CBCS SCHEME

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17MAT31

Third Semester B.E. Degree Examination, Aug./Sept. 2020
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 to represent the periodic function $f(x) = x - x^2$ from $x = -\pi$ to $x = \pi$. **(08 Marks)**

b. 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 amp.	1.98	1.30	1.05	1.30	-0.88	-0.25	1.98

Expand A as a Fourier series upto first harmonic. Obtain the amplitude of the first harmonic. **(06 Marks)**

c. Find the half range cosine series for the function $f(x) = (x-1)^2$ in $0 < x < 1$. **(06 Marks)**

OR

2 a. Find the Fourier series of $f(x) = 2x - x^2$ in (0, 3). **(08 Marks)**

b. Obtain the constant term and the coefficients of the first sine and cosine terms in the Fourier series expansion of y as given in the following table: **(06 Marks)**

x:	0	1	2	3	4	5	6
y:	9	18	24	28	26	20	9

c. Obtain the half-range sine series for the function,

$$f(x) = \begin{cases} x, & 0 < x < \frac{\pi}{2} \\ \pi - x, & \frac{\pi}{2} < x < \pi \end{cases}.$$ **(06 Marks)**

Module-2

3 a. Find the Fourier transform of $f(x) = \begin{cases} a^2 - x^2, & |x| \le a \\ 0, & |x| > a \end{cases}$. Hence deduce that

$$\int_0^\infty \frac{(\sin x - x\cos x)}{x^3}\cos\frac{x}{2}\,dx = \frac{3\pi}{16}.$$ **(08 Marks)**

b. Find the Z-transform of,
(i) $\cos n\theta$ and (ii) $\cosh n\theta$ **(06 Marks)**

c. Solve $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ with $y_0 = 0 = y_1$, using z-transforms technique. **(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 Z-transform of,
(i) $(n+1)^2$ (ii) $\sin(3n+5)$ **(06 Marks)**

c. Find the inverse Z-transform of $\frac{2z^2+3z}{(z+2)(z-4)}$. **(06 Marks)**

Module-3

5 a. Find the two regression lines and hence the correlation coefficient between x and y from the data. **(08 Marks)**

x	1	2	3	4	5	6	7	8	9	10
y	10	12	16	28	28	36	41	49	40	50

b. Fit a second degree parabola to the following data: **(06 Marks)**

x	0	1	2	3	4
y	1	1.8	1.3	2.5	6.3

c. Using Newton-Raphson method find the root of $x\sin x+\cos x=0$ near $x=\pi$ corrected to 4 decimal places. **(06 Marks)**

OR

6 a. Two variables x and y have the regression lines $3x+2y=26$ and $6x+y=31$. Find the mean values of x and y and the correlation coefficient between them. **(08 Marks)**

b. Fit a curve of the form, $y=ae^{bx}$ to the following data: **(06 Marks)**

x:	5	15	20	30	35	40
y:	10	14	25	40	50	62

c. Using Regula-Falsi method find the root of $xe^x=\cos x$ in the interval (0, 1) carrying out four iterations. **(06 Marks)**

Module-4

7 a. Using Newton's forward and backward interpolation formulae, find f(1) and (10) from the following table: **(08 Marks)**

x	3	4	5	6	7	8	9
f(x)	4.8	8.4	14.5	23.6	36.2	52.8	73.9

b. Given that $f(5)=150$, $f(7)=392$, $f(11)=1452$, $f(13)=2366$, $f(17)=5202$. Using Newton's divided difference formulae find f(9). **(06 Marks)**

c. Using Simpson's $\frac{1}{3}^{rd}$ rule evaluate $\int_0^{0.6} e^{-x^2}dx$ by taking seven ordinates. **(06 Marks)**

OR

8 a. Using Newton's Backward difference interpolation formula find f(105) from, **(08 Marks)**

x	80	85	90	95	100
f(x)	5026	5674	6362	7088	7854

b. If $f(1)=-3$, $f(3)=9$, $f(4)=30$, $f(6)=132$ find Lagrange's interpolation polynomial that takes the same value as f(x) at the given point. **(06 Marks)**

c. Evaluate $\int_4^{5.2}\log_e x\,dx$ by Simpson's $\frac{3}{8}^{th}$ rule with $h=0.1$. **(06 Marks)**

