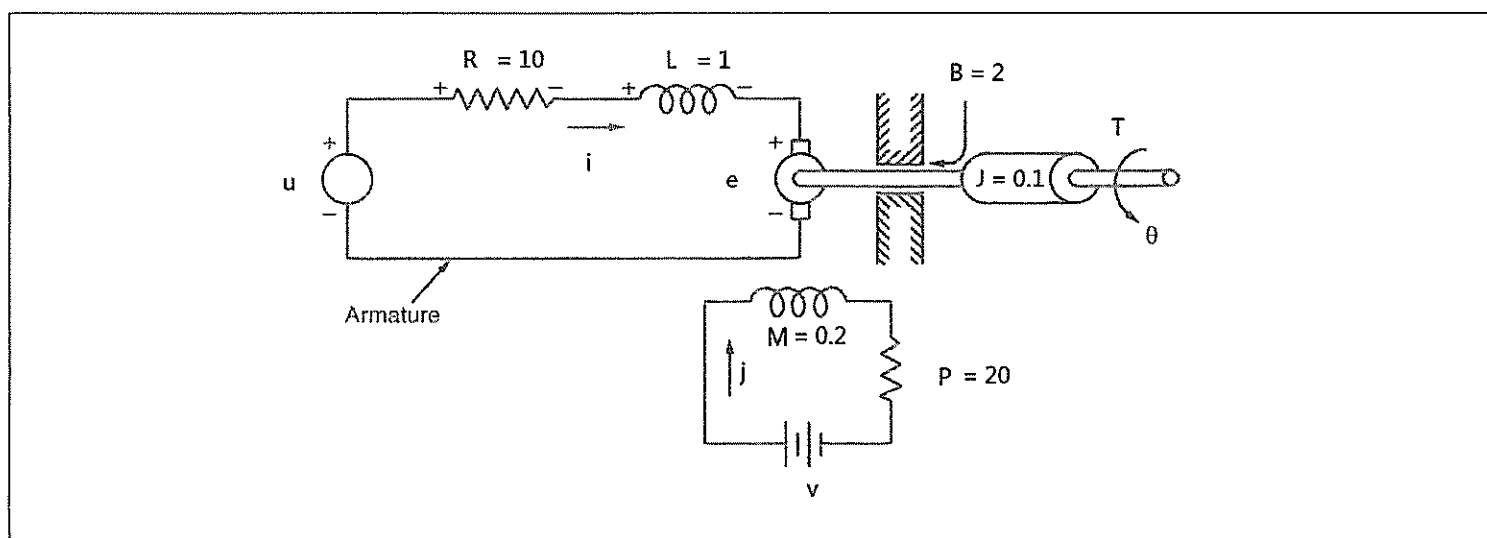


**Problem 1 (25 % , 計算題)**

The following figure represents a simplified model of an armature voltage-controlled DC servomotor consisting of a stationary field and a rotating armature and load. The various parameters and variables in the figure are described as follows.  $u$  = externally applied armature voltage,  $i$  = armature current,  $R$  = resistance of the armature winding,  $L$  = armature winding inductance,  $e$  = back-emf voltage induced by the rotating armature winding,  $B$  = viscous damping due to bearing friction,  $J$  = moment of inertia of the armature and load, and  $\theta$  = shaft position. The back-emf voltage is given by:  $e = 50 \times \dot{\theta}$ , and the torque generated by the motor is given by:  $T = 0.1 \times i$ . Please find the transfer function from the externally applied armature voltage to the shaft position and calculate the poles and zeros of the transfer function.

