CBCS SCHEME

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17MAT31

Third Semester B.E. Degree Examination, July/August 2022
Engineering Mathematics - III

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Find the Fourier Series of $f(x) = \begin{cases} -\pi, & -\pi < x < 0 \\ x, & 0 < x < \pi \end{cases}$.

Hence deduce that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots\ldots = \frac{\pi^2}{8}$. **(08 Marks)**

b. Find the Fourier Half – range sine series of $f(x) = \begin{cases} x, & 0 < x < 1 \\ 2 - x, & 1 < x < 2 \end{cases}$. **(06 Marks)**

c. Express y as a Fourier Series upto first harmonics for the following table : **(06 Marks)**

X	0	1	2	3	4	5
Y	4	8	15	7	6	2

OR

2 a. Compute the first two harmonics of the Fourier Series of f(x) given the following table :

x :	0	$\pi/3$	$2\pi/3$	π	$4\pi/3$	$5\pi/3$	2π
f(x) :	1.0	1.4	1.9	1.7	1.5	1.2	1.0

(08 Marks)

b. Find the Fourier series of $f(x) = x^2 - 2$ when $-2 < x < 2$. **(06 Marks)**

c. Obtain the Fourier Cosine series for $f(x) = \begin{cases} \cos x, & 0 < x < \frac{\pi}{2} \\ 0, & \frac{\pi}{2} < x < \pi \end{cases}$. **(06 Marks)**

Module-2

3 a. Find the Infinite Fourier transform of

$f(x) = \begin{cases} 1, & |x| \le a \\ 0, & |x| > a \end{cases}$ and hence evaluate $\int_0^\infty \frac{\sin ax}{x} dx$. **(08 Marks)**

b. If the Fourier sine transform of f(x) is given by $F_s(\alpha) = \frac{\pi}{2} e^{-2\alpha}$, find the function f(x). **(06 Marks)**

c. Find the Z – transform of $3n - 4\sin\frac{n\pi}{4} + 5a$. **(06 Marks)**

OR

4 a. Find the Fourier Cosine transform of e^{-ax}, hence evaluate $\int_0^\infty \frac{\cos\lambda x}{x^2 + a^2} dx$. **(08 Marks)**

b. Find the inverse Z – transform of $\frac{5Z}{(2-z)(3z-1)}$. **(06 Marks)**

c. Solve $u_{n+2} - 5u_{n+1} + 6u_n = 1$, with $u_0 = 0$, $u_1 = 1$, by using Z – transform method. **(06 Marks)**

Module-3

5 a. Calculate the coefficient of correlation and obtain the lines of regression for the following data :

x :	1	2	3	4	5	6	7	8	9
y :	9	8	10	12	11	13	14	16	15

(08 Marks)

b. Fit a Parabola to the following data :

x :	1	2	3	4	5
y :	2	6	7	8	10

(06 Marks)

c. Use Newton – Raphson method to find a real root of equation $x \sin x + \cos x = 0$ near $x = \pi$, correct to four decimal places. **(06 Marks)**

OR

6 a. In a partially destroyed laboratory record of correlation data, the following results only are available : Variance of x is 9. Regression equations are $8x - 10y + 66 = 0$, $40x - 18y = 214$. Find i) the mean values of x and y ii) standard deviation of y iii) the coefficient of correlation between x and y. **(08 Marks)**

b. By the method of least squares, fit a straight line to the following data : as $y = ax + b$.

x :	1	2	3	4	5
y :	14	13	9	5	2

(06 Marks)

c. Compute the real root of the equation $x \log_{10} x - 1.2 = 0$, lying between 2.7 and 2.8 correct to four decimal places, using the method of false position. **(06 Marks)**

Module-4

7 a. Given $\sin 45^0 = 0.7071$, $\sin 50^0 = 0.7660$, $\sin 55^0 = 0.8192$, $\sin 60^0 = 0.8660$, find $\sin 57^0$ using an appropriate Interpolation formula.. **(08 Marks)**

b. A curve passes through the points (0, 18), (1, 10), (3, -18) and (6, 90). Find the polynomial f(x) using Lagrange's formula. **(06 Marks)**

c. Use Simpson's $\left(\frac{1}{3}\right)^{rd}$ rule to find $\int_0^{0.6} e^{-x^2}\,dx$ by taking seven ordinates. **(06 Marks)**

