

系所別	組別	考試科目 (中文名稱)	考試日期	節次	備註
機電自動化	甲	電子學或動力學	4月13日	第三節 (3:30~5:00)	考生可攜帶 計算機作答

註：電子學及動力學任選五題作答，詳列計算步驟，(答題數不可超過5題，第6題(含)以上不予計分)

[1] A circuit of Wheatstone bridge is shown in Figure (A-1).

共四頁

(a) Determine the relationship among the four resistors if $V_{AB} = 0$? (10 points)

(b) Determine V_{AB} if $V_s = 5V$, $R_1 = 2.2k\Omega$, $R_2 = 18k\Omega$, $R_3 = 4.7k\Omega$ and $R_4 = 3.3k\Omega$. (10 points)

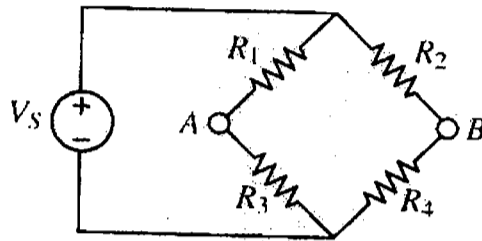


Figure (A-1)

[2] A circuit of 60Hz notch filter is shown in Figure (A-2).

(a) Derive the equation for the voltage transfer function $V_L(\omega) / V_s(\omega)$. (10 points),

(b) Determine the value of C if $L = 100mH$ and the resonant frequency of LC circuit is 60Hz? (10 points)

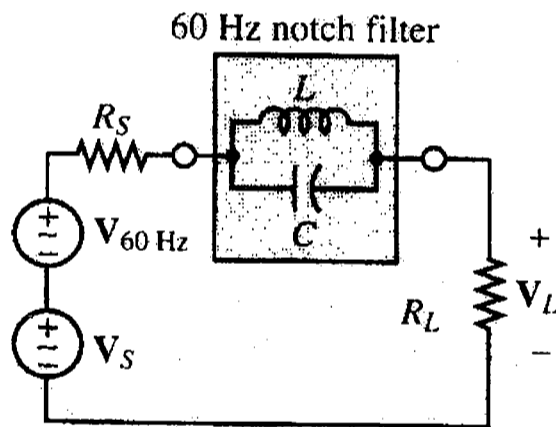


Figure (A-2)

[3] A circuit of Wheatstone Bridge Filter is shown in Figure (A-3).

(a) Determine a capacitor with 350Hz cutoff frequency if all resistors are 350Ω ? (10 points) and (b)

determine the magnitude and phase at 30Hz? (10 points)

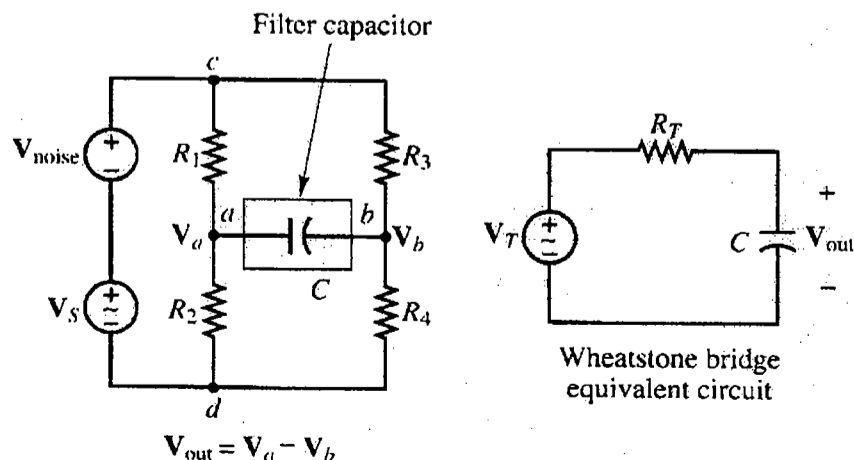


Figure (A-3)

[4] If a force is applied to the piezoelectric transducer, the transducer will generate a charge q according to the expression

$$q = K_p x_i \quad (\text{force leading to a displacement})$$

A charge amplifier circuit as shown in Figure (A-4) is utilized to amplify the transducer output voltage, v_{out} .

(a) Describe the characteristics of this circuit in terms of its function? (10 points)

(b) Show that $v_{out}(t) = -\frac{K_p x_i}{C_F}$? (10 points)

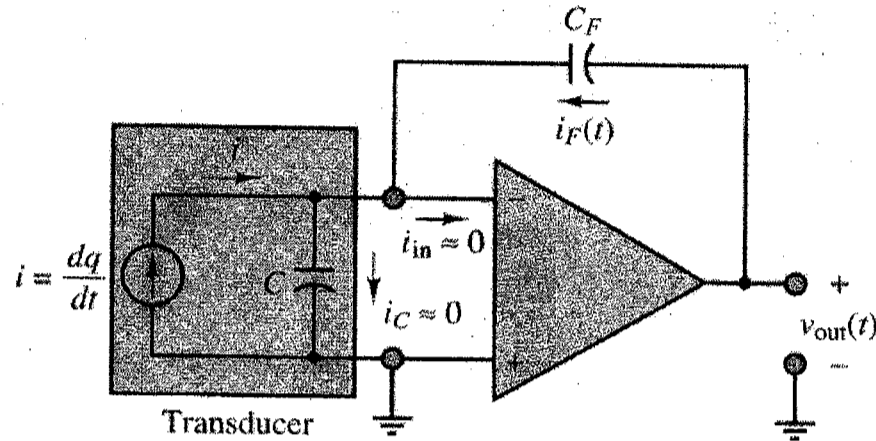


Figure (A-4)

[5] A BJT circuit is shown in Figure (A-5). Assume the BJT has a .6V offset voltage at the BE junction.

