K. J. Somaiya Institute of Technology, Sion, Mumbai-22
(Autonomous College Affiliated to University of Mumbai)

May-June 2025
(B. Tech) Program: EXTC Scheme I/II/~~III/III~~
Regular: FY/SY/TY/LY Semester: VIII
Course Code: EXDLC8033 and Course Name: Autonomous Vehicle
Date of Exam:23rd May 2025 Duration: 02.5 Hours Max. Marks: 60

Instructions:
(1)All questions are compulsory.
(2)Draw neat diagrams wherever applicable.
(3)Assume suitable data, if necessary.

Q. No.	Question	Max. Marks	CO	BT level
Q 1	Solve any **two** questions out of three: (05 marks each)	10		
a)	Explain Value of characteristic of use cases of valet parking with block diagram.	5	2	U
b)	Explain Velocity measurement with two chirp using Radar	5	1	U
c)	Explain process of arbitration in CAN Bus and CAN bus transmission multiple nodes connected to CAN Bus.	5	3	U
Q 2	Solve any **two** questions out of three: (05 marks each)	10		
a)	Explain how maps are represented in autonomous vehicle.	5	6	U
b)	A 3-wheeled holonomic robot has its omni-wheels placed 120° apart in a circular configuration. Each wheel can exert a force and move in its own direction. The robot is instructed to move with a velocity vector Where, Each wheel is at a distance R=0.2m from the centre. Determine the **velocity** each wheel must have to achieve this motion.	10	4	A
c)	What is the role of steering feel Emulator in steering by wire design?	5	1	U
Q.3	Solve any **two** questions out of three. (10 marks each)	20		
a)	For FMCW radar, chirp bandwidth is 150 MHz, its duration is 0.1ms , carrier frequency is 77 GHz and beat frequency is 300 kHz (difference between transmitted and received frequency:. A) Determine the range of RADAR. B) **Calculate the velocity resolution** if the radar uses 128 chirps for Doppler processing and the chirp repetition interval is 1 ms.	10	6	A
b)	Explain sensor calibration with Example.	10	1	U

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c)	In a modern vehicle, several Electronic Control Units (ECUs) communicate using a **500 kbps CAN bus**. Consider **3 nodes (ECUs)** talking same time. **Node (ECU)** / **Function** / **Identifier (Hex)** / **Data Length** / **Data to Transmit (Hex)** **ECU A: Engine Control** / Engine RPM data / 0x0C0 / 2 bytes / 0x1F, 0xA4 (RPM Data) **ECU B: ABS Control** / Wheel Speed data / 0x120 / 4 bytes / 0x3C, 0x10, 0x00, 0x05 **ECU C: Airbag Control** / Crash detection alert / 0x040 / 1 byte / 0xFF (Crash Alert) Explain the CAN data frame and transmission on CAN Bus. Calculate the total time of CAN bus transmission for ECUA.	10	4	A
Q.4	Solve any **two** questions out of three. (10 marks each)	20		
a)	Explain High Definition map creation Process.	10	5	U
b)	How does the chirp duration and sweep slope impact radar performance? How does the chirp duration and sweep slope impact radar performance?	10	2	U
c)	Explain system software architecture of the DragonFly vehicle perception, decision-making, control, and communication. How do these modules interact to achieve autonomous navigation and obstacle avoidance.	10	6	U

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