

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(END SEMESTER EXAMINATION)**

**CLASS: MTECH  
BRANCH: EVT**

**SEMESTER : II  
SESSION : SP/2023**

**SUBJECT: EE586 ADVANCED CONTROL TECHNIQUES FOR ELECTRIC VEHICLE  
TIME: 3 HOURS**

**FULL MARKS: 50**

**INSTRUCTIONS:**

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
  2. Attempt all questions.
  3. The missing data, if any, may be assumed suitably.
  4. Before attempting the question paper, be sure that you have got the correct question paper.
  5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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		CO	BL
Q.1(a)	What is describing function? How it linearized the nonlinearity explain with an example.	[5] 1	2
Q.1(b)	Find the describing function of an ideal relay.	[5] 1	3
Q.2(a)	What is the different cause of non-linearity present in the system and what are the method of analysis?	[5] 2	3
Q.2(b)	What are three different method of Phase plain analysis? Explain with Example.	[5] 2	3
Q.3(a)	Drew the phase trajectory of $\ddot{Y} + 5\dot{Y} + 2Y + Y^2 = 0$	[5] 3	4
Q.3(b)	What are the procedure for determination of existence of limit cycle?	[5] 3	4
Q.4(a)	A system is described by the state equation as $\dot{x}=u$ . It is desire to minimized the performance measure $J = \int_0^{t_2} (x + 2u)dt$ subjected to boundary condition $x_0 = 5,$ $x_2 = 3,$ $t_2 = 5sec$ In addition, the state and the input are constrained as $x \geq 1 \text{ and } -2 \leq u \leq 2$	[5] 4	5
Q.4(b)	Define and explain Bellman's principal of optimality	[5] 4	4
Q.5(a)	Explain the working of the Model Reference adoptive control system	[5] 5	3
Q.5(b)	Find the extremal for the functional $J(x)= \int_0^{t_2} \left[ 2x(t) + \frac{1}{2}\dot{x}^2(t) \right] dt$ subjected to the condition $\dot{x}(1) = 4$ and $x(t_2) = 4, t_2$ is free.	[5] 4,5	5

:::::21/07/2023:::::