CBCS SCHEME

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15MAT31

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Engineering Mathematics - III

Time: 3 hrs. Max. Marks: 80

Note: ***Answer FIVE full questions, choosing one full question from each module.***

Module-1

1 a. An alternating current after passing through a rectifier has the form,

$$I = \begin{cases} I_0 \sin x & \text{for } 0 < x < \pi \\ 0 & \text{for } \pi < x < 2\pi \end{cases}$$

where I_0 is the maximum current and the period is 2π. Express I as a Fourier series. **(08 Marks)**

b. Determine the constant term and the first cosine and sine terms of the Fourier series expansion of y from the following data: **(08 Marks)**

x^0	0	45	90	135	180	225	270	315
y	2	1.5	1	0.5	0	0.5	1	1.5

OR

2 a. Obtain the Fourier series expansion of the function, $f(x) = |x|$ in $(-\pi, \pi)$ and hence deduce that,

$$\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots\ldots = \frac{\pi^2}{8}$$ **(06 Marks)**

b. Find the Fourier series expansion of the function,

$$f(x) = \begin{cases} \pi x & \text{in } 0 \le x \le 1 \\ \pi(2-x) & \text{in } 1 \le x \le 2 \end{cases}$$ **(05 Marks)**

c. The following table gives the variations of periodic current over a period.

t(sec)	0	$\frac{T}{6}$	$\frac{T}{3}$	$\frac{T}{2}$	$\frac{2T}{3}$	$\frac{5T}{6}$	T
A(amplitude)	1.98	1.30	1.05	1.3	-0.88	-0.25	1.98

Show by harmonic analysis that there is a direct current part of 0.75 amp in the variable current and obtain the amplitude of first harmonic. **(05 Marks)**

Module-2

3 a. Find the complex Fourier transform of the function $f(x) = \begin{cases} 1 & \text{for } |x| \le a \\ 0 & \text{for } |x| > a \end{cases}$. Hence evaluate

$$\int_0^\infty \frac{\sin x}{x} dx.$$ **(06 Marks)**

b. Find the Fourier sine transform of $\frac{e^{-ax}}{x}$. **(05 Marks)**

c. Compute the inverse z-transforms of $\frac{3z^2 + 2z}{(5z-1)(5z+2)}$. **(05 Marks)**

OR

4 a. Find the z-transform of $e^{-an}n + \sin n\frac{\pi}{4}$. **(06 Marks)**

b. Solve $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ with $y_0 = y_1 = 0$ using z-transform. **(05 Marks)**

c. Find the Fourier cosine transform of, $f(x) = \begin{cases} 4x & 0 < x < 1 \\ 4 - x & 1 < x < 4 \\ 0 & x > 4 \end{cases}$. **(05 Marks)**

Module-3

5 a. Find the Correlation coefficient and equations of regression lines for the following data:

x	1	2	3	4	5
y	2	5	3	8	7

(06 Marks)

b. Fit a straight line to the following data:

x	0	1	2	3	4
y	1	1.8	3.3	4.5	6.3

(05 Marks)

c. Find a real root of the equation $xe^x = \cos x$ correct to three decimal places that lies between 0.5 and 0.6 using Regula-falsi method. **(05 Marks)**

OR

6 a. The following regression equations were obtained from a correlation table.

$y = 0.516x + 33.73$

$x = 0.516y + 32.52$

Find the value of (i) Correlation coefficient (ii) Mean of x's (iii) Mean of y's. **(06 Marks)**

b. Fit a second degree parabola to the following data:

x	1.0	1.5	2.0	2.5	3.0	3.5	4.0
y	1.1	1.3	1.6	2.0	2.7	3.4	4.1

(05 Marks)

c. Use Newton-Raphson's method to find a real root of $x\sin x + \cos x = 0$ near $x = \pi$, carry out three iterations. **(05 Marks)**

Module-4

7 a. The following data gives the melting point of an alloy of lead and zinc, where t is the temperature in °C and P is the percentage of lead in the alloy:

P%	60	70	80	90
t	226	250	276	304

Find the melting point of the alloy containing 84% of lead, using Newton's interpolation formula. **(06 Marks)**

b. Apply Lagrange's interpolation formula to find a polynomial which passes through the points (0, −20), (1, −12), (3, −20) and (4, −24) **(05 Marks)**

c. Find the approximate value of $\int_0^{\frac{\pi}{2}} \sqrt{\cos\theta}\, d\theta$ by Simpson's $\frac{3}{8}^{th}$ rule by dividing it into 6 equal parts. **(05 Marks)**