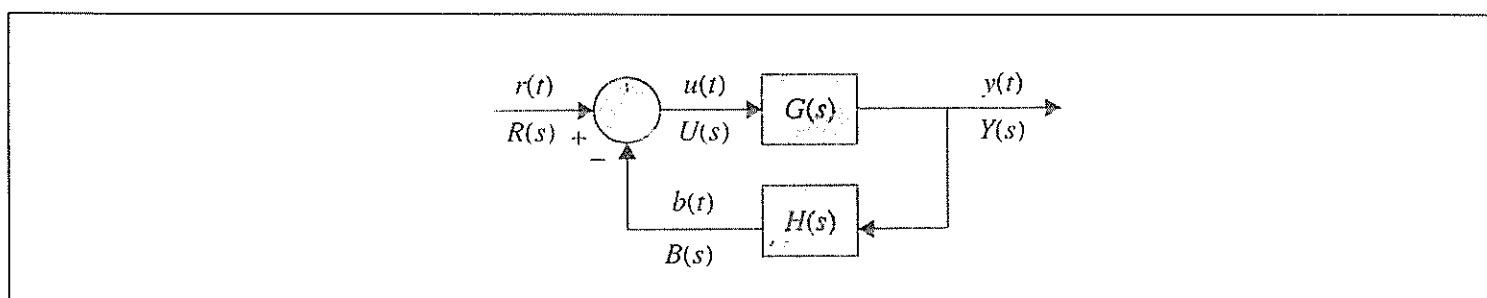


**Problem 2 (25 % , 計算題)**

Consider the closed-loop system shown in the following figure. If  $G(s)$  and  $H(s)$  are defined as follows:

$$G(s) = \frac{1}{s(s+1)(s+2)} \quad \text{and} \quad H(s) = K.$$

Please draw the root locus of the closed-loop system and find the values of  $K$  when the closed-loop system is stable or unstable.



**Problem 3 (25 % , 計算題)**

Please draw the Bode magnitude and phase plots for the following transfer function:

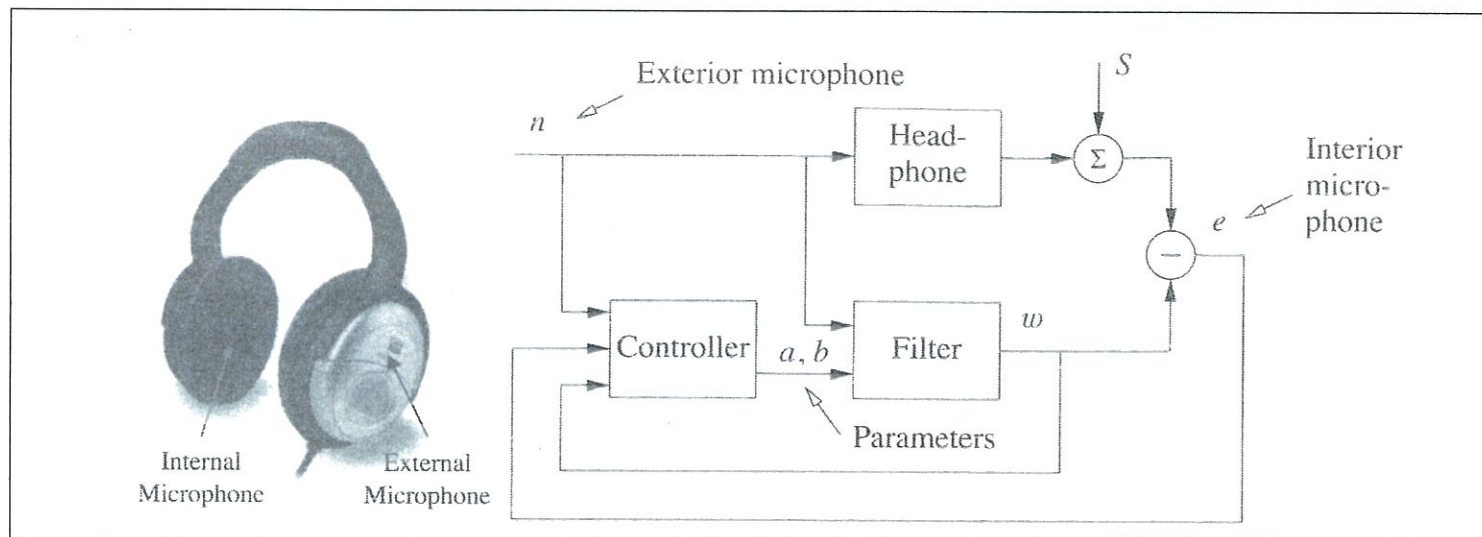
$$G(s) = \frac{2000(s+0.5)}{s(s+10)(s+50)}.$$

You need to clearly describe the procedure of drawing these plots and clearly identify the related important break points and asymptotes to properly characterize these plots.

見背面

**Problem 4 (25 % , 申論題)**

Noise cancellation is used in consumer electronics and in industrial systems to reduce the effects of noise and vibrations. A typical example and the schematic diagram of a pair of headphones with noise cancellation are shown in the following figure. If you are the control engineer to design proper controllers to cancel the noise, please discuss the functionality of the components shown in the figure and use proper control theory or methodology to justify whether the design can be used to achieve the goal on noise reduction or cancellation.



試題隨卷繳回