Prob.1 True or False questions (one point per correct answer, points will be deducted for incorrect answers, while the minimum point is zero). (10%)

1. Node-voltage method can be applied to non-planar circuit.
2. Loop-current method can be applied to planar circuit only.
3. To achieve maximum average power transfer, the matched load impedance should be chosen as : $Z_L = Z_{th}$.
4. A network with higher quality factor, Q, means higher frequency selectivity.
5. A sinusoidal signal and a square-type signal are fed into the same network, respectively, the former will consume more power that the later.
6. Two voltage sources with same magnitude while different frequencies are applied to a resistive load, respectively. Higher frequency means higher average power will be delivered to the load.
7. The voltage supplied by the electric company indicates 220 VAC and 110 KVA, implies the maximum current allowed is 50 A.
8. Network A indicates the maximum average power consumed is 100 kW, while network B shows 100 KVA. This implies that B will consume more power than A.
9. A leading power factor means the input current is leading the voltage.
10. If there are many electric motors operating in a factory, the power factor seen from the electric power company should be a lagging power factor.

Prob.2 A circuit as shown in Fig. 2 has a resistance load, R_L, connected on terminals a-b. Find the followings:

(a) Obtain a Thevenin's equivalent circuit as seen from terminals a-b. (10%)

(b) Calculate the maximum power can be transferred to R_L. (5%)

(c) The percentage of power dissipated by R_L. (5%)

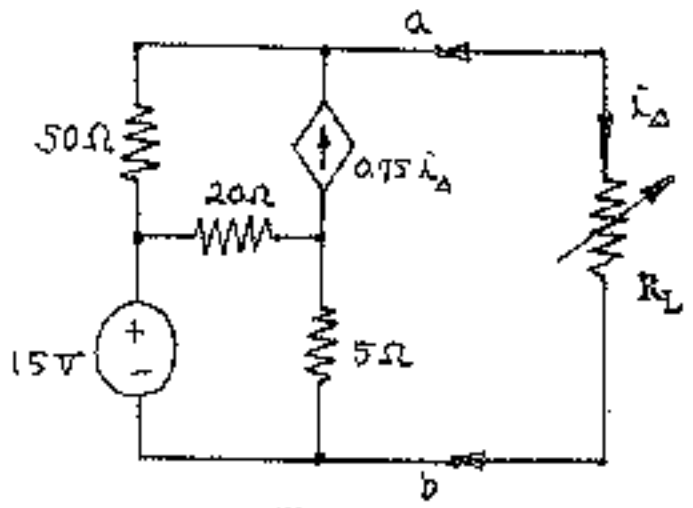


Fig. 2

Prob.3 A mechanical system shown in Fig. 3 is excited by a rotating wheel that gives approximated a sinusoidal displacement for x_1.

(a) Obtain a differential equation using x_1 as the input variable, while x_2 as the output variable. (5%)

(b) Draw an analogy circuit of the above mechanical system using basic circuit elements, e.g. resistors, inductors, capacitors, ideal source(s), and assuming x_1 as an ideal current source. (10%)

(c) Using the phasor concept to solve for a sinusoidal steady-state response of x_2. (5%)

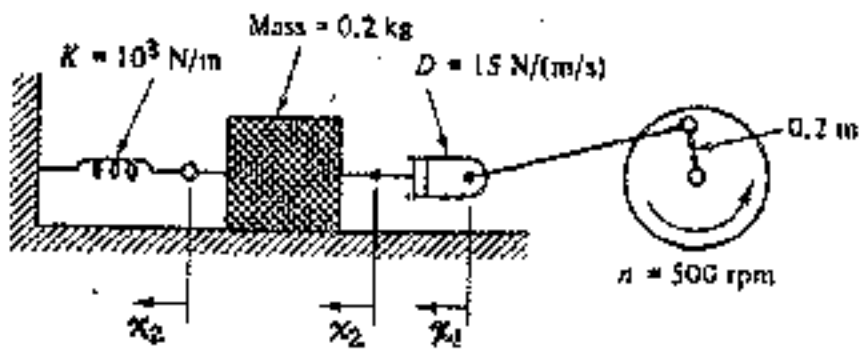


Fig. 3

Prob.4 (a) Compare bipolar and CMOS technologies from gate delay, degree of integration, power dissipation, noise margin, component cost, fan out and driving capability. (5%)

