BME Special Program
Faculty of Engineering
Mansoura University
Control Systems – Self Study
Dr. John F. W. Zaki

Duration: 2 Hours
Final Mark: 50
2nd Year 1st Semester
Final Exam
Jan 2018

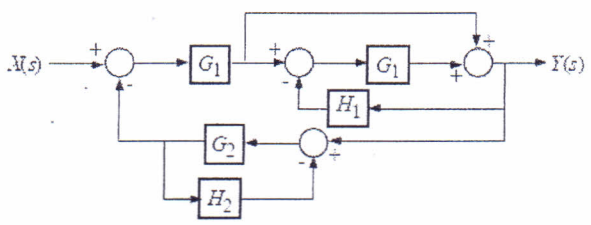
Please Answer ALL the Questions. Ensure your answer is well organized and written clearly to guarantee your mark.

1. (15 Min - 6 points) **Find the solution to the differential equation:**

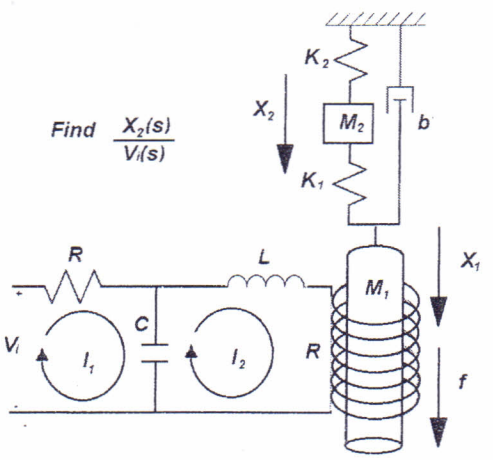
$$\ddot{x} + 4\dot{x} + 5x = 10e^t \qquad where \qquad x(0) = 1, \qquad \dot{x}(0) = 2$$

2. (10 Min - 8 points) **Complete the following statements:**
   (a) There are two modes of control to the DC Motor. They are —— and ——.
   (b) In the —— control of a DC motor, the ——— current is constant.
   (c) The flux is proportional to —— and the torque is proportional to —— and —— while the back EMF is proportional to ——.
   (d) Plot the equivalent circuit to your answer in (b).
   (e) The main advantage of closed loop system over open loop system are —— and —— while the disadvantages are —— and ——. However, the open loop system advantages are —— and ——.

3. (20 Min - 8 points) **Find $\frac{Y(s)}{X(s)}$ using block diagram reduction**



4. (15 Min - 6 points) **Find $\frac{x_2(s)}{v_i(s)}$. Ignore any back EMF**



5. (30 Min - 10 points) **Find the Root Locus of the following Open Loop Transfer Function showing details of each step.**

$$G(s) = \frac{1}{s(s+1)(s+2)(s+3)}$$

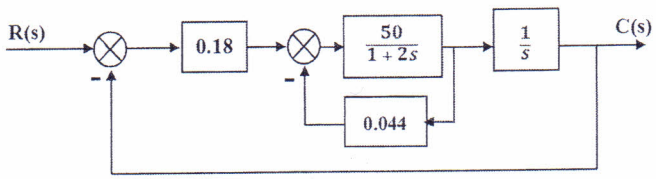
6. (15 Min - 6 points) **For the following closed loop system:**

$$T(s) = \frac{5}{s^5+5s^4+11s^3+23s^2+28s+12}$$

   (a) Find The roots location

   (b) Determine the stability of the system

7. (15 Min - 6 points) **For the following system, find:**



   (a) The damping ratio ζ

   (b) The natural frequency ω_n

   (c) The maximum overshoot M_p

   (d) The peak time t_p

   (e) The rising time t_r

   (f) The settling time t_s for the 2% error.

Good Luck...

Dr. John FW Zaki