OR

8 a. From the following table :

x°	10	20	30	40	50	60
$\cos x$	0.9848	0.9397	0.8660	0.7660	0.6428	0.5

Calculate $\cos 25^\circ$ using Newton's forward interpolation formula. **(06 Marks)**

b. Use Newton's divided difference formula and find f(6) from the following data:

x :	5	7	11	13	17
f(x) :	150	392	1452	2366	5202

(05 Marks)

c. Evaluate $\int_0^1 \frac{dx}{1+x}$ using Weddle's rule by taking equidistant ordinates. **(05 Marks)**

Module-5

9 a. Find the area between the parabolas $y^2 = 4x$ and $x^2 = 4y$ with the help of Green's theorem in a plane. **(06 Marks)**

b. Solve the variational problem $\delta\int_0^1 (12xy + y'^2)dx = 0$ under the conditions $y(0) = 3$, $y(1) = 6$. **(05 Marks)**

c. Prove that the shortest distance between two points in a plane is along the straight line joining them. **(05 Marks)**

OR

10 a. A cable hangs freely under gravity from the fixed points. Show that the shape of the curve is a catenary. **(06 Marks)**

b. Use Stoke's theorem to evaluate for $\vec{F} = (x^2 + y^2)i - 2xyj$ taken around the rectangle bounded by the lines $x = \pm a$, $y = 0$, $y = b$. **(05 Marks)**

c. Evaluate $\iint_S (yzi + zxj + xyk).\hat{n}ds$ where S is the surface of the sphere $x^2 + y^2 + z^2 = a^2$ in the first octant. **(05 Marks)**

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15MATDIP31

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Additional Mathematics – I

Time: 3 hrs. Max. Marks: 80

Note: ***Answer FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Find the modulus and amplitude of $\frac{(3-\sqrt{2}i)^2}{1+2i}$. **(06 Marks)**

b. Find the cube root of $(1-i)$. **(05 Marks)**

c. Prove that $\left(\frac{1+\sin\theta+i\cos\theta}{1+\sin\theta-i\cos\theta}\right)^n = \cos\left(n\frac{\pi}{2}-n\theta\right)+i\sin\left(n\frac{\pi}{2}-n\theta\right)$. **(05 Marks)**

OR

2 a. For any three vector a, b, c show that
$\left[\vec{a}+\vec{b}, \vec{b}+\vec{c}, \vec{c}+\vec{a}\right] = 2\left[\vec{a}\,\vec{b}\,\vec{c}\right]$ **(06 Marks)**

b. Find the value of λ so that the vectors $\vec{a}=2\hat{i}-3\hat{j}+\hat{k}$, $\vec{b}=\hat{i}+2\hat{j}-3\hat{k}$ and $\vec{c}=\hat{j}+\lambda\hat{k}$ are coplanar. **(05 Marks)**

c. Find the angle between the vectors $\vec{a}=5\hat{i}-\hat{j}+\hat{k}$ and $\vec{b}=2\hat{i}-3\hat{j}+6\hat{k}$ **(05 Marks)**

Module-2

3 a. Find the n^{th} derivative of $\cos x\cos 2x\cos 3x$. **(06 Marks)**

b. If $y=a\cos(\log x)+b\sin(\log x)$, prove that $x^2y_{n+2}+(2n+1)xy_{n+1}+(n^2+1)y_n=0$. **(05 Marks)**

c. Find the angle between the radius vector and tangents for the curve $r^2\cos 2\theta = a^2$ **(05 Marks)**

OR

4 a. If $u=e^{ax+by}+(ax-by)$ prove that $b\frac{\partial u}{\partial x}+a\frac{\partial u}{\partial y}=2abu$. **(06 Marks)**

b. If $u=\sin^{-1}\left(\frac{x^2+y^2}{x-y}\right)$ prove that $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}=\tan u$. **(05 Marks)**

c. If $x=u(1-v)$, $y=uv$. Find $\frac{\partial(x,y)}{\partial(u,v)}$. **(05 Marks)**

