SE Sem III (EXTC) (CBSGS)
Applied mathematics - III

18/5/2017 (10)

Q.P. Code : 13608

(3 Hours) **[Total marks : 80**

Note :-
1) Question number **1** is **compulsory.**
2) Attempt any **three** questions from the remaining **five** questions.
3) **Figures** to the **right** indicate **full** marks.

Q 1.A) Show that $u = y^3 - 3x^2y$ is a harmonic function. Also find its harmonic conjugate. **(5)**

B) Find half range Fourier sine series for $f(x) = x^3$, $-\pi < x < \pi$. **(5)**

C) If $\bar{F} = xye^{2z}i + xy^2coszj + x^2cosxykk$ find $div\bar{F}$ and $curl\bar{F}$ **(5)**

D) Evaluate $\int_0^\infty e^{-2t}sin^3t\,dt$. **(5)**

Q.2) A) Prove that $J_{-\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}}\,cosx$ **(6)**

B) Find an analytic function f(z) whose imaginary part is $e^{-x}(ysiny + xcosy)$ **(6)**

C) Obtain Fourier series for $f(x) = 1 + \frac{2x}{\pi}$ $-\pi \leq x \leq 0$

$= 1 - \frac{2x}{\pi}$ $0 \leq x \leq \pi$

Hence deduce that $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots$ **(8)**

Q.3) A) Show that $\bar{F} = (2xyz^2)i + (x^2z^2 + zcosyz)j + (2x^2yz + ycosyz)k$, is a conservative field. Find its scalar potential φ such that $\bar{F} = \nabla\varphi$ and hence, find the work done by $\bar{F}$ in displacing a particle from A(0,0,1) to B($1,\pi/4,2$) along straight line AB **(6)**

B) Show that the set of functions $f_1(x) = 1, f_2(x) = x$ are orthogonal over (-1, 1). Determine the constants a and b such that the function $f_3(x) = -1 + ax + bx^2$ is orthogonal to both f_1 and f_2 on that interval **(6)**

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C) Find (i) $L^{-1}\left\{log\left[\frac{s^2+a^2}{\sqrt{s+b}}\right]\right\}$

(ii) $L\{(e^{-t}cost.H(t-\pi)\}$ (8)

Q.4) A) Prove that $\int J_5(x)\,dx = -J_4(x) - \frac{4}{x}J_3(x) - \frac{8}{x^2}J_2(x)$ (6)

B) Find inverse Laplace of $\frac{s}{(s^2-a^2)^2}$ using Convolution theorem. (6)

C) Expand $f(x) = \frac{3x^2-6x\pi+2\pi^2}{12}$ in the interval $0 \le x \le 2\pi$ as a Fourier series.

Hence, deduce that $\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \ldots$ (8)

Q.5) A) Using Gauss Divergence theorem, prove that $\iint_S (y^2z^2i + z^2x^2j + z^2y^2k).\bar{N}ds = \frac{\pi}{12}$

where S is the part of the sphere $x^2 + y^2 + z^2 = 1$ and above the xy-plane. (6)

B) Prove that $J_3(x) + 3J_0(x) + 4J_0''(x) = 0$ (6)

C) Solve $(D^3-2D^2+5D)y = 0$, with $y(0) = 0$, $y'(0) = 0$ and $y''(0) = 1$, (8)

Q.6) A) Evaluate by Green's theorem for $\int_C (\frac{1}{y}dx + \frac{1}{x}dy)$ where C is the

the boundary of the region define by x = 1, x = 4, y = 1 and $y = \sqrt{x}$ (6)

B) Find the bilinear transformation which maps the points z = 1, i, -1

onto points w = i, 0 –i (6)

C) Find Fourier cosine integral representation for $f(x) = e^{-ax}, x > 0$

Hence, show that $\int_0^\infty \frac{cos\omega s}{1+\omega^2}d\omega = \frac{\pi}{2}e^{-x}$, $x \ge 0$ (8)

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Dt: 24.5.17

S.E-Sem-III EXTC (CBGS)

Q.P. Code : 545402

(3 Hours) **[Total Marks : 80**

N.B. : (1) **Question No. 1** is compulsory.
(2) **Attempt any 3** questions from Q.2 to Q.6.
(3) Figures to the **right** in the bracket indicate **full** marks.
(4) Assume suitable data if necessary.

