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SLOT: B2+TB2

REG. NO.:

SCHOOL OF MECHANICAL ENGINEERING
CONTINUOUS ASSESSMENT TEST - II
FALL SEMESTER 2025-2026

Programme Name & Branch : B Tech & Automotive/Mechanical Engineering
Course Code : BAMEE318
Course Name : Vehicle Systems Engineering
Faculty Name(s) : Dr Ravi K
Class Number(s) : VL2026270101437
Date of Examination : 28/09/2026 [FN2: 11:00 AM - 12:30 PM]
Exam Duration : 90 minutes **Maximum Marks: 50**

General instruction(s):

- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcome Statements:

  CO 2: Describe the working principles and performance characteristics of internal combustion engine (ICE) powertrain systems, including emission formation and control techniques.

  CO 4: Examine the principles and performance of vehicle control systems, including steering, braking, and stability mechanisms.

Q. No	Question	M	CO	BL
1.	A car has pivot pins 1.2 m apart, the length of each track arm is 0.16 m and the track rod behind the axle is 1.133 m long. Determine the wheelbase which will give true rolling of all wheels when the car is turning so that the inner wheel stub axle is at 60° to the center line of the car. Also, calculate turning circle radius of all the wheel if the track is 1.5 m.	10	4	4
2.	a. Suggest and justify the appropriate geometry for design of the central and the end sections near the steering heads.	4	4	3
	b. Compare the Ackermann steering mechanism with the Davis steering mechanism based on link pairs (turning vs. sliding), mechanical wear, exactness of correct steering condition across turning angles, and spatial layout. Explain why Ackermann is universally preferred despite only satisfying true rolling at three specific positions.	6	4	3
3.	Synthesize the working integration of Anti-lock Braking System (ABS) and Traction Control System (TCS). In your answer, detail: a. The major components of ABS and its 2 hydraulic operating modes (Normal, Increase).	10	4	4

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	b. The primary methods used by TCS to regulate wheel slip during acceleration.			
4	a. State the three main functions of piston rings and distinguish between compression rings and oil control rings.	4	2	3
	b. In a single-line hydraulic braking system: Driver pedal effort (F) = 150 N, Pedal leverage ratio ($L = b/a$) = 5: 1, Area of master cylinder (A_m) = 5 cm^2, Area of each front wheel cylinder piston (A_f) = 25 cm^2, Area of each rear wheel cylinder piston (A_r) = 10 cm^2, Distance moved by effort at master cylinder (L_m) = 1.5 cm Calculate: 1. The force applied and pressure on the master cylinder piston. 2. Force on each front and rear cylinder piston. 3. Total force on front brakes, total force on rear brakes, and the Front-to-Rear brake ratio. 4. Total force ratio (Output force/Input force). 5. Wheel-cylinder piston movement (L_w). 6. Total movement ratio.	6	4	4
5.	A four-cylinder, 4-stroke petrol engine has a bore of 85 mm and a stroke of 90 mm. The engine runs at 3000 RPM. Test measurements yield: a. Indicated Mean Effective Pressure (IMEP, p_{im}): 9.5 bar b. Brake Torque (T): 125 N · m c. Fuel Consumption ($\dot{m}_f$): 14.0 kg/hr d. Calorific Value of Fuel (CV): 44,000 kJ/kg e. Cooling Water Flow Rate ($\dot{m}_{cw}$): 22.0 kg/min with a temperature rise of 40°C ($c_{p,w}$ = 4.186 kJ/kg · K) f. Exhaust Gas Flow Rate ($\dot{m}_{ex}$): 220 kg/hr with a temperature rise of 400°C above ambient ($c_{p,ex}$ = 1.05 kJ/kg · K) Calculate: a. Indicated Power (IP) and Brake Power (BP) [3 Marks] b. Mechanical Efficiency (η_{mech}), ITE, and BTE [3 Marks] Draw up a complete Heat Balance Sheet in kW and % separating Exhaust Loss and Radiation/Unaccounted Loss [4 Marks]	10	2	4