Module-3

5 a. Obtain the reduction formula for $\int_0^{\frac{\pi}{2}}\cos^n x\,dx$ (n>0). **(06 Marks)**

b. Evaluate $\int_0^1 x^6\sqrt{1-x^2}\,dx$. **(05 Marks)**

c. Evaluate $\int_0^1\int_0^1\int_0^y xyz\,dx\,dy\,dz$. **(05 Marks)**

OR

6 a. Obtain the reduction formula for $\int_0^{\frac{\pi}{2}} \sin^n x dx$, n > 0. **(06 Marks)**

b. Evaluate $\int_0^a x^2(a^2 - x^2)^{\frac{3}{2}} dx$. **(05 Marks)**

c. Evaluate $\int_0^1 \int_0^{\sqrt{x}} xydydx$. **(05 Marks)**

Module-4

7 a. A particle moves along a curve $x = e^{-t}$, $y = 2\cos 3t$, $z = 2\sin 3t$ where t is the time. Determine the component of velocity and acceleration vector at t = 0 in the direction of $\hat{i} + \hat{j} + \hat{k}$. **(08 Marks)**

b. Find the value of the constant a, b, such that $\vec{F} = (axy + z^3)\,\hat{i} + (3x^2 - z)\hat{j} + (bxz^2 - y)\hat{k}$ is irrotational. **(08 Marks)**

OR

8 a. If $\vec{F} = (x + y + 1)\hat{i} + \hat{j} - (x + y)\hat{k}$ show that $\vec{F} \cdot \text{curl}\, \vec{F} = 0$. **(06 Marks)**

b. If $\phi(x, y, z) = x^3 + y^3 + z^3 - 3xyz$ find $\nabla\phi$ at (1, −1, 2). **(05 Marks)**

c. Find the directional derivative $\phi(x, y, z) = x^2yz + 4xz^2$ at (1,−2,−1) in the direction of $2\hat{i} - \hat{j} - 2\hat{k}$. **(05 Marks)**

Module-5

9 a. Solve $\frac{dy}{dx} = \frac{y}{x - \sqrt{xy}}$. **(06 Marks)**

b. Solve $ye^{xy}dx + (xe^{xy} + 2y)dy = 0$ **(05 Marks)**

c. $\frac{dy}{dx} - \frac{2y}{x} = x + x^2$. **(05 Marks)**

OR

10 a. Solve $\frac{dy}{dx} = \frac{y}{x} + \sin\left(\frac{y}{x}\right)$. **(06 Marks)**

b. Solve $(y^3 - 3x^2y)dx - (x^3 - 3xyz)dy = 0$ **(05 Marks)**

c. Solve $(1 + y^2)dx + (x - \tan^{-1} y)dy = 0$ **(05 Marks)**

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CBCS SCHEME

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Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Analog Electronics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Define h parameters using two port systems. **(05 Marks)**

b. Derive expressions for input impedance, output impedance and voltage gain for common emitter fixed bias configuration using re model. **(07 Marks)**

c. Find Z_i, Z_o, A_v and A_i for the network shown in Fig.Q.1(c). Given data $h_{fb} = -0.99$, $h_{ib} = 14.3\Omega$, $h_{ob} = 0.5\ \mu A/v$. **(04 Marks)**

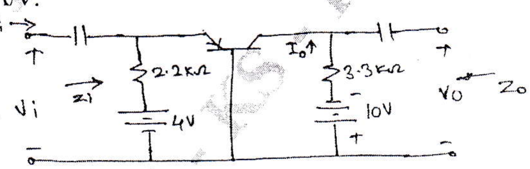

Fig.Q.1(c)

OR

2 a. Explain hybrid π model. **(04 Marks)**

b. Find r_e, Z_i, Z_o and A_v for the circuit shown in Fig.Q.2(b). Given data B = 90, $r_o = 50k\Omega$. **(05 Marks)**

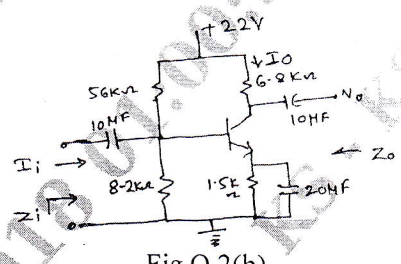

Fig.Q.2(b)

c. Derive the expressions for Z_i, Z_o, A_v and A_i for fixed bias configuration using approximate Cε hybrid equivalent model. **(07 Marks)**

Module-2

3 a. List the differences between JFET and MOSFET. **(04 Marks)**

b. Explain with neat sketches, operation and characteristics of n-channel E-MOSFET. **(08 Marks)**

c. Find: i) input impedance ii) output impedance iii) voltage gain for the circuit shown in Fig.Q.3(c). Given data $g_m = 2ms$, $r_d = 50K\Omega$. **(04 Marks)**

