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**COURSE NAME:  
(Advanced Vehicle Control Systems)**

**Assignment Title:  
(Advanced Vehicle Control Systems)  
Assignment)**

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## Introduction

This course focuses on Stability, performance and robustness of closed-loop control systems. Robust controller design by convex optimization. Model-based H-2 and H-infinity control. Data-driven fixed structure controller design with loopshaping, H2 and H-infinity performance. Two-degree of freedom RST digital polynomial controller. Robust pole placement with Q parameterization. Parameter adaptation algorithms. Direct and Indirect adaptive control. Switching adaptive control. Gain-scheduled controller design. The course covered important concepts such as;

- Analyze a linear dynamical system (both time and frequency responses)
- Represent a linear system by a transfer function
- Identify a dynamic system using experimental data
- Design a PID controller
- Design a simple controller for a dynamic system

## Multiple choice questions

1. When was first practical power steering invented?

- a) 1820
- b) 1760
- c) 1920
- d) 1926

**Answer: D**

2. What is the frictional force in a braking system if the brake pads offer a normal force of 20Newton and the coefficient of friction is 0.4?

- a) 4Newton
- b) 8Newton
- c) 2Newton
- d) 40Newton

**Answer: B**

3. What is the full form of EHPS with respect to vehicle dynamics?

- a) Electric-hydro power steering
- b) Electro-hydraulic power steering
- c) Electro-hydraulic pulse steering

d) Electro-hydraulic power system

**Answer: B**

4. When was first calliper-type disc brakes patented?

- a) 1902
- b) 1800
- c) 1945
- d) 1850

**Answer: A**

5. What is the frictional force in a braking system if the brake pads offer a normal force of 10Newton and the coefficient of friction is 0.4?

- a) 4Newton
- b) 8Newton
- c) 2Newton
- d) 40Newton

**Answer: A**

6. What is the frictional force in a braking system of a truck if the drum brake pads offer a normal force of 30Newton and the coefficient of friction at the area of contact is 0.5?

- a) 4Newton
- b) 7.5Newton
- c) 15Newton
- d) 40Newton

**Answer: C**

7. What is the full form of MDPS with respect to vehicle dynamics?

- a) Motor driven pulse steering
- b) Motor driven power steering
- c) Multi driving power steering
- d) Motor driven power system

**Answer: B**

8. Volvo XC90 has automatic braking system.

- a) True
- b) False

**Answer: A**

9. Which is not a self driving car?

- a) Tesla Model S
- b) NEXT TWO
- c) Renault duster
- d) Nissan LEAF

**Answer: C**

10. What is the frictional force in a braking system of a car if the disc brake pads offer a normal force of 15Newton and the coefficient of friction at the area of contact is 0.5?

- a) 4Newton
- b) 7.5Newton
- c) 2Newton
- d) 40Newton

**Answer: B**

11. Which is the first autopilot ship?

- a) Tesla Model S
- b) NEXT TWO
- c) J.A Moffet
- d) Nissan LEAF

**Answer: C**

12. When was first autopilot system developed?

- a) 1911
- b) 1912
- c) 1932
- d) 1931

**Answer: B**

13. Which is the first helicopter with autopilot?

- a) Piasecki HUP Retriever
- b) NEXT TWO
- c) J.A Moffet
- d) Nissan LEAF

**Answer: A**

14. Who developed the first autopilot system?

- a) Lawrence Sperry
- b) Joseph Henry
- c) Norman Bel Geddes
- d) Walther Bothe

**Answer: A**

15. When was the first steering wheel made?

- a) 1911
- b) 1894
- c) 1832
- d) 1831

**Answer: B**

16. Which among the following is a false statement regarding “Mechatronic system”?

- a) Its initial cost of setup is high
- b) Does not require highly skilled labours for operating it
- c) More output in less time
- d) It provides flexibility in production

**Answer: B**

17. Which among the following is a correct statement regarding “Mechatronic system”?

- a) Its initial cost of setup is low
- b) Cheaper maintenance
- c) More output in less time
- d) Any individual can operate these systems

**Answer: C**

18. How many principle axes do a Cartesian robot has?

- a) 2
- b) 3
- c) 4
- d) 5

**Answer: B**

19. What does SCARA stand for in terms of industrial mechatronic robots?

- a) Selectively Compliance Assembled Robot Arm

- b) Selective Complicated Assembly Robot Arm
- c) Selective Compliance Assembly Robot Arm
- d) Static Complicated Assembly Robot Arm

**Answer: C**

20. Which axis of SCARA (Selective Compliance Assembly Robot Arm)robot is rigid and static?

- a) X axis
- b) Y axis
- c) Z axis
- d) No axis

**Answer: C**

### **Conclusion**

The lay emphasis on

- System dynamics: Modelling of typical physical systems. Operating point. Linearization. Differential equation representation. State space representation of systems. Laplace transforms. Transfer functions. Block diagrams. SISO and MIMO systems. Time and frequency domain responses of systems,
- Feedback control: Positive and negative feedback. Stability. Methods for stability analysis. Closed loop performance specification. PID controllers. Ziegler-Nichols. Self-tuning methods,
- Enhanced controllers: Cascade control. Feedforward control. Control of non-linear systems. Control of systems with delay,
- Digital controllers: Effects of sampling. Implementation of PID controller. Stability and tuning,
- Advanced control topics: Hierarchical control. Kalman filter. System Identification. Model predictive control. Statistical process control. The use of expert systems and neural networks in industrial control,
- Design packages for process control systems: Examples including Simulink and MATLAB,
- Case studies: Examples will be chosen from a range of industrial systems including mechanical, chemical and fluid systems

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## **Bibliography**

- Feedback Control Theory by Doyle, Francis and Tannenbaum; Maxwell Macmillan, 1992.
- Adaptive Control by Landau, Lozano, M'Saad and Karimi, Springer, 2011.