

Texas A&M University
Department of Mechanical Engineering
MEEN 364 Dynamic Systems and Controls
EXAM 2 – April 14, 2004
7:00 – 9:00 PM; HECC 209

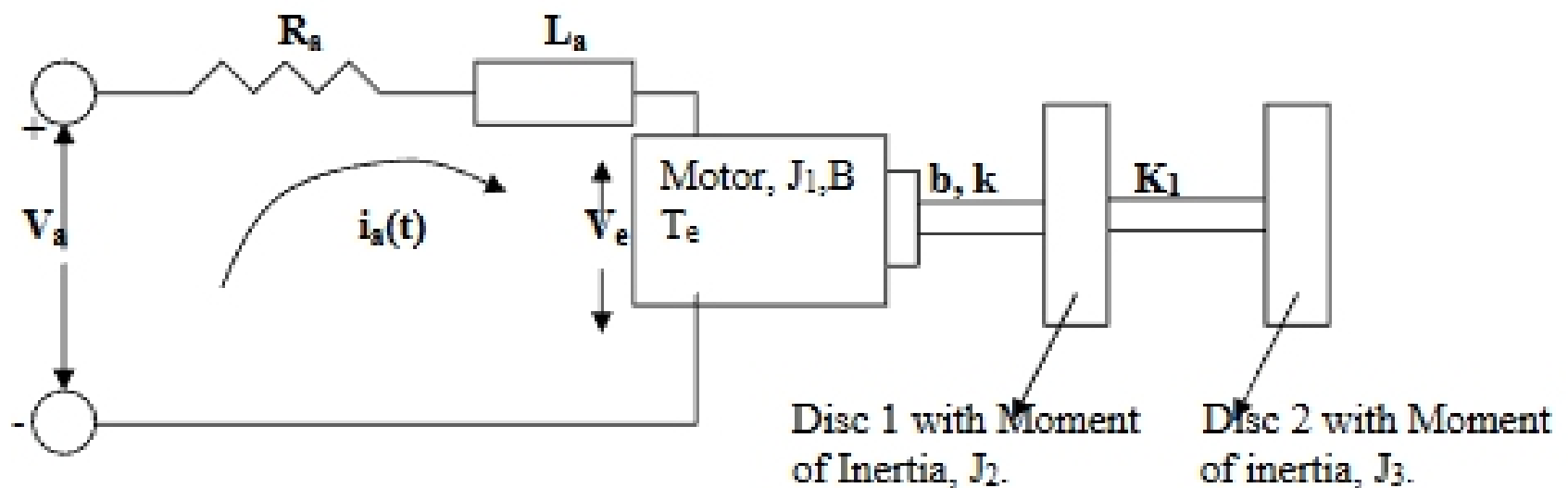
**NO CALCULATORS ARE ALLOWED
CLOSED BOOKS AND CLOSED NOTES**

Name: _____

Please circle your section below: Section (Lab Time):

501(M 1:50-4:40 PM) 502(T 8:00-10:50 AM) 503(R 8:00-10:50 AM)
504(W 1:50-4:40 PM) 505(R 2:20-5:10 PM) 506(T 2:20-5:10 PM)

1) Consider the following electromechanical system:



Description of Variables:

- J_1, J_2, J_3 – Moments of Inertia of Motor, Disc 1 and Disc 2 respectively.
- k, K_1 – Torsional spring constants.
- b – Torsional damping coefficient of the shaft connecting the Motor to Disc 1.
- B – Viscous friction coefficient of Motor
- R_a, L_a – Motor resistance and inductance
- $V_a(t)$ – Motor input voltage
- $i_a(t)$ – Motor current
- $V_e(t)$ – Back emf, which is proportional to the speed of the motor.
- $T_e(t)$ – electromechanical torque produced by the motor, which is proportional to the current.

a) [15 points] Derive the governing differential equations of motion for this system.

b) [10 points] Determine state-space representation of the following block diagram.