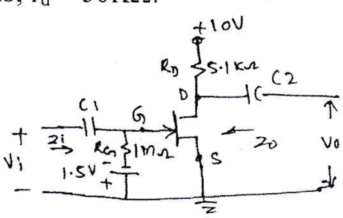

Fig.Q.3(c)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

4 a. Find transconductance and drain current for the JFET if I_{DSS} = 20mA, V_P = -5V, V_{GS} = -4V and gmo = 4ms. **(04 Marks)**

b. Derive an expressions for Z_i, Z_o and A_v using small signal JFET amplifier under fixed bias configuration. **(07 Marks)**

c. Sketch the following circuit diagrams:
   i) JFET ac equivalent model of source follower
   ii) Cascaded FET amplifier. **(05 Marks)**

Module-3

5 a. An amplifier rated at a 40W output is connected to a 10Ω speaker, Find:
   i) Input power required for full output if power gain is 25dB
   ii) Input voltage for rated output if the amplifier voltage gain is 40dB. **(04 Marks)**

b. Explain high frequency response of FET amplifier. **(07 Marks)**

c. Explain multistage frequency effects. **(05 Marks)**

OR

6 a. Derive an expressions for Miller input and output capacitor. **(06 Marks)**

b. Determine A_V, Z_i and A_{vs} for the law frequency response of the BJT amplier circuit shown in Fig.Q.6(b). Assume $r_0 = \infty$. **(06 Marks)**

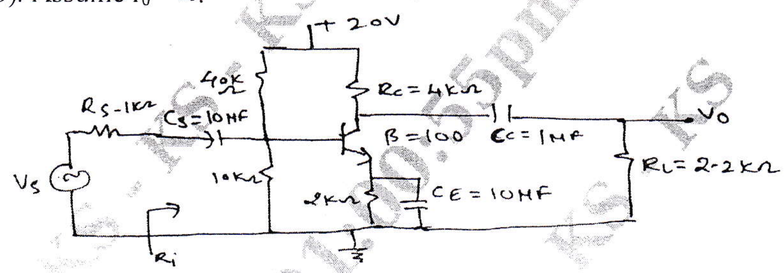

Fig.Q.6(b)

c. Draw the circuit diagram of high frequency response of BJT amplifier under CE mode with capacitances. **(04 Marks)**

Module-4

7 a. List the conditions for sustained oscillations. **(04 Marks)**

b. Determine the voltage gain, input impedance and output impedance with feedback for series voltage feedback having A = -100, R_i = 10KΩ and R_o = 20KΩ for feedback factor β = -0.1. **(05 Marks)**

c. Explain with neat circuit diagram the operation of colpit oscillator. **(07 Marks)**

OR

8 a. Show that gain with feedback in voltage series feedback system reduced by a factor (1 + AB). **(05 Marks)**

b. Explain the operation of FET RC phase oscillator with neat circuit diagram. **(06 Marks)**

c. Design the RC elements of a Wein bridge oscillator for the operation at f = 10kHz and draw the oscillator circuit diagram. **(05 Marks)**

Module-5

9 a. Define class A, class B, class C and class D power amplifiers. **(04 Marks)**

b. Calculate the output voltage and the zener current for the regulator shown in Fig.Q9(b) for R_L = 1KΩ. **(04 Marks)**

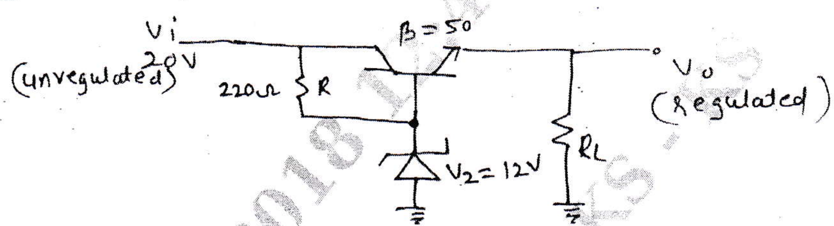

Fig.Q.9(b)

c. Explain with neat diagram and waveforms class B push pull power amplifier. **(08 Marks)**

OR

10 a. Compare the series and shunt voltage regulators. **(04 Marks)**

b. Define the following:

i) Cross over distortion
ii) Harmonic distortion
iii) Percentage load regulation
iv) Amplifiers efficiency **(04 Marks)**

c. Calculate input power, output power and efficiency of the series fed class A power amplifier circuit shown in Fig.Q10(c). **(08 Marks)**

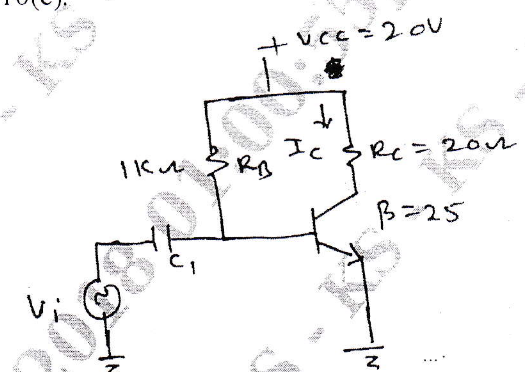

Fig.Q.10(c)