Module-5

9 a. Verify Green's theorem for $\oint_C (xy + y^2)dx + x^2dy$ where C is bounded by $y = x$ and $y = x^2$. **(08 Marks)**

b. Using Gauss divergence theorem evaluate $\iint_S \vec{F} \cdot \hat{n}\, ds$,

where $\vec{F} = (x^2 - yz)\hat{i} + (y^2 - zx)\hat{j} + (z^2 - xy)\hat{k}$ over the rectangular parallel piped $0 \le x \le a$, $0 \le y \le b$ and $0 \le z \le c$. **(06 Marks)**

c. With usual notations derive Euler's equation, $\frac{\partial f}{\partial y} - \frac{d}{dx}\left(\frac{\partial f}{\partial y'}\right) = 0$. **(06 Marks)**

OR

10 a. If $\vec{F} = (5xy - 6x^2)\hat{i} + (2y - 4x)\hat{i}$, evaluate $\oint_C \vec{F}.d\vec{r}$ along the curve C in the xy-plane, $y = x^3$ from (1, 1) to (2, 8). **(08 Marks)**

b. Find the extremals of the functional with y(0) = 0 and y(1) = 1. **(06 Marks)**

c. Show that Geodesics on a plane arc straight lines. **(06 Marks)**

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17MATDIP31

Third Semester B.E. Degree Examination, Aug./Sept. 2020
Additional Mathematics – I

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 modulus and amplitude of, $1+\cos\alpha+i\sin\alpha$ **(06 Marks)**

b. Express the complex number $\frac{(1+i)(2+i)}{(3+i)}$ in the form a + ib. **(07 Marks)**

c. Find a unit vector normal to both the vectors $4i-j+3k$ and $-2i+j-2k$. Find also the sine of the angle between them. **(07 Marks)**

OR

2 a. Show that $\left[\frac{1+\sin\theta+i\cos\theta}{1+\sin\theta-i\cos\theta}\right]^n=\cos n\left(\frac{\pi}{2}-\theta\right)+i\sin n\left(\frac{\pi}{2}-\theta\right)$. **(06 Marks)**

b. If $\vec{A}=i-2j-3k$, $\vec{B}=2i+j-k$, $\vec{C}=i+3j-k$ find (i) $\left(\vec{A}\times\vec{B}\right)\times\left(\vec{B}\times\vec{C}\right)$ (ii) $\vec{A}\times\left(\vec{B}\times\vec{C}\right)$ **(07 Marks)**

c. Show that $\left[\vec{a}\times\vec{b},\ \vec{b}\times\vec{c},\ \vec{c}\times\vec{a}\right]=\left[\vec{a},\vec{b},\vec{c}\right]^2$. **(07 Marks)**

Module-2

3 a. If $y=(x^2-1)^n$ then prove that $(1-x^2)y_{n+2}-2xy_{n+1}+n(n+1)y_n=0$. **(06 Marks)**

b. Find the pedal equation of the curve $r^m=a^m(\cos m\theta+\sin m\theta)$. **(07 Marks)**

c. Show that the following curves intersect orthogonally $r=a(1+\cos\theta)$, $r=b(1-\cos\theta)$. **(07 Marks)**

OR

4 a. Show that $\sqrt{1+\sin 2x}=1+x-\frac{x^2}{2}-\frac{x^3}{6}+\frac{x^4}{24}......$ using Maclaurin's series expansion. **(06 Marks)**

b. If $u=e^{ax+by}f(ax-by)$, prove that $b\frac{\partial u}{\partial x}+a\frac{\partial u}{\partial y}=2abu$. **(07 Marks)**

c. Find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$ where $u=x^2+y^2+z^2$, $v=xy+yz+zx$, $w=x+y+z$. **(07 Marks)**

Module-3

5 a. Obtain a reducation formula for $\int\cos^n x\,dx$. **(06 Marks)**

b. Evaluate $\int_0^2\frac{x^4}{\sqrt{4-x^2}}dx$. **(07 Marks)**

c. Evaluate $\int_0^a\int_0^x\int_0^{x+y}e^{x+y+z}\,dz\,dy\,dx$. **(07 Marks)**

OR

6 a. Obtain a reducation formula for $\int \sin^n x \, dx$. **(06 Marks)**

b. Evaluate $\int_0^1 \int_0^{\sqrt{1-y^2}} x^3 y \, dx dy$. **(07 Marks)**

c. Evaluate $\int_{-c}^{c} \int_{-b}^{b} \int_{-a}^{a} (x^2 + y^2 + z^2) dz dy dx$. **(07 Marks)**

Module-4

7 a. A particle moves along the curve $x = 1 - t^3$, $y = 1 + t^2$ and $z = 2t - 5$.

