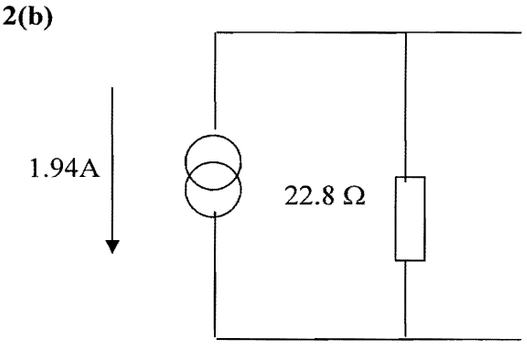
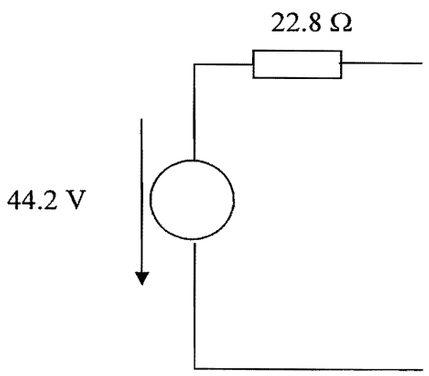
Short Answers-Paper 3, PartIA, 2009

1(a) Textbook;
1(b) $R_{in} = 2198\Omega$; $G = -9.01$

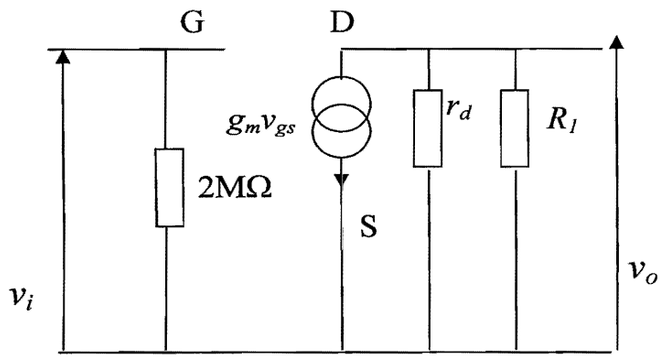
2(a) Textbook;
2(b)





3 $\overline{Z_T} = (8 + j2)\Omega$; $\overline{I} = 29.1\angle -14^0\, A$

4(a) $R_1 = 63.3k\Omega$; $R_2 = 10k\Omega$
4(b)



4(c) $Gain = \frac{-g_m R_1 r_d}{R_1 + r_d} = 48.1;\ R_{out} = \frac{R_1 r_d}{R_1 + r_d} = 41.8k\Omega$

4(d) C_1=182.6nF

5(a) Textbook

5(b) $\bar{I} = 6.26\angle -80^0 A$; cosΦ=0.178 lag

5(c) Motor Power=182.6W;Motor VARs=1454VARs;Cable power loss=78.4W

5(d) $C = 84.4\mu F$

Section B Digital

6 (a) 2 bistables (c) If Q_A and Q_B are MSB and LSB respectively then $J_A = Q_B \quad K_A = \overline{Q_B}$

$J_B = \overline{Q_A} \quad K_B = Q_A$

7 (b) Sawtooth waveform of period 2811 clock cycles = 351.4 μs.

8 (b) Output voltage = 0.8789 V (c) Output voltage = 2.49 V

9 (a) (i) $Z = A.C + B.\overline{C}$ (ii) Z = 1 independent of C (iii) Static 1 hazard between 2μs and 3μs

(iv) Remove hazard by adding term A.B term.

(b) $O_0 = A_0$, $O_1 = A_1 \oplus A_0$, $O_2 = A_1.\overline{A_0}$, $O_3 = A_1.A_0$ NAND gate implementation is

$O_3 = \overline{\overline{A_1.A_0}} \quad O_2 = \overline{A_1.\overline{A_0}} \quad O_1 = \overline{\overline{A_1.\overline{A_0}}.\overline{\overline{A_1}.A_0}}$

Section C Electromagnetics

10 (c) C = 0.163 nFm^{-1}

11 (c) $L = \frac{\mu_0}{\pi} \ln \frac{2a-b}{b} \approx \frac{\mu_0}{\pi} \ln \frac{2a}{b}$

12 (a) R = 2.45 Ω (b) L = 0.11 H (c) Z = (2.45 + j34.6)Ω I = 2.89 A

(d) B = 1.8 T gives H = 500 Am^{-1} and I = 1.4 A, B = 0.9 T gives H = 25 Am^{-1} and I = 0.07 A so

input current is very 'peaky' owing to core saturation.