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Control Engineering
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Time allowed: 3 hours
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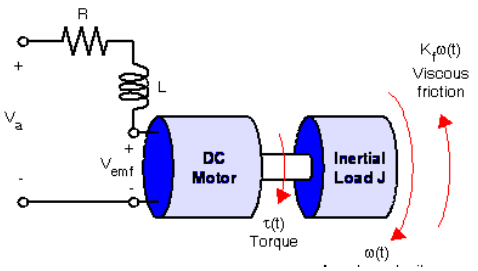
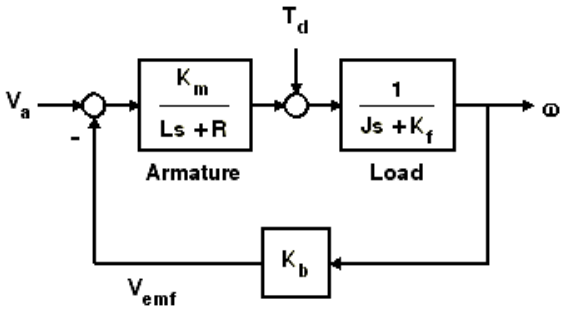
Q1.A.(60 M.) A simplified circuit and block diagram of an armature controlled dc motor is shown below.



Answer the following questions:

1. Derive a mathematical model in the form of Transfer Function.
2. Check stability of the system.
3. Find the time domain response if the system is subjected to a step input in the applied voltage, calculate all time domain specifications.
4. Find state space model
5. Find ω(t) if ωo(t)=0.1 , neglect all other initial conditions.
6. .Find the eignvalues, comment.
7. If an integral control is inserted to the system (see the figure),
8. use root-locus technique to show the effect of the modification to the stability.
9. Find the value of K for the damping ratio to be 0.7.

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For this example, the physical constants are:
 R = 2.0;          % Ohms
 L = 0.5;          % Henrys
 Km = Kb = 0.1;    % torque and back emf constants
 Kf = 0.2;         % Nms
 J = 0.02;         % kg.m^2/s^2
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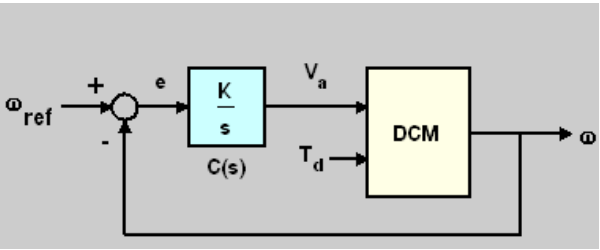

Q2.(40 M.) A mathematical model for a system is given by the following matrices (MATLAB Syntax):

```
A=[0.1   0.2; 0.3   0.4];
B=[1 0]T;
C=[0   1];
D=[0];
```

1. Convert the model into transfer matrix form
2. Check the stability of the system
3. Calculate damping ratio, maximum overshoot and damping natural frequency.
4. Find x(t), xo(t)=[0.1 0]

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