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CBCS SCHEME

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15EC33

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Digital Electronics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Define combinational logic. Design a combinational circuit which takes two, 2 bit binary numbers as its input and generates an output equal to 1, when the sum of the two numbers is even. **(10 Marks)**

b. Simplify using Karnaugh map. Write the Boolean equation and realize using NAND gates.
$D = f(w, x, y, z) = \Sigma m(0, 2, 4, 6, 8) + \Sigma d(10, 11, 12, 13, 14, 15)$. **(06 Marks)**

OR

2 a. Define canonical SOP and canonical POS. Expand $f = (\bar{a} + b + c)(a + c + \bar{d})$ into canonical POS. **(04 Marks)**

b. Solve using Quine-McCluskey tabulation method,
$f(a, b, c, d) = \Sigma m(0, 1, 4, 5, 9, 10, 12, 14, 15) + \Sigma\phi(2, 8, 13)$
Obtain the minimal form of the given function. Verify the result using k–map. **(12 Marks)**

Module-2

3 a. Define decoder. Implement full subtractor using a decodes. Write the truth table. **(08 Marks)**

b. Compare ripple carry adder and look ahead carry adder. Explain the circuit and operation of a 4 bit binary adder with look ahead carry. **(08 Marks)**

OR

4 a. Design and implement one bit comparator. **(04 Marks)**

b. Implement the multiple functions :
$f_1(a, b, c, d) = \Sigma(0, 4, 8, 10, 14, 15)$ and
$f_2(a, b, c, d) = \Sigma(3, 7, 9, 13)$
using two 3 to 8 decoders, i.e. 74138 ICs. **(06 Marks)**

c. Implement full adder circuit using 8 : 1 multiplexer. **(06 Marks)**

Module-3

5 a. What is gated SR Latch? Explain the operation of gated SR Latch, with a logic diagram, truth table and logic symbol. **(08 Marks)**

b. Derive the characteristic equation of SR, JK, D and T flip-flops with the help of function tables. **(08 Marks)**

OR

6 a. Explain the operation of a switch debouncer built using SR Latch. Draw the supporting waveforms. **(04 Marks)**

b. Explain 0s and 1s catching problem of Master Slave JK flip flop with waveform. Suggest the solution for this problem. **(04 Marks)**

c. What is edge triggered flip flop? With a neat circuit diagram, explain the operation of positive edge triggered D flip flop, using NAND gates. **(08 Marks)**

Module-4

7 a. With the help of neat diagram, explain PISO and PIPO operation of unidirectional shift registers. **(08 Marks)**

b. Design a 4 bit binary ripple 'UP' counter using negative edge triggered JK flip flop. Show the up counter execution with the help of timing diagram. **(08 Marks)**

OR

8 a. Implement a Mod 8 twisted ring counter using D flip flops. Give the counting sequence and decoding gate inputs. **(06 Marks)**

b. Design a synchronous MOD-6 counter using JK flip flop for the following count sequence 0, 2, 3, 6, 5, 1 and repeat. Write the transition table, logic equations and the counter implementation diagram. **(10 Marks)**

Module-5

9 a. Compare Mealy and Moore sequential circuit models with suitable example. **(04 Marks)**

b. For the logic diagram shown in Fig.Q9(b), write the state and output equations. Give the transition table and the state diagram. **(12 Marks)**

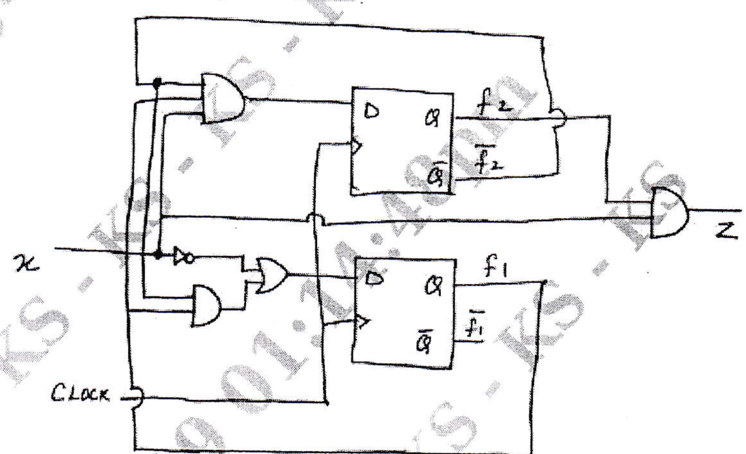

Fig.Q9(b)