1. a) Compare Combinational circuits with Sequential circuits. **5**
b) Compare Synchronous counter with Asynchronous counter. **5**
c) Compare Moore machine with Mealy machine. **5**
d) Compare SRAM with DRAM. **5**

2. a) Implement the following Boolean equation using single 4:1 MUX and few logic gates : $F(A,B,C,D) = \Sigma\, m(0, 2, 5, 6, 7, 9, 12, 15)$. **10**
b) State and prove the De Morgan's theorem. **5**
c) Implement $Y = A + \bar{B}C$ using only NOR gates. **5**

3. a) Draw a neat circuit of BCD adder using IC 7483 and explain. **10**
b) Using Quine McClusky method, minimize the following: **10**
$F(P,Q,R,S) = \Sigma$ m(0,1,2,3,5,7,8,9,11,14).

4. a) Design synchronous counter using D type flip flops for getting the following sequence: $0 \rightarrow 3 \rightarrow 1 \rightarrow 5 \rightarrow 6 \rightarrow 0$. **10**
Take care of lockout condition.
b) Convert JK type flip flop into D type flip flop. **5**
c) Write $(27)_{16}$ into its BCD code and Octal code. **5**

5. a) Write the VHDL code for 3-bit up-down counter with negative edge triggered clock and active low Preset and Clear terminals. **10**
b) Compare TTL with CMOS logic families. **5**
c) Draw the internal logic diagram of Programmable Logic Array (PLA). **5**

6. a) What is shift register? Explain any one type of shift register. Give its application. **10**
b) Design a Mealy type sequence detector circuit to detect a sequence 1011 using D type flip flops. **10**

S.E. Sem III (CBGS) (EXTC) 12/5/17 (4)

A E – I.

Q.P. Code : 545202

(3 Hours) **Total Marks : 80**

1. Question No.**1** is compulsory.
2. Answer any **three** from remaining questions.
3. **Figures** to the right indicate full marks.
4. Assume suitable data if required.

Q1. Attempt any four.

a Explain the effect of temperature of on VI characteristics of a PN junction diode. 05

b What are the important parameters of a JFET? How these parameters are determined graphically? 05

c What is Early effect? Explain how it affects the BJT characteristics in CB configuration. 05

d For the circuit shown in figure.1 draw the output waveform. Assume diode is ideal. 05

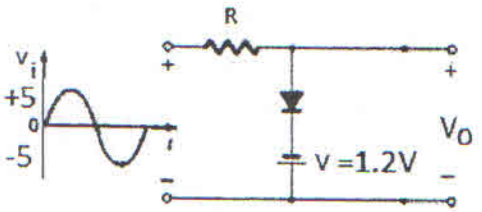

Fig.1

e For the FET shown in figure.2 the drain current equation is 05

$I_{DQ} = 9\left(1 + \frac{V_{GSQ}}{3}\right)^2$ mA, Determine I_{DQ}, V_{GSQ}, V_{DSQ}, V_D

. V_{DD}=20V, R_D=2kΩ, R_S=1.5KΩ, $-V_{SS}$=-10V.

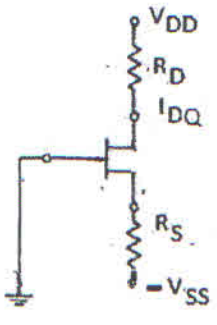

Fig .2

Q2. a Describe the construction and operation of an N-channel MOSFET in enhancement mode. Draw its characteristics and equivalent circuit of the device. 10

b Describe the different MOSFET biasing techniques .Determine the drain current, drain to source voltage, and Power dissipated in the transistor of CS circuit with an N-channel E MOSFET shown in figure 3. $R_1 = 30k\Omega$, $R_2 = 20k\Omega$, $R_D = 20k\Omega$, $R_S = 0.5k\Omega$, $V_{DD} = 5V, V_{TN} = 1V, k_N = 0.1mA/V2$ 10