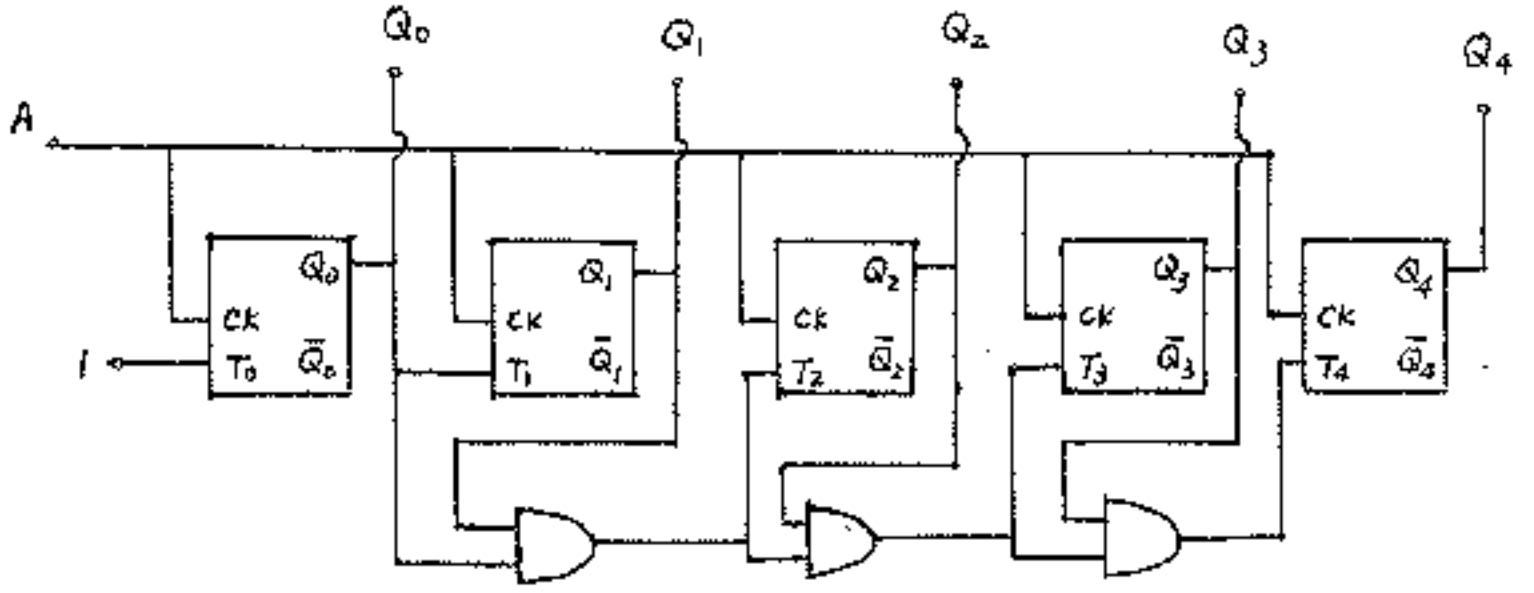
(b) The standard TTL components are listed as 74XX, where XX is the component number. State the characteristics of the following families: 74HXX, 74LXX, 74SXX and 74LSXX. (5%).

Prob.5 Implement the following Boolean functions by PLA and PAL, respectively. (10%)

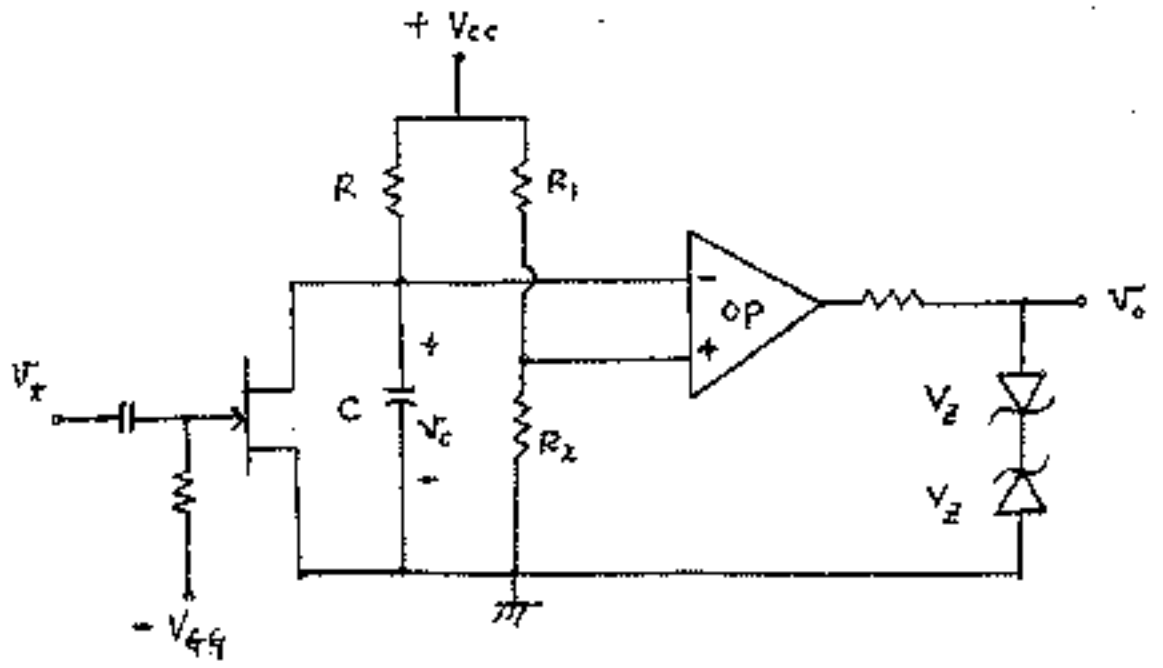
$$F_0 = \overline{A} + \overline{B}C \qquad F_1 = \overline{B}\overline{C} + AB$$

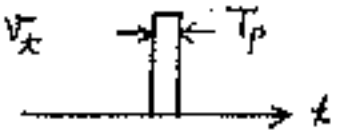
$$F_2 = \overline{B}C + A \qquad F_3 = AB + \overline{B}C$$

Prob.6 Consider the circuit with five negative edge trigger T Flip-Flops as shown below. Draw the waveforms of Q_0, Q_1, Q_2, Q_3 and Q_4, and state what circuit it is if a series pulses is applied to the terminal A. (10%)



Prob.7 A retriggerable monostable multivibrator is shown below. Neglect the time of discharge of the capacitor C. If a trigger pulse v_t with pulse width T_p is applied, (a) draw the waveforms v_c and v_o, and (b) derive the pulse width of output v_o. (10%)





八十四學年度 動力機械研究 所 乙 組碩士班研究生入學考試

科目 電子學 科號 1902 共 4 頁第 4 頁 *請在試卷【答案卷】內作答

Prob.8 A differential amplifier constructed with MOSFETs and the small-signal model of MOSFET are shown below. Derive the differential-mode gain A_{DM}, the common-mode gain A_{CM}, and the common-mode rejection ratio CMRR. (10%)