OR

10 a. Write the basic recommended steps for the design of a clocked synchronous sequential circuit. **(06 Marks)**

b. How to convert a Mealy machine to a Moore machine? **(02 Marks)**

c. A sequential circuit has one input and one output. The state diagram is shown in Fig.Q10(c). Design a sequential circuit using D flip flop. **(08 Marks)**

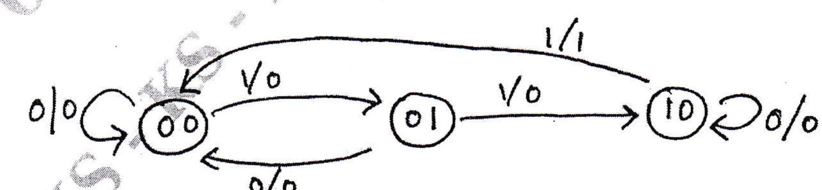

Fig.Q10(c)

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CBCS SCHEME

USN | | | | | | | | | | | **15EC34**

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Network Analysis

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Reduce the network shown in Fig.Q1(a) to a single voltage source in series with a resistance using source shift and source transformations. **(08 Marks)**

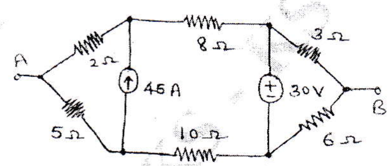

Fig.Q1(a)

b. Using star/delta transformation, determine the resistance between M and N for the network shown in Fig.Q1(b). **(08 Marks)**

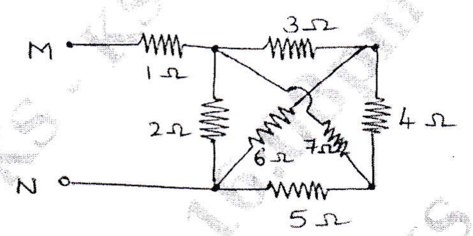

Fig.Q1(b)

OR

2 a. Find the power delivered by the dependent voltage source in the circuit shown in Fig.Q2(a) by Mesh current method. **(06 Marks)**

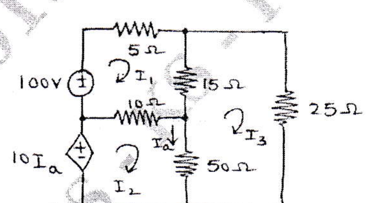

Fig.Q2(a)

b. Define super Mesh and super node. **(02 Marks)**

c. Use the node-voltage method to find the power developed by the 20V source in the circuit shown in Fig.Q2(c). **(08 Marks)**

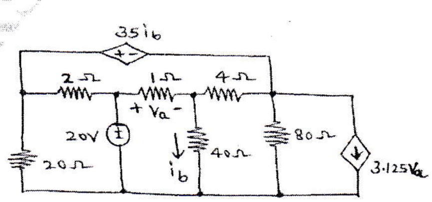

Fig.Q2(c)

Module-2

3 a. Use superposition theorem to find v_x in the circuit shown in Fig.Q3(a). **(08 Marks)**

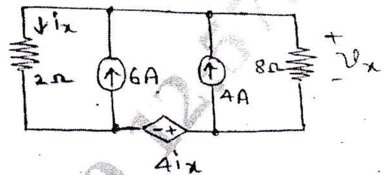

Fig.Q3(a)

b. State and prove reciprocity theorem. **(08 Marks)**

OR

4 a. State and prove Thevenin's theorem. **(06 Marks)**

b. Find the Norton's equivalent circuit across AB terminals for the network shown in Fig.Q4(b) and hence determine current through 5Ω resistor. **(06 Marks)**

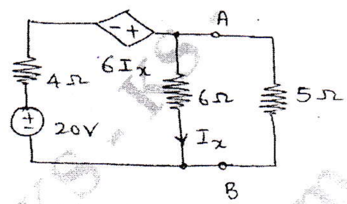

Fig.Q4(b)

c. Find the value of Z_L for which Maximum Power transfer occurs in the circuit shown in Fig.Q4(c). **(04 Marks)**

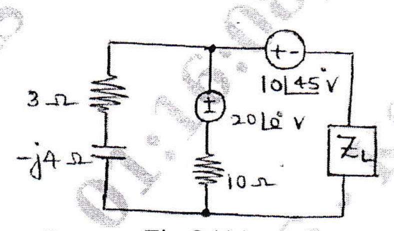

Fig.Q4(c)