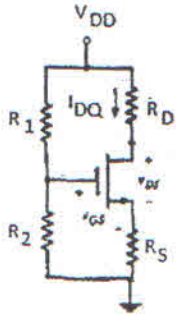

Fig.3

Q3. a Draw input and output characteristics of CE amplifier. Explain graphical analysis to determine parameters.(Zi, Zo, AV, and Ai) 10

b In the Common Emitter configuration with voltage divider bias $I_E = 1mA$ $V_{CE} = 2V$, $R_E = 1k\Omega$ and $\beta = 49$. Determine the values of R_C , R_1 and R_2 such that the stability factor does not exceed 5. Assume $V_{CC} = 5V$ and $V_{BE} = 0.3V$. 10

Q4. a For the amplifier shown in figure.4 analyze and determine 10

i) Small-signal hybrid pi parameters of BJT
ii) Small-signal voltage gain
iii) Input and output impedance.

The circuit parameters are: $R_1 = 56k\Omega$, $R_2 = 12.2k\Omega$, $R_E = 0.4k\Omega$, $R_C = 2k\Omega, R_L = 10k\Omega$, $V_{CC} = 10V$ and BJT parameters are $\beta = 100, V_{BE} = 0.7V$

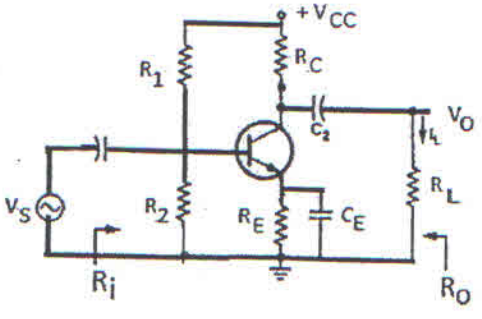

Fig.4

b Draw JFET CS amplifier with voltage divider bias and derive the expressions for the voltage gain, input impedance and output impedance. 10

Q5 a For the amplifier shown in figure.5 derive the expression for voltage gain, input and output impedance. The parameters of the MOSFET in the circuit shown in fig .5 are ; $R_G = 1M\Omega$, $V_{DD} = 5V, -V_{SS} = -5V, V_{TN} = 0.8\,V, k_N = 0.85\ \ mA/V^2$ 10

(i) Determine the values of R_S and R_D such that I_{DQ}=0.1mA and maximum symmetrical 1V peak sinusoidal signal occurs at output.(ii) Find the small signal transistor parameters. (iv) Determine the small-signal voltage gain A_v

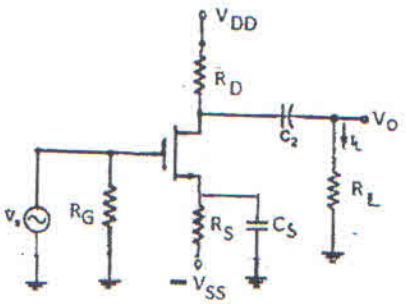

Fig.5

b Draw the circuit diagram of Wein Bridge Oscillator and derive the expression for the frequency of oscillation and minimum gain required for sustained oscillation 10

Q6 Write a short note on following 20

a Twin-T Oscillator.

b Varactor Diode (Construction and operation)

c D C load line concept in BJT. Why Q point should be at the middle of DC load line and fixed?

d MOS capacitor

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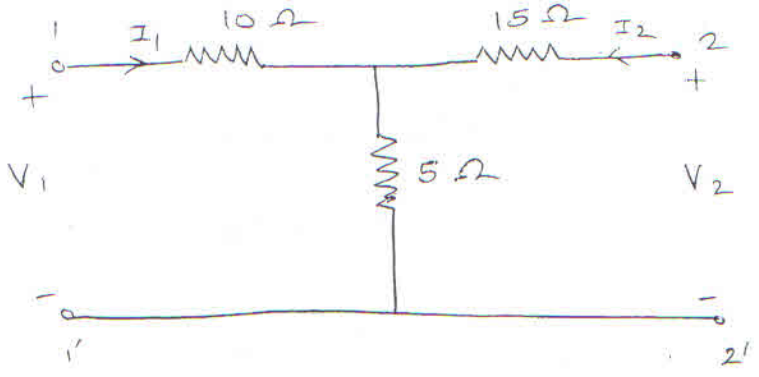
QP Code : 545601

