

**R18**

**Code No: 155AR**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**B. Tech III Year I Semester Examinations, July/August - 2023**

**CONTROL SYSTEMS**

**(Common to ECE, EIE)**

**Time: 3 Hours**

**Max. Marks: 75**

**Note:** i) Question paper consists of Part A, Part B.

ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.

iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

**PART – A**

**(25 Marks)**

- 1.a) What do you mean by characteristic equation? [2]
- b) Why negative feedback is preferred in control systems? [3]
- c) What do you mean by time response of a control system? [2]
- d) Give the procedure for construction of root locus. [3]
- e) The damping ratio and the undamped natural frequency of a second order system are 0.4 and 6 rad/sec respectively. Calculate the resonant peak and resonant frequency. [2]
- f) List the advantages of frequency response analysis. [3]
- g) What do you mean by transient accuracy? [2]
- h) Explain the terms insensitivity and robustness of control systems. [3]
- i) What do you mean by Controllability? [2]
- j) Explain the following terms with respect to state variable approach:  
i) State variables ii) State- space and iii) State vector [3]

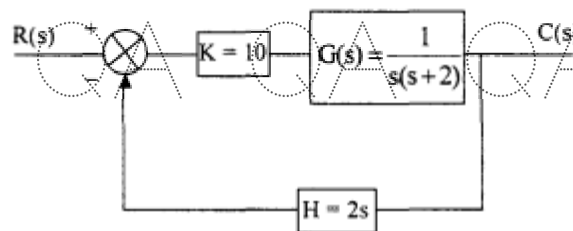
**PART – B**

**(50 Marks)**

2. Explain with a neat diagram, Obtain the mathematic modelling of an automatic tank level control system. [10]

**OR**

- 3.a) Explain the steps involved in Signal flow graph representation of control systems.
- b) For the following system, determine the sensitivity of the closed loop transfer function with respect to G, H and K. Assume angular frequency as 3 rad/sec. [5+5]

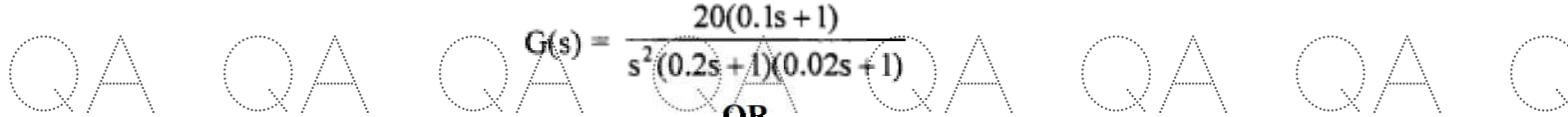




4. Derive expressions for rise time, peak time and peak overshoot of a second order system excited by a step unit. [10]

**OR**

- 5.a) Derive expression for the steady state errors of type-1 and type-2 systems excited by a unit parabolic input.  
b) How can you determine the relative stability of a system by using the Routh stability criterion? [5+5]
6. Obtain magnitude and phase angle bode plots for the system. [10]



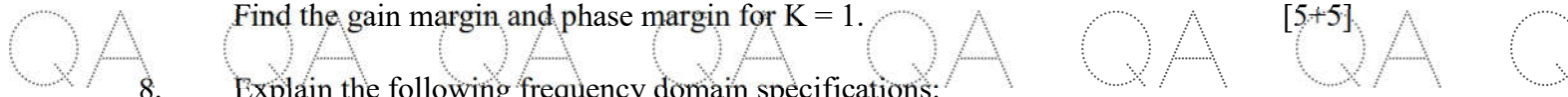
$$G(s) = \frac{20(0.1s + 1)}{s^2(0.2s + 1)(0.02s + 1)}$$

**OR**

- 7.a) State and explain Nyquist Criterion.  
b) Consider a unity feedback system with

$$G(s) = \frac{K}{s(0.5s + 1)(0.05s + 1)}$$

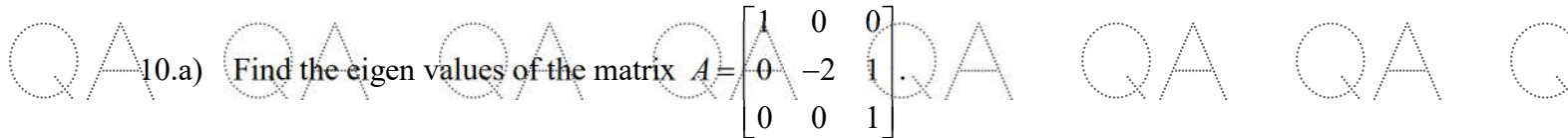
Find the gain margin and phase margin for  $K = 1$ .



8. Explain the following frequency domain specifications:  
a) Resonant Peak    b) Resonant frequency and    c) Bandwidth [10]

**OR**

9. What is a lag compensator? Explain the design procedure of a lag compensator. [10]

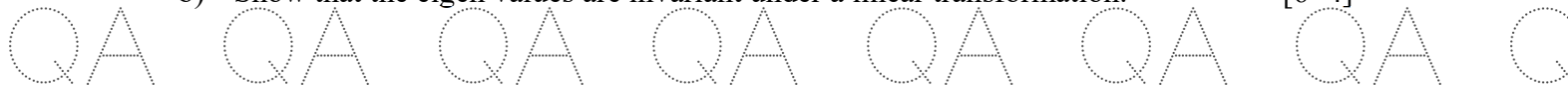


- 10.a) Find the eigen values of the matrix  $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -2 & 1 \\ 0 & 0 & 1 \end{bmatrix}$ .

- b) State the properties of state transition matrix. [5+5]

**OR**

- 11.a) Obtain the state variable formulation of a field-controlled DC Motor.  
b) Show that the eigen values are invariant under a linear transformation. [6+4]



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