(i) Determine its velocity and acceleration.

(ii) Find the components of velocity and acceleration at t = 1 in the direction $2i + j + 2k$. **(06 Marks)**

b. Find the directional derivative of, $\phi = x^2yz + 4xz^2$ at (1, -2, -1) along $2i - j - 2k$. **(07 Marks)**

c. If $\vec{F} = (x + y + az)i + (bx + 2y - z)j + (x + cy + 2z)k$ find a, b, c such that $\text{curl}\,\vec{F} = 0$ and then find ϕ such that $\vec{F} = \nabla\phi$. **(07 Marks)**

OR

8 a. If $\vec{r} = xi + yj + zk$ and $r = |\vec{r}|$ prove that $\nabla(r^n) = nr^{n-2}.\vec{r}$ **(06 Marks)**

b. If $\vec{F} = (x + y + 1)i + j - (x + y)k$ show that $\vec{F}.\text{curl}\,\vec{F} = 0$. **(07 Marks)**

c. Show that $\vec{F} = (y + z)i + (z + x)j + (x + y)k$ is irrotational. Also find a scalar function ϕ such that $\vec{F} = \nabla\phi$. **(07 Marks)**

Module-5

9 a. Solve : $\dfrac{dy}{dx} = \dfrac{y - x}{y + x}$. **(06 Marks)**

b. Solve : $(y^3 - 3x^2y)dx - (x^3 - 3xy^2)dy = 0$. **(07 Marks)**

c. Solve : $xy(1 + xy^2)\dfrac{dy}{dx} = 1$. **(07 Marks)**

OR

10 a. Solve : $\dfrac{dy}{dx} + y\cot x = \cos x$. **(06 Marks)**

b. Solve : $(4xy + 3y^2 - x)dx + x(x + 2y)dy = 0$. **(07 Marks)**

c. Solve : $\dfrac{dy}{dx} = \dfrac{x + 2y - 3}{2x + y - 3}$. **(07 Marks)**

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17EC32

Third Semester B.E. Degree Examination, Aug./Sept.2020
Electronic Instrumentation

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain with suitable example accuracy and precision. **(05 Marks)**

b. What is loading effect? A simple circuit of $R_1 = 20\ \Omega$ and $R_2 = 25\ \Omega$ connected to a 250 V dc source. If the voltage across R_2 is to be measured by the voltmeter having
   (i) A sensitivity of 500 Ω/V
   (ii) A sensitivity of 10,000 ΩV
   Find which voltmeter will read more accurately. Both the meters are used on the 150 V range. **(10 Marks)**

c. Explain multirange voltmeter with a neat diagram. **(05 Marks)**

OR

2 a. List and explain the types of measurement errors. **(06 Marks)**

b. The meter A has a range of 0-100V and multiplier resistance of 25 KΩ. The meter B has a range 0-1000 V and a multiplier resistance of 150 KΩ. Both meters have basic meter resistance of 1 KΩ. Find which meter is more sensitive. **(04 Marks)**

c. What is a thermocouple? Explain the different types of thermocouple and what are the limitations of thermocouple. **(10 Marks)**

Module-2

3 a. Explain the working of linear ramp type DVM. **(10 Marks)**

b. Explain with a diagram, the working of digital PH meter. **(10 Marks)**

OR

4 a. With the help of neat diagram, explain the working of successive approximation type DVM. **(10 Marks)**

b. With the help of a diagram, explain the operation of universal counter timer. **(10 Marks)**

Module-3

5 a. With a neat block diagram, explain the general purpose of CRO. **(08 Marks)**

b. Explain in detail the working of square and pulse generator. **(06 Marks)**

c. Explain working of sweep frequency generator. **(06 Marks)**

OR

6 a. Explain in detail the working of digital storage oscilloscope and list the advantages of DSO. **(10 Marks)**

b. Explain general pulse characteristics. **(04 Marks)**

c. Explain in detail the working of function