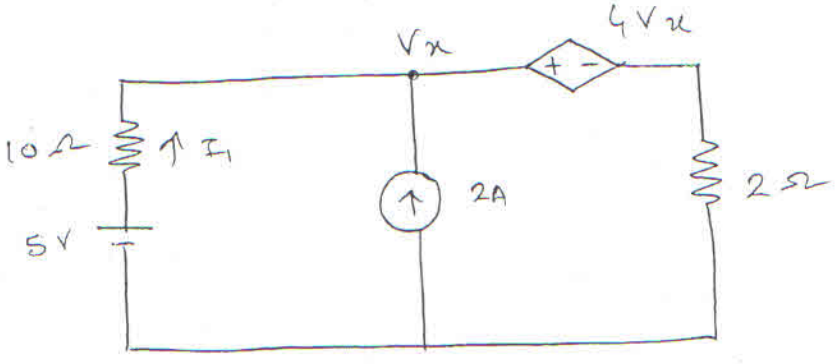
(3 Hours) **[Total Marks : 80**

N. B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **three** questions from the remaining **five**.
(3) Assume suitable data with justification if missing.

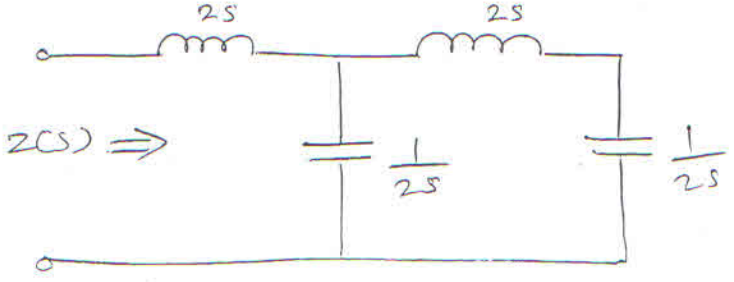
1. (a) Determne the z-parameters for the network shown in the following figure 5



(b) Find current I_1 in the network shown in fig. 5



(c) Determine the driving point impedance function of the one-port network shown 5



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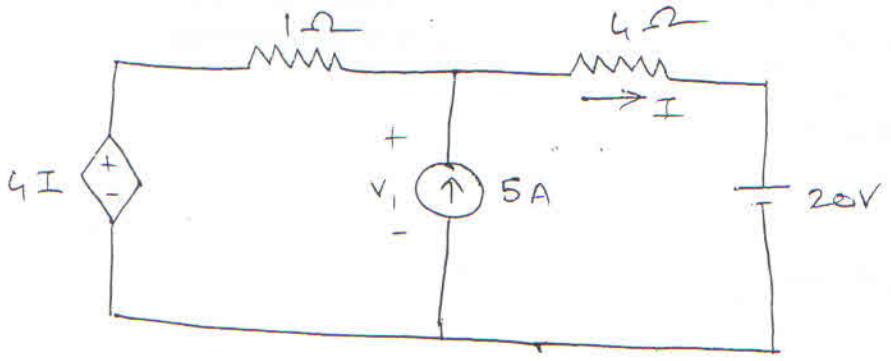
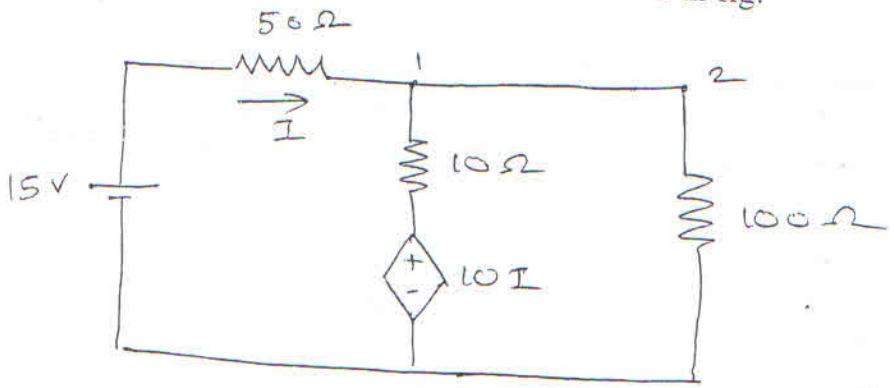
(d) Test whether $(P(s) = s^5 + 12s^4 + 45s^3 + 60s^2 + 44s + 48$ is Hurwitz. 5