Module-3

5 a. In the network shown in Fig.Q5(a), the switch k is closed at t = 0. Find the values of i_1, i_2 $\frac{di}{dt}$ and $\frac{d^2i_2}{dt^2}$ at t = 0. **(08 Marks)**

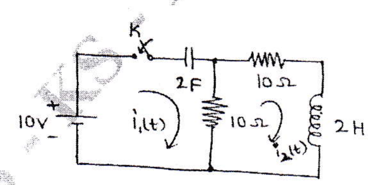

Fig.Q5(a)

b. In the circuit shown n Fig.Q5(b), the capacitor C_1 is charged to a voltage V_0 at t = 0, the switch is closed. Solve for the charge as a function of time. **(08 Marks)**

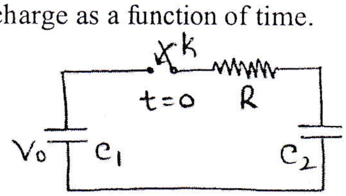

Fig.Q5(b)

OR

6 a. State and prove the following : i) Initial value theorem ii) Final value theorem. **(08 Marks)**

b. For the waveform shown in Fig.Q6(b), the equation of the waveforms is Sin(t) from 0 to π, and $-\sin(t)$ from π to 2π, show that the Laplace transform of this waveform is :

$$F(s) = \frac{1}{s^2+1} \cot h\left(\frac{\pi S}{2}\right).$$ **(08 Marks)**

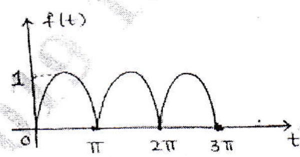

Fig.Q6(b)

Module-4

7 a. Define the following terms :
i) Resonance ii) Bandwidth. **(02 Marks)**

b. Prove that $f_0 = \sqrt{f_1 f_2}$ where f_1 and f_2 are the two half power frequencies of a resonant circuits. **(06 Marks)**

c. A series RLC circuit has R = 2Ω, L = 2 mH and C = 10μf calculate Q–factor, bandwidth, Resonant frequency and half power frequencies f_1 and f_2. **(08 Marks**

OR

8 a. Show that a two-branch parallel circuit is resonant at all frequencies if $R_L = R_C = \sqrt{\frac{L}{C}}$. **(08 Marks)**

b. Find the values of L for which the circuit given in Fig.Q8(b) resonates at w = 5000 r/sec. **(08 Marks)**

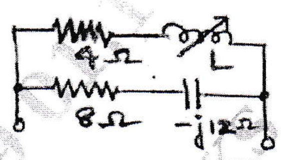

Fig.Q8(b)

Module-5

9 a. Express Z – parameters interms of Y-parameters. **(08 Marks)**

b. Obtain ABCD parameters interms of impedance parameters (Z) and hence show that AD–BC = 1. **(08 Marks)**

OR

10 a. For the network shown in Fig.Q10(a), contains an voltage controlled source and current controlled source, for the elemental values specified, determine Z and Y parameters. **(08 Marks)**

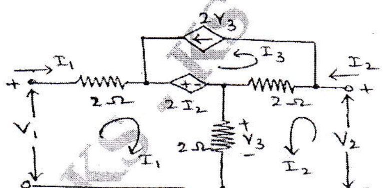

Fig.Q10(a)

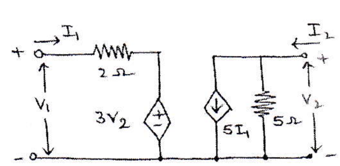

Fig.Q10(b)

b. Determine transmission parameters for the network shown in Fig.Q10(b). **(08 Marks)**

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CBCS Scheme

USN | | | | | | | | | | 15EC36

Third Semester B.E. Degree Examination, Dec.2017/Jan.2018

Engineering Electromagnetics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. State and explain Coulomb's law in vector form. **(05 Marks)**

b. Find the electric field $\overline{E}$ at origin, if the following charge distributions are present in free space:

i) Point charge 12 nc at P(2, 0, 6).

ii) Uniform line charge of linear charge density 3 nc/m at x = 2, y = 3.

iii) Uniform surface charge of density $P_s = 0.2$ nc/m^2 at x = 2. **(06 Marks)**

c. Define volume charge density. Also find the total charge within each of the indicated volumes.