OR

8 a. Given f(40) = 184, f(50) = 204, f(60) = 226, f(70) = 250, f(80) = 276, f(90) = 304, find f(38) and f(85) using suitable Interpolation formulae. **(08 Marks)**

b. Use Newton's divided difference formula to find f(40), given the data :

x	0	2	3	6
f(x)	-4	2	14	158

(06 Marks)

c. Use Weddle's rule to compute the area bounded by the curve $y = f(x)$, x - axis and the extreme ordinates from the following table : **(06 Marks)**

x :	0	1	2	3	4	5	6
y :	0	2	2.5	2.3	2	1.7	1.5

Module-5

9 a. Using Gauss – divergence theorem, evaluate $\int_S \vec{F}.\vec{ds}$, where $\vec{F} = 4x\hat{i} - 2y^2\hat{j} + z^2\hat{k}$ and s is the surface bounding the region $x^2 + y^2 = 4$, $z = 0$ and $z = 3$. **(08 Marks)**

b. Find the work done in moving a particle in the force field $\vec{F} = 3x^2\hat{i} + (2xz - y)\hat{j} + z\hat{k}$, along the Straight from (0, 0, 0) to (2, 1, 3). **(06 Marks)**

c. Find the extremal of the functional $I = \int_0^{\pi/2} (y^2 - y'^2 - 2\, y \sin x)\, dx$ under the end conditions $y = 0 = y(\pi/2) = 0$. **(06 Marks)**

OR

10 a. Verify Stoke's theorem for the vector field $\vec{F} = (2x - y)\hat{i} - yz^2\hat{j} - y^2z\hat{k}$ over the upper half surface $x^2 + y^2 + z^2 = 1$, bounded by its projection on the xy – plane. **(08 Marks)**

b. Find the Geodesics on a plane. **(06 Marks)**

c. A heavy cable hangs freely under gravity between two fixed points. Show that the shape of the cable is a catenary. **(06 Marks)**

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17MATDIP31

Third Semester B.E. Degree Examination, July/August 2022
Additional Mathematics – I

Time: 3 hrs. Max. Marks: 100

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. Find the modulus and amplitude of $1-i\sqrt{3}$ and hence express it in polar form. **(07 Marks)**

b. Express the following in the form $a+ib$ and also find the conjugate $\dfrac{1}{1-\cos\theta+i\sin\theta}$. **(07 Marks)**

c. Find the sine of the angle between $\vec{a}=2\hat{i}-2\hat{j}+\hat{k}$ and $\vec{b}=\hat{i}-2\hat{j}+2\hat{k}$. **(06 Marks)**

OR

2 a. Prove that $(1+\cos\theta+i\sin\theta)^n+(1+\cos\theta-i\sin\theta)^n=2^{n+1}\cos\dfrac{n\theta}{2}\cos\dfrac{n\theta}{2}$. **(06 Marks)**

b. Find $\vec{a}\cdot\left(\vec{b}\times\vec{c}\right)$, $\vec{b}\times\left(\vec{a}\times\vec{c}\right)$ and $\vec{c}\cdot\left(\vec{a}\times\vec{b}\right)$ where $\vec{a}=\hat{i}+\hat{j}-\hat{k}$, $\vec{b}=2\hat{i}-\hat{j}+2\hat{k}$, $\vec{c}=3\hat{i}-\hat{j}-\hat{k}$. **(06 Marks)**

c. Find the value of λ so that the points $A(-1,4,-3)$, $B(3,2,-5)$, $C(-3,8,-5)$ and $D(-3,\lambda,1)$ may lie on one plane. **(08 Marks)**

Module-2

3 a. If $y=a\cos(\log x)+b\sin(\log x)$ prove that $x^2y_{n+2}+(2n+1)xy_{n+1}+(n^2+1)y_n=0$. **(08 Marks)**

b. Find the angle between the curves $r=a\cos\theta$, $2r=a$. **(06 Marks)**

c. Using Euler's theorem, prove that $xu_x+yu_y=2\tan u$, where $u=\sin^{-1}\left(\dfrac{x^3+y^3}{x+y}\right)$. **(06 Marks)**