2. (a) Find V_1 in the network shown in fig. using superposition theorem. 10



(b) Find the voltage at node 2 in the network shown in fig. 5



(c) State and prove initial value theorem. 5

3. (a) Synthesize the following function in cauer I and cauer II form. 10

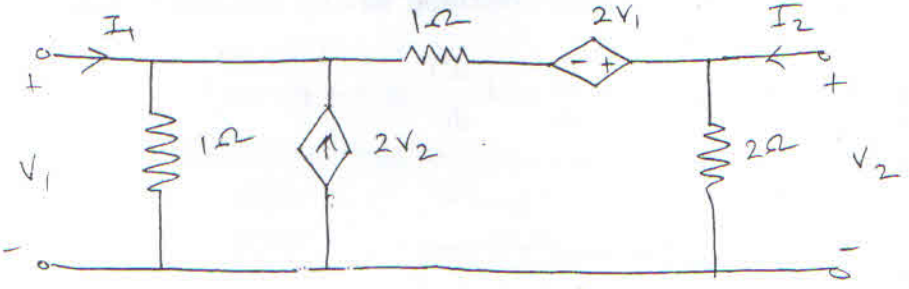
$$Z(s) = \frac{(s+1)(s+4)}{s(s+2)}$$

(b) Check if the following function is a positive real function. 5

$$F(s) = \frac{2s^3 + 2s^2 + 3s + 2}{s^2 + 1}$$

(c) The parameters of a transmission line are R = 6Ω/km, L = 2.2 mH/km, G = 0.25×10^{-6} Ω/km, C = 0.005×10^{-6} F/km. Determine the characteristic impedance and propagation contant at a frequency of 1 GHz. 5

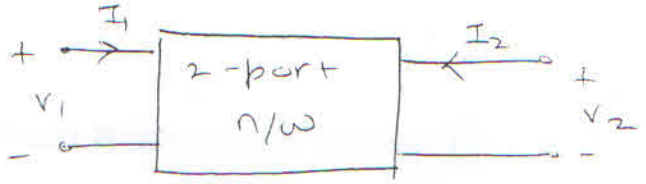
4. (a) Find the Y and Z parameters of the network shown in fig. **10**



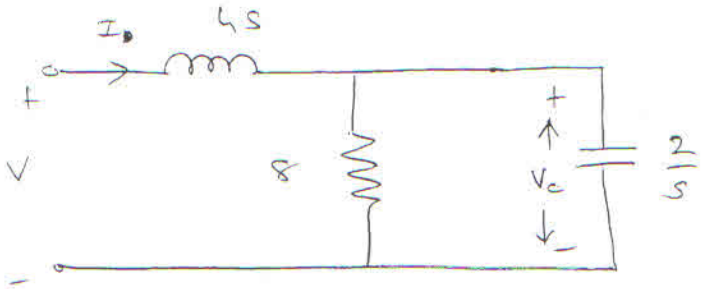
(b) In the two port n/w shown in fig. compute h-perameters from the following data **5**