(a) Determine the emitter current and the collector-base voltage? (10 points)

(b) If the emitter resistor is changed to 22k, how does the operating of the BJT change? (10 points)

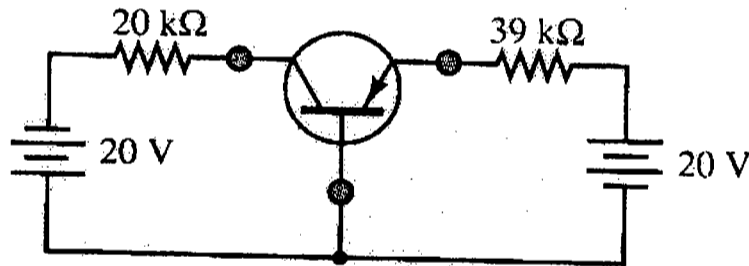
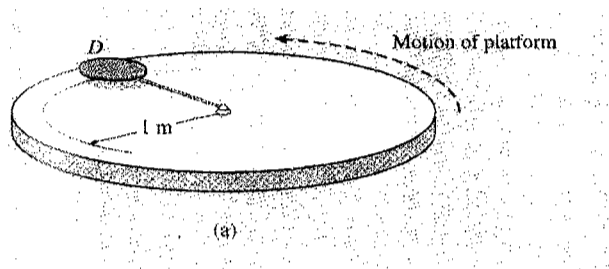


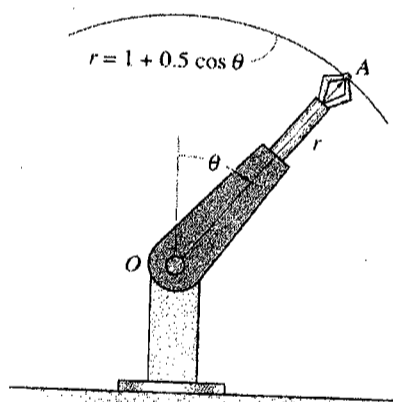
Figure (A-5)

Note: 20 points for each problem

- [6] The 3-kg disk D is attached to the end of a cord as shown in Fig. The other end of the cord is attached to a ball-and-socket joint located at the center of a platform. If the platform is rotating rapidly, and the disk is placed on it and released from rest as shown, determine the time it takes for the disk to reach a speed great enough to break the cord. The maximum tension the cord can sustain is 100 N, and the coefficient of kinetic friction between the disk and the platform is $\mu_k = 0.1$

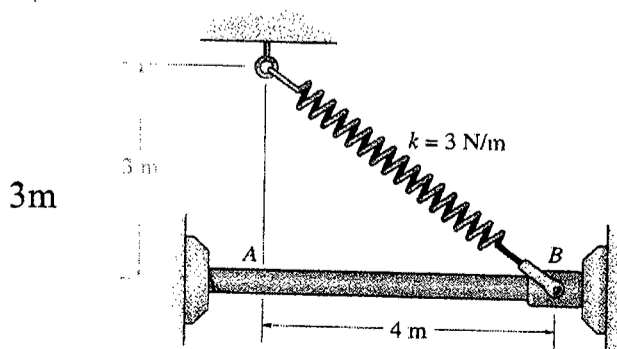


- [7] Because of telescopic action, the end of the industrial robotic arm extends along the path $r = (1 + 0.5 \cos \theta)$ m. At the instant $\theta = \pi/3$, the arm has an angular rotation $\dot{\theta} = 0.25 \text{ rad/s}$, which is increasing at $\ddot{\theta} = 0.25 \text{ rad/s}^2$. Determine the radial and transverse components of the velocity and acceleration of the object A held in its grip at this instant.



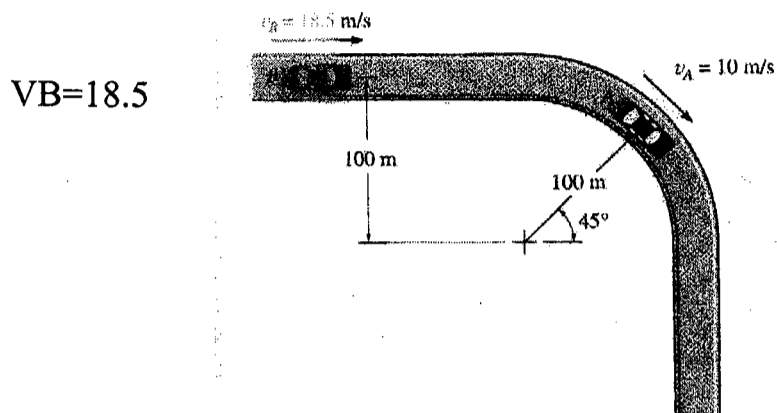
Prob. 12-154

- [8] The 2-kg collar is attached to a spring that has an unstretched length of 3 m. If the collar is drawn to point B and released from rest, determine its speed when it arrives at point A.



Prob. 14-75

- [9] At the instant shown, the car at A is traveling at 10m/s around the curve while increasing its speed with an acceleration 5 m/(s²). The car at B is traveling at 18.5 m/s along the straightaway and increasing its speed with an acceleration 2 m/(s²). Determine the relative velocity and relative acceleration of A with respect to B at this instant.



- [10] Determine the moment of inertia I_y for the slender rod. The rod's density ρ and cross-section area A are constant. Express the result in terms of the rod's total mass m .