OR

4 a. Obtain the Maclaurin's series expansion of the function $\sqrt{1+\sin 2x}$ upto x^4. **(08 Marks)**

b. Find the pedal equation of the curve $r=a(1-\cos\theta)$. **(06 Marks)**

c. If $u=\dfrac{yz}{x}$, $v=\dfrac{zx}{y}$, $w=\dfrac{xy}{z}$ show that $\dfrac{\partial(u,v,w)}{\partial(x,y,z)}=4$. **(06 Marks)**

Module-3

5 a. Obtain a reduction formula for $\int\sin^n x\,dx$ $(n>0)$. **(08 Marks)**

b. Evaluate $\displaystyle\int_0^\infty \frac{x^2}{(1+x^6)^{\frac{7}{2}}}dx$. **(06 Marks)**

c. Evaluate $\displaystyle\int_0^1\int_{x^2}^{x}\left(x^2+3y+2\right)dy\,dx$. **(06 Marks)**

OR

6 a. Evaluate $\int_0^1\int_0^y xy\,dx\,dy$. (08 Marks)

b. Evaluate $\int_0^{2a} x^2\sqrt{2ax-x^2}\,dx$. (06 Marks)

c. Evaluate $\int_0^1\int_0^2\int_1^2 x^2yz\;dx\,dy\,dz$. (06 Marks)

Module-4

7 a. A particle moves along the curve $x=1-t^3$, $y=1+t^2$ and $z=2t-5$. Find the components of velocity and acceleration at $t=1$ in the direction $2i+j+2k$. (08 Marks)

b. Find the directional derivatives of $\phi=x^2yz+4xz^2$ at $(1,-2,-1)$ along $2i-j-2k$. (06 Marks)

c. Show that $\vec{F}=(y+z)i+(z+x)j+(x+y)k$ is irrotational. (06 Marks)

OR

8 a. If $\vec{F}=(x+y+z)\hat{i}+\hat{j}-(x+y)\hat{k}$, show that $\vec{F}\times\text{curl}\,\vec{F}=0$. (08 Marks)

b. If $\phi(x,y,z)=x^3+y^3+z^3-3xyz$, find $\nabla\phi$, $|\nabla\phi|$ at $(1,-1,2)$. (06 Marks)

c. Find $\text{div}\,\vec{F}$ and $\text{curl}\,\vec{F}$ where $\vec{F}=(xz^3\hat{i}-2x^2yz\hat{j}+2yz^4\hat{k})$ at $(1,-1,1)$. (06 Marks)

Module-5

9 a. Solve $x^2y\,dx-(x^3+y^3)dy=0$. (08 Marks)

b. Solve $(x^2+y)dx+(y^3+x)dy=0$. (06 Marks)

c. Solve $(5x^4+3x^2y^2-2xy^3)dx+(2x^3y-3x^2y^2-5y^4)dy=0$. (06 Marks)

OR

10 a. Solve $\frac{dy}{dx}+y\cot x=\sin x$. (08 Marks)

b. Solve $\frac{dy}{dx}-y\tan x=y^2\sec x$. (06 Marks)

c. Solve $(x^2y-2xy^2)dx-(x^3-3x^2y)dy=0$. (06 Marks)

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CBCS SCHEME

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17EC36

Third Semester B.E. Degree Examination, July/August 2022
Engineering Electromagnetics

Time: 3 hrs. Max. Marks: 100

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. Also explain how force due to many charges can be determined. **(10 Marks)**

b. Point charges of 50 nC each are located at A(1, 0, 0), B(−1, 0, 0), C(0, 1, 0) and D(0, −1, 0) in free space. Find the total force exerted on the charge at A. **(10 Marks)**

OR

2 a. Define the term Electric field intensity and derive the expression for the electric field intensity at any point due to an infinite line charge of density ρ_L C/m distributed along Z-axis. **(10 Marks)**

b. Calculate the flux density $\vec{D}$ at point P(2, −3, 6) produced by:
(i) Point charge Q_A = 55 mC at (−2, 3, 6)
(ii) A uniform line charge ρ_L = 200 mC/m on X-axis
(iii) A uniform surface charge ρ_S = 120 μc/m^2 on the plane Z = −5 m. **(10 Marks)**

Module-2

3 a. State and explain Gauss's law. **(05 Marks)**

b. A surface charge of density ρ_S C/m^2 is uniformly spread over an infinite plane. Apply Gauss law to determine the electric field intensity at any point due to this charge distribution. **(07 Marks)**

c. Calculate the divergence of vector $\vec{D}$ at a point P due to charge distribution defined by the equation.

