ Occupancy rate
- ○ Motion behavior

Section 2 (Answer all question(s))

Marks CO BL

Q11. Explain how design considerations influence the selection of hardware components in autonomous vehicles. | 3 | 1 | 4

Rubric	Marks
design considerations for autonomous vehicles.	3

Q12. (a) Propose a basic safety framework for an autonomous vehicle, focusing on potential risk assessments and mitigation strategies. | 7 | 2 | 2

Rubric	Marks
framework for an autonomous vehicle - 4 Marks Mitigation strategies - 3 Marks	7

(OR)

(b) Describe how vehicle modeling contributes to effective control system design. Provide an example to support your explanation.

Rubric	Marks
Describe how vehicle modeling contributes to effective control system design - 4 Marks Provide an example to support your explanation - 3 Marks	7

Section 3 (Answer all question(s))

Marks CO BL

Q13. Evaluate the effectiveness of LIDAR scan matching and the Iterative Closest Point (ICP) algorithm in real-time vehicle localization. | 4 | 3 | 5

Rubric	Marks
Evaluate the effectiveness of LIDAR scan matching in real-time vehicle localization. - 2 marks Iterative Closest Point (ICP) algorithm in real-time vehicle localization - 2 marks	4

Q14. (a) Design a multiple sensor fusion framework integrating GPS, IMU and LIDAR for robust vehicle state estimation. | 6 | 3 | 6

Rubric	Marks
integration of GPS for robust vehicle state estimation - 2 marks integration of IMU for robust vehicle state estimation - 2 marks integration of LIDAR for robust vehicle state estimation - 2 marks	6

(OR)

(b) Explain how feedforward neural networks can be utilized to enhance vehicle localization accuracy. Provide a practical example.

Rubric	Marks
Explain how feedforward neural networks can be utilized to enhance vehicle localization accuracy - 4 marks Provide a practical example - 2 marks	6

Section 4 (Answer all question(s))

Marks CO BL

Q15. Explain how the convolution and pooling layers contribute to feature extraction in a Convolutional Neural Network (CNN). **3 3 4**

Rubric	Marks
Concept of extraction in a Convolutional Neural Network (CNN) - 3 marks	3

Q16. (a) Design a basic CNN architecture for image classification, explaining the role of each layer in the network. **7 3 6**

Rubric	Marks
CNN architecture for image classification- 4 marks explaining the role of each layer in the network - 3 marks	7

(OR)

(b) Describe how visualizing the filters of a CNN can help in understanding the features being learned by the model.

Rubric	Marks
concept of visualizing the filters of a CNN - 4 marks the features being learned by the model - 3 marks	7

Section 5 (Answer all question(s))

Marks CO BL

Q17. Compare monocular and stereo vision in terms of their effectiveness for depth perception in autonomous vehicles. **3 4 4**

Rubric	Marks
3 points for Comparing monocular and stereo vision in autonomous vehicles - 3 marks	3

Q18. (a) Explain how Convolutional Neural Networks (CNNs) can be applied for 2D object detection and semantic segmentation in autonomous driving. **7 4 3**

Rubric	Marks
CNNs can be applied for 2D object detection in autonomous driving - 4 marks semantic segmentation in autonomous driving - 3 marks	7

(OR)

(b) Design a basic motion planning framework for autonomous vehicles, considering driving missions, scenarios and behavior models.

Rubric	Marks
motion planning framework for autonomous vehicles - 4 marks considering driving missions, scenarios and behavior models - 3 marks	7

Section 6 (Answer any 2 question(s))

Marks CO BL

Q19. Evaluate the importance of map-aware motion prediction in reducing the risk of collisions during autonomous driving. **5 5 5**

Rubric	Marks
Evaluate the importance of map-aware motion prediction in autonomous driving - 3 marks solution for reducing the risk of collisions during autonomous driving - 2 marks	5

Q20. Design a basic framework for updating occupancy grids in real-time using LIDAR scan data. Discuss key challenges and solutions. **5 5 6**

Rubric	Marks
Design a basic framework for updating occupancy grids in real-time using LIDAR scan data - 3 marks Discuss key challenges and solutions - 2 marks	5

Q21. Explain how hierarchical motion planning can be used to optimize navigation in complex urban environments. Provide relevant examples. **5 5 3**

Rubric	Marks
motion planning can be used to optimize navigation - 3 marks Provide relevant examples - 2 marks	5

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