|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Roll No |  |  |  |  |  |  |  |  |  |  |  |

PRESIDENCY UNIVERSITY BENGALURU

 SCHOOL OF ENGINEERING

 MAKE-UP EXAMINATION - JULY 2024

|  |  |
| --- | --- |
| **Semester :III** | **Date :10-07-2024** |
| **Course Code : EEE3052** | **Time :** **01.30pm to 04.30pm** |
| **Course Name :** **Control Systems for Robotic Applications** | **Max Marks :100** |
| **Program :B.TECH-ISE** | **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.*

|  |
| --- |
| **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] |
|  |
| 2 | The performance characteristics of a control system are specified in terms of the transient response to unit step input. The transient response of a practical control system exhibits damped oscillations before attaining the steady state. Define the following performance indices with respect to the step response of a second order system with their mathematical expressions (a) Rise time    (b) Peak time | (CO 1) | [Knowledge] |
|  |
| 3 | Define the terms Transfer function, Poles and Zeros  | (CO 2) | [Knowledge] |
|  |
| 4 | For analyzing and designing control systems, we must have a basis of comparison for time response of various control systems. This is accomplished by subjecting the systems to be compared with the typical test signals and recording the time responses. List the commonly used test signals with their mathematical representation and Laplace transform.  | (CO 2) | [Knowledge] |
|  |
| 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] |
|  |
| 6 | Explain the state model of a linear system by listing the output and state equation | (CO 3) | [Knowledge] |
|  |  |  |  |
| 7 | Draw the block diagram representation of a PI controller | (CO 4) | [Knowledge] |
|  |

|  |
| --- |
| **PART B** |
|  **ANSWER ANY 5 QUESTIONS 5Q X 10M=50M** |
| 8 | A control system is to be designed for an aircraft. The dynamical behavior of the open-loop system was unsatisfactory and led to the introduction of the feedback control system. The basic characteristic of the transient response of this closed-loop system is closely related to the location of the closed-loop poles. While testing closed loop model of air craft with a bounded input, it is observed that output is also bounded. Comment on its stability. Explain the various possible locations of poles in S plane and comment on stability. | (CO 1) | [Comprehension] |
|  |
| 9 | 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 1) | [Comprehension] |
|  |
| 10 | The nature of time response of the second order system depends on the damping. 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 2) | [Comprehension] |
|  |
| 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 shownbelow 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] |
|  |
| 12 | 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 3) | [Comprehension] |
|  |
| 13 | An autonomous mobile robot used in an automobile industry is required to carry some raw materials from one location to another through a predefined path. It is required that the robot should follow the path without any deviation or error. Suggest a suitable controller for the above robot control system which should be economical also. | (CO 4) | [Comprehension] |
|  |
| 14 | For the system given below, determine the stability using Lyapunov’s Direct method.            http://guqbms.inpods.com:57953/api/v1/downloadFile?fileId=14091&tenantid=13 =   http://guqbms.inpods.com:57953/api/v1/downloadFile?fileId=14090&tenantid=13  | (CO 4) | [Comprehension] |
|  |

|  |
| --- |
| **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] |
|  |
| 16 | For the open loop system whose transfer function is given below1. 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] |
|  |
| 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] |
|  |
|  |