(i) $\vec{D} = \frac{1}{2}\left[10xyz\,\hat{a}_x + 5x^2z\,\hat{a}_y + [2z^3 - 5x^2y]\hat{a}_z\right]$ at P(−2, 3, 5)

(ii) $\vec{D} = 5z^2\,\hat{a}_\rho + 10\rho z\,\hat{a}_z$ at P(3, −45°, 5) **(08 Marks)**

OR

4 a. Show that electric field intensity is equal to negative gradient of electric potential :

$$\vec{E} = -\nabla V$$ **(05 Marks)**

b. Three identical point charges of 4PC each are located at the corners of an equilateral triangle of 0.5 mm on a side in free space. How much work must be done to move one charge to a point equidistant from the other two and on the line joining them? **(08 Marks)**

c. Obtain the expression for continuity equation of current and what is its significance. **(07 Marks)**

Module-3

5 a. Derive Laplace's and Poisson's equations form Gauss's law. **(05 Marks)**

b. Using Laplace's equation, derive the expression for the capacitance of a coaxial cable. Assume suitable boundary conditions. **(08 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.

c. Given the potential field $V = [A\rho^4 + B\rho^{-4}]\sin 4\phi$:

(i) Show that $\nabla^2 V = 0$

(ii) Select A and B such that V = 100 V and |E| = 500 V/m at P(1, 22.5°, 2) **(07 Marks)**

OR

6 a. Derive the expression for the magnetic field intensity due to a long conductor carrying a steady current 'I'. **(07 Marks)**

b. Evaluate on both sides of the Stoke's theorem for the field $\vec{H} = 6xy\hat{a}_x - 3y^2\hat{a}_y$ A/m and on the rectangular path around the region $[2 \le x \le 5]$; $[-1 \le y \le 1]$ and z = 0. Let the positive direction of $\vec{ds}$ be $\hat{a}_z$. **(08 Marks)**

c. Compare scalar and vector magnetic potentials. **(05 Marks)**

Module-4

7 a. Derive Lorentz force equation and mention the application of its solution. **(06 Marks)**

b. Derive an expression for the force between two differential current elements carrying steady currents I_1 and I_2 respectively. **(06 Marks)**

c. Point charge Q = 18 nC has a velocity 5×10^6 m/s in the direction :

$\hat{a}_v = 0.6\hat{a}_x + 0.75\hat{a}_y + 0.3\hat{a}_z$

Calculate the magnetic force exerted on the charge by the field

(i) $\vec{B} = [-3\hat{a}_x + 4\hat{a}_y + 6\hat{a}_z]$ mT (ii) $\vec{E} = [-3\hat{a}_x + 4\hat{a}_y + 6\hat{a}_z]$ KV/m

(iii) When both $\vec{B}$ and $\vec{E}$ acting together. **(08 Marks)**

OR

8 a. Derive the magnetic boundary conditions at the interface between two different magnetic materials. **(08 Marks)**

b. Obtain the expression for the magnetic force exerted on a magnetic material. **(06 Marks)**

c. Given a magnetic material for which $X_m = 3.1$ and within which $\vec{B} = 0.4y\,\hat{a}_z$T. Find $\vec{H}$, μ, μ_r, $\vec{M}$ and $\vec{J}$. **(06 Marks)**

Module-5

9 a. Using Faraday's law, deduce the Maxwell's equation to relate time varying electric and magnetic fields. **(08 Marks)**

b. What is displacement current? For a harmonically varying field, show that the conduction and displacement currents densities are in phase quadrature. **(06 Marks)**

c. Let $\mu = 3 \times 10^{-5}$ H/m, $\epsilon = 1.2 \times 10^{-10}$ F/m and σ = 0 everywhere, if $\vec{H} = 2\cos(10^8 t - \beta x)\,\hat{a}_z$ A/m. Use Maxwell's equations to obtain the expressions for $\vec{B}$, $\vec{D}$, $\vec{E}$ and β. **(06 Marks)**

OR

10 a. Derive the wave equation interms of $\vec{E}$ and $\vec{H}$ for a general medium. **(08 Marks)**