(i) with the o/p port short circuited,
$V_1 = 25V, I_1 = 1A, I_2 = 2A$

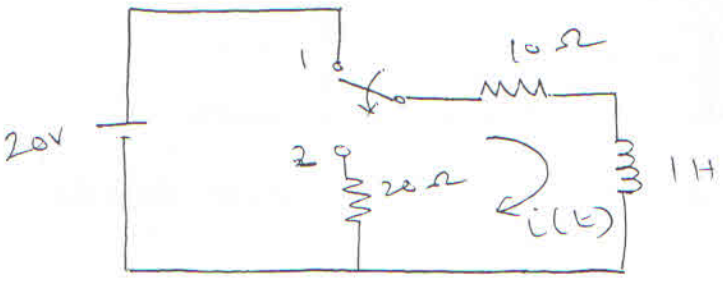
(ii) with the i/p port open circuited,
$V_1 = 10V, V_2 = 50V, I_2 = 2A$



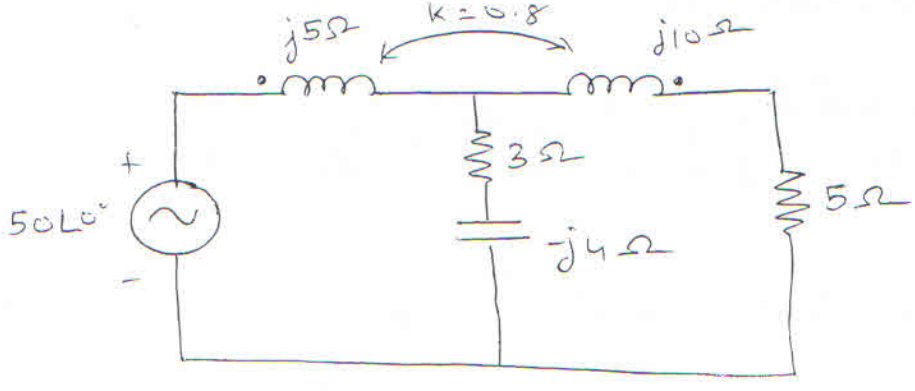
(c) For the circuit given below, determine $\frac{V_c}{V}$ and draw the pole-zero plot. **5**



5. (a) In the network shown in fig. switch is changed from position 1 to position 2 at t = 0, steady state condition having reached before switching. Find the values of i, $\frac{di}{dt}$ and $\frac{d^2i}{dt^2}$ at $t = 0^+$. **10**

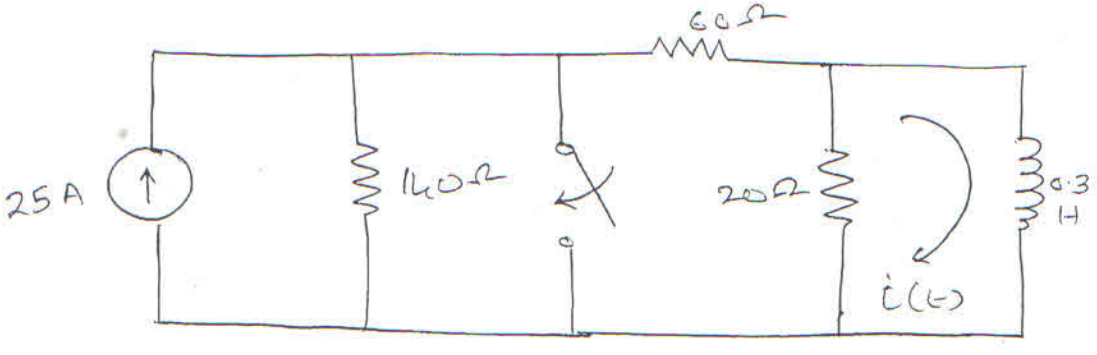


(b) Find the voltage across the 5Ω resistor in the network shown in figure. **5**



(c) Explain the RF bahaviour of transmission line for various conditions. **5**

6. (a) Find the current i(t) for t > 0 **10**



(b) Synthesize the following using the Foster I realization. 5

$$F(s) = \frac{(s+1)(s+5)(s+3)}{s(s+2)(s+6)(s+4)}$$

(c) Draw the following normalized quantities on a Smith Chart. 5

(i) $(3 + j3)\Omega$

(ii) $(1 - j2)\Omega$

(iii) $(2)\Omega$

(iv) $(j1)\Omega$