i) $0 \le \rho \le 0.1,\ \ 0 \le \phi \le \pi,\ \ 2 \le z \le 4;\ \ \rho_v = \rho^2 z^2 \sin(0.6\phi)$

ii) Universe : $\rho_v = \dfrac{e^{-2r}}{r^2}$ **(05 Marks)**

OR

2 a. Define Electric flux and flux density. **(04 Marks)**

b. Given a 60 μC point charge located at the origin, find the total electric flux passing through:

i) That portion of the sphere $\gamma = 26$ cm bounded by $0 < \theta < \dfrac{\pi}{2}$ and $0 < \phi < \dfrac{\pi}{2}$.

ii) The closed surface defined by $\rho = 26$ cm and $z = \pm 26$ cm.

iii) The plane z = 26 cm. **(07 Marks)**

c. Derive the expression for $\overline{E}$ due to infinite line charge of charge density ρ_L (c/m). **(05 Marks)**

Module-2

3 a. State and prove Gauss law for point charge. **(05 Marks)**

b. State and prove divergence theorem. **(05 Marks)**

c. In each of the following parts, find value for div $\overline{D}$ at the point specified:

i) $\overline{D} = (2xyz - y^2)\bar{a}_x + (x^2 z - 2xy)\bar{a}y + x^2 y \bar{a}_z$ c/m^2 at $P_A(2, 3, -1)$.

ii) $\overline{D} = 2\rho z^2 \sin^2\phi \bar{a}_\rho + \rho z^2 \sin 2\phi \bar{a}_\phi + 2\rho^2 z \sin^2\phi \bar{a}_z$ c/m^2 at $P_B(\rho = 2, \phi = 110^\circ, z = -1)$. **(06 Marks)**

OR

4 a. Define potential difference and absolute potential. **(04 Marks)**

b. A point charge of 6 nc is located at origin in free space, find potential of point p, if p is located at (0.2, -0.4, 0.4) and

i) V = 0 at infinity

ii) V = 0 at (1, 0, 0)

iii) V = 20 V at (-0.5, 1, -1) **(06 Marks)**

c. Derive point form of continuity equation for current. **(06 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-3

5 a. Derive the expression for Poisson's and Laplace's equation. **(05 Marks)**

b. Two plates of parallel plate capacitors are separated by distance 'd' and maintained at potential zero and V_0 respectively. Assuming negligible fringing effect, determine potential at any point between the plates. **(06 Marks)**

c. State and prove uniqueness theorem. **(05 Marks)**

OR

6 a. State and explain Biot-Savart law. **(06 Marks)**

b. Find the magnetic flux density at the centre '0' of a square of sides equal to 5m and carrying 10 amperes of current. **(06 Marks)**

c. At a point p(x, y, z), the components of vector magnetic potential $\overline{A}$ are given as $A_x = 4x + 3y + 2z$, $A_y = 5x + 6y + 3z$ and $A_z = 2x + 3y + 5z$. Determine $\overline{B}$ at point P. **(04 Marks)**

Module-4

7 a. Derive Lorentz force equation. **(05 Marks)**

b. Derive an expression for the force on a differential current element placed in a magnetic field. **(06 Marks)**

c. A conductor 4m long lies along the y-axis with a current of 10 amps in the $\overline{a}_y$ direction. Find the force on the conductor if the field is $\overline{B} = 0.005\,\overline{a}_x$ Telsa. **(05 Marks)**

OR

8 a. Define: i) Magnetization, ii) Permeability. **(04 Marks)**

b. Find the magnetization in a magnetic material where

i) $\mu = 1.8 \times 10^5$ (H/m) and 120 (A/m)

ii) $\mu_r = 22$, there are 8.3×10^{28} atoms/m^3 and each atom has a dipole moment of 4.5×10^{-27} (A/m^2) and

iii) $B = 300\ \mu T$ and $\chi_m = 15$. **(06 Marks)**

c. Discuss the boundary conditions at the interface between two media of different permeabilities. **(06 Marks)**

Module-5

9 a. State and explain Faraday's law of electromagnetic induction. **(04 Marks)**

b. Find the frequency at which conduction current density and displacement current are equal in a medium with $\sigma = 2 \times 10^{-4}$ ℧/m and $\varepsilon_r = 81$. **(06 Marks)**

c. List Maxwell's equations in point form and integral form. **(06 Marks)**

OR

10 a. Obtain solution of the wave equation for a uniform plane wave in free space. **(06 Marks)**

b. State and prove Poynting theorem. **(06 Marks)**

c. The depth of penetration in a certain conducting medium is 0.1 m and the frequency of the electromagnetic wave is 1.0 MHz. Find the conductivity of the conducting medium. **(04 Marks)**

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