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

c. The $\vec{H}$ field in free space is given by $\vec{H}(x,t) = 10\cos(10^8 t - \beta x)\,\hat{a}_y$ A/m. Find β, λ and $\vec{E}(x,t)$. **(06 Marks)**

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CBCS SCHEME

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Third Semester B.E. Degree Examination, July/August 2022
Network Analysis

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Using Source transformation find 'V' for circuit shown in Fig. Q1 (a). **(10 Marks)**

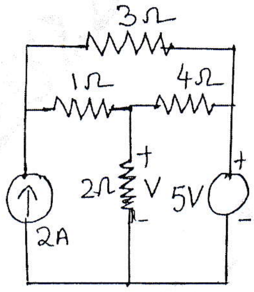

Fig. Q1 (a)

b. Using star-delta transformation find equivalent resistance across terminals a and b for circuit shown in Fig. Q1 (b). **(10 Marks)**

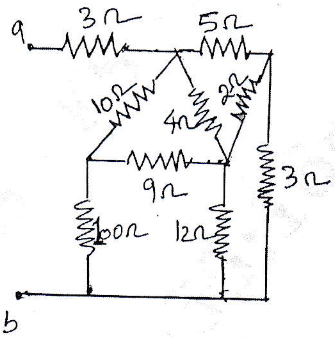

Fig. Q1 (b)

OR

2 a. Find magnitude of voltage source 'V_1' which results in effective voltage of 20 volts across 5 Ω resistor in the circuit, shown in Fig. Q2 (a). Also find power dissipated by inductance of reactance 2Ω. **(10 Marks)**

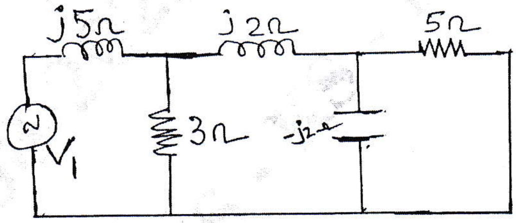

Fig. Q2 (a)

b. Find power delivered by each source for circuit shown in Fig. Q2 (b) using nodal analysis. **(10 Marks)**

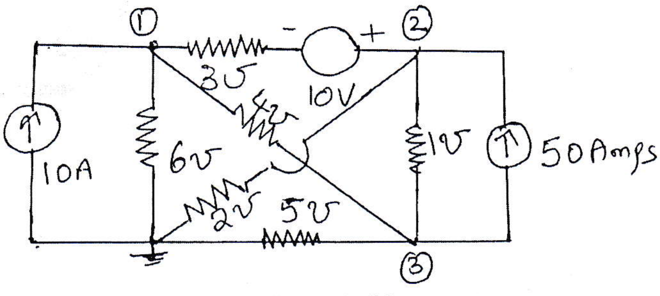

Fig. Q2 (b)

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-2

3 a. Find current through 2 Ω resistor using superposition theorem for circuit shown in Fig. Q3 (a). Also state Millman's thorem and write expression for equivalent voltage and impedance. . **(10 Marks)**

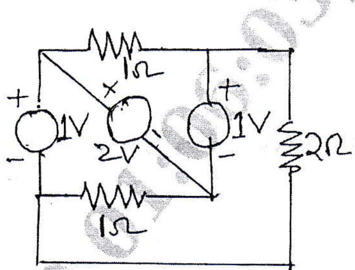

Fig. Q3 (a)

b. Verify Reciprocity theorem for circuit shown in Fig. Q3 (b). **(10 Marks)**

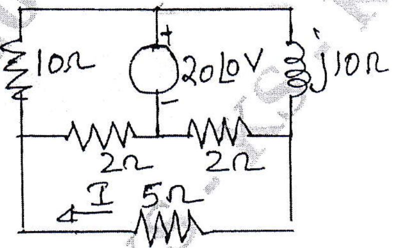

Fig. Q3 (b)

OR

4 a. Find current through galvanometer of resistance 50 Ω using Thevinin's Theorem for circuit shown in Fig. Q4 (a). **(10 Marks)**

