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PRESIDENCY UNIVERSITY BENGALURU

SCHOOL OF ENGINEERING

SUMMER TERM END TERM EXAMINATION – AUG- 2024

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| **Semester: IV** | **Date :05-08-2024** |
| **Course Code: EEE2007** | **Time:** **09.30am to 12.30pm** |
| **Course Name:** **Control System Engineering** | **Max Marks :100** |
| **Program: B. TECH-EEE** | **Weightage :50%** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Question paper consists of 3 parts.*
3. *Scientific and non-programmable calculator are permitted.*
4. *Do not write any information on the question paper other than Roll Number.*

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| **PART A** | | | |
| **ANSWER ANY 5 QUESTIONS 5Q X 4M=20M** | | | |
| 1 | The feedback concept has been the foundation for control system analysis and design. List the differences between open loop and closed loop control systems. | (CO 1) | [Knowledge] |
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| 2 | The Mason’s Gain Formula (MGF) determines the transfer function of a linear system which is represented as signal flow graph. State the MGF and explain the terms | (CO 1) | [Knowledge] |
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| 3 | Define the transfer function of a linear time invariant system. Describe the poles, zeros and order of a transfer function | (CO 2) | [Knowledge] |
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| 4 | Define the terms rise time and settling time of a system with their mathematical expressions. | (CO 2) | [Knowledge] |
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| 5 | The error constants Kp, Kv and Ka describe the ability of a system to reduce or eliminate steady state errors. List the expressions for the various error constants and steady state error. | (CO 3) | [Knowledge] |
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| 6 | Routh-Hurwitz stability criterion is an analytical method used for the  determination of stability of a linear time-invariant system. List down the  difficulties that arise while constructing Routh array and the procedures to  overcome the same. | (CO 3) | [Knowledge] |
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| 7 | Explain the state model of a linear system by listing the output and state  equation | (CO 4) | [Knowledge] |
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| **PART B** | | | | |
| **ANSWER ANY 5 QUESTIONS 5Q X 10M=50M** | | | | |
| 8 | Draw the Signal Flow Graph and find the overall gain of the following block diagram. | | (CO1) | [Comprehension] |
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| 9 | Damping Ratio is dimensionless parameter which describes how an oscillating or vibrating body comes to rest. If there is no damping, then an oscillating system will never come to rest.   1. Explain different types of systems based on the damping factor. 2. Sketch the approximate time response of second order system when the damping ratio is a) 1.5 b)1 c)0.5 d) 0.2 e)0 | | (CO 1) | [Comprehension] |
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| 10 | | Steady-state error is a property of the input/output response for a linear system and defined as the difference between the desired value and the actual value of a system output in the limit as time goes to infinity. The magnitudes of the steady-state errors due to these individual inputs are indicative of the goodness of the system. For the feedback control systems given below, identify the type of input signal which gives rise to a constant steady state error and evaluate the expected steady state error values. | (CO 2) | [Comprehension] |
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| 11 | The robot arms used in industrial manufacturing require control of the position of the end piece. The simplified block diagram model of the system is shown  below and has parameters ζ = 0.6 and ωn = 5rad / sec. The system is subjected to a unit step input, Estimate all the possible time response specification and comment on its performance. | | (CO 2) | [Comprehension] |
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| 12 | While designing a control system, its required to know the exact location of closed loop system poles in S plane because the location of poles are closely related to stability. Suggest a suitable method to find the location of closed loop poles in S plane.  For a system with the characteristic equation given below identify the number of poles lying LHS, RHS and Imaginary axis of S plane  S5 + S4 + 2S3 +2S2 + S + 1 =0 | | (CO 3) | [Comprehension] |
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| 13 | Explain the lag, lead and lag-lead compensator with neat circuit diagram. | | (CO 4) | [Comprehension] |
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| 14 | While developing an automatic control system, its verified that system is stable and need to check the controllability and observability. Suggest suitable methods for the same and the system is represented in the state space model as | | (CO 4) | [Comprehension] |
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| **PART C** | | | |
| **ANSWER ANY 2 QUESTIONS 2Q X 15M=30M** | | | |
| 15 | Using Block diagram reduction techniques, reduce the block diagram given below and obtain the transfer function | (CO1) | [Application] |
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| 16 | For the open loop system whose transfer function is given below   1. Identify the type and order. 2. Find the location of poles and zeros 3. Determine the static error constants for step, ramp and parabolic (acceleration) inputs 4. Determine the steady state errors for step, ramp and parabolic (acceleration) inputs when applied separately. | (CO2) | [Application] |
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| 17 | The state model of a robotic arm which uses PI controller is given below. It is required to check its stability using classical methods like Root Locus method, Bode plots etc. Obtain the transfer function of this system so that stability analysis can be done with the classical methods. | (CO3) | [Application] |
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