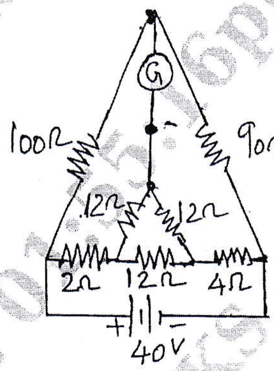

Fig. Q4 (a)

b. Write the conditions for maximum power for A.C. circuit when load is,

(i) Pure resistance (ii) Variable impedance

Find maximum power transferred to load of variable resistance connected across terminals ab for circuit shown in Fig. Q4 (b). **(10 Marks)**

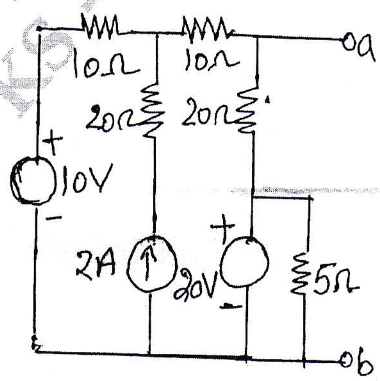

Fig. Q4 (b)

Module-3

5 a. Write equivalent form of initial and final conditions of elements resistance, inductance and capacitance. **(07 Marks)**

b. The network shown in Fig. Q5 (b), is in steady state with switch 'K' closed. At t = 0 switch is opened. Determine voltage across the switch, V_K and $\frac{dV_K}{dt}$ at $t = 0^+$ **(07 Marks)**

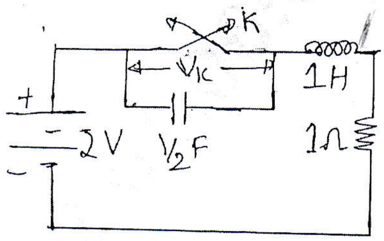

Fig. Q5 (b)

c. The network shown in Fig. Q5 (c) has switch 'K' opened at t = 0. Solve for V, $\frac{dV}{dt}$ and $\frac{d^2V}{dt^2}$ at $t = 0^+$ if I = 1 amp, R = 100 Ω and L = 1 Henry. Refer Fig. Q5 (c). **(06 Marks)**

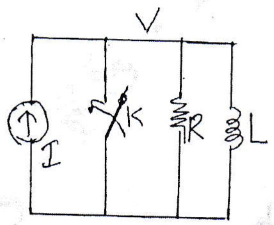

Fig. Q5 (c)

OR

6 a. Derive the expression for finding Laplace Transform of a periodic waveform of time period 'T' seconds. Also find the Laplace transform of the wave form shown in Fig. Q6 (a). **(10 Marks)**

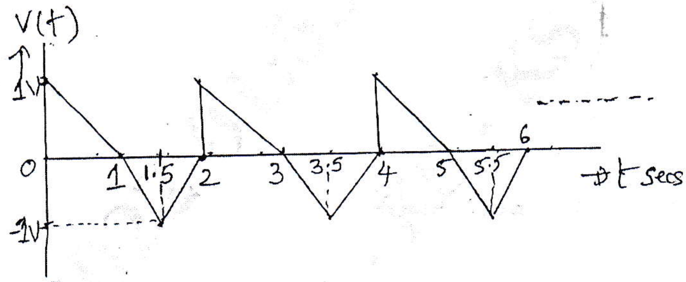

Fig. Q6 (a)

b. In given network shown in Fig. Q6 (b), find $i_2(t)$ if switch is closed at t = 0 using Laplace transform. **(10 Marks)**

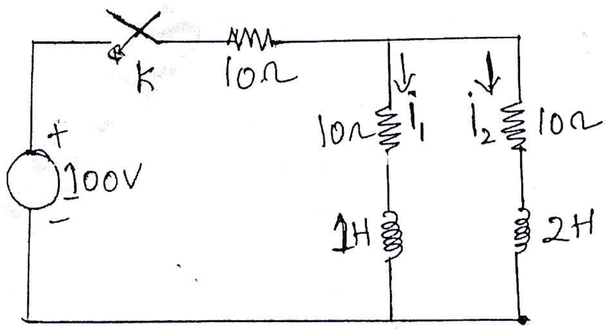

Fig. Q6 (b)

Module-4

7 a. Show that resonant frequency is the geometric mean of half power frequencies. **(06 Marks)**

b. Show that in a R-L-C series circuit with frequency 'W' of supply being varied at constant voltage the voltage across the capacitor becomes maximum at a frequency,

$$\omega_C = \left[\frac{1}{LC} - \frac{R^2}{2L^2}\right]^{\frac{1}{2}}.$$ **(06 Marks)**

c. A coil having a resistance of 5 Ω and an inductance of 100 mH is connected in series with a 50 μF capacitor across 200 V, variable supply frequency. Find voltage across coil and capacitor when the power factor of the circuit becomes unity. Also find power dissipated at resonance. **(08 Marks)**

OR

8 a. Define selectivity and Q-factor of a resonant circuit. Also discuss the frequency response curves for parallel resonance. **(09 Marks)**

b. Find the value of 'L' for which the circuit shown is resonant at a frequency ω = 5000 rad/sec. Refer Fig. Q8 (b). **(07 Marks)**

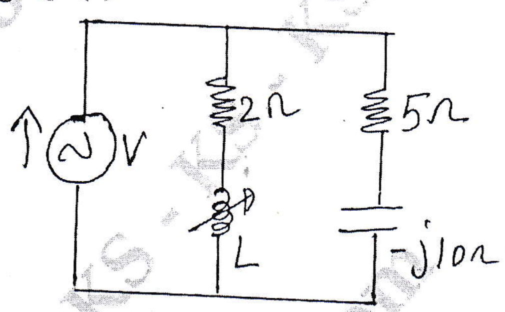

Fig. Q8 (b)

c. Determine the values of R_L and R_C which cause the circuit shown in Fig. Q8 (c) is resonant at all frequencies.

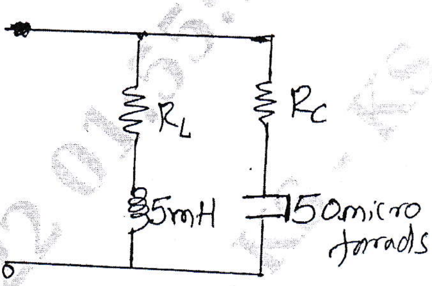

Fig. Q8 (c) **(04 Marks)**

Module-5

9 a. Define Y-parameters and express ABCD parameters in term of h-parameters. **(08 Marks)**

b. Find Y and h parameters for the network shown in Fig. Q9 (b). **(12 Marks)**

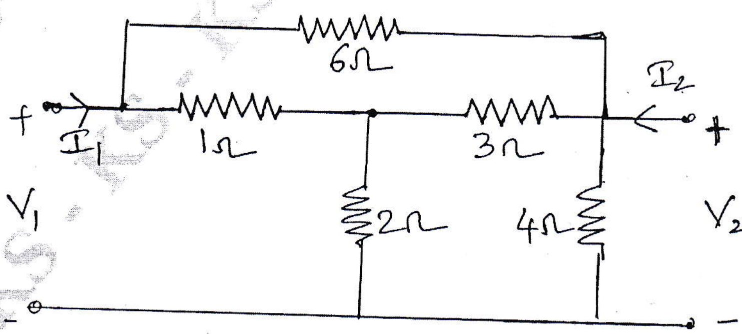

Fig. Q9 (b)

OR

10 a. Write the conditions for reciprocity and symmetry of Z, Y, T and h-parameters. **(08 Marks)**

b. For the network shown in Fig. Q10 (b), find Z and ABCD parameters and check for reciprocity. **(12 Marks)**

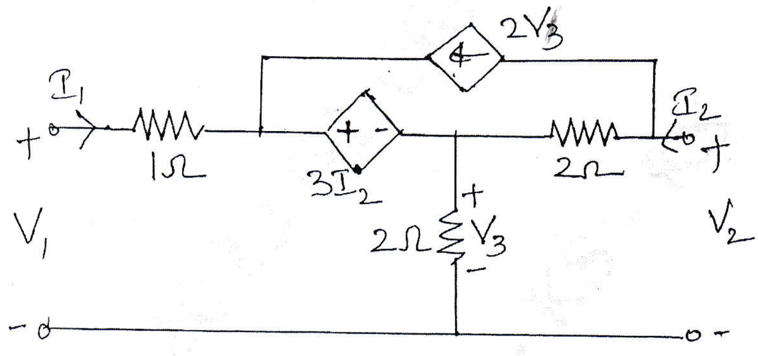

Fig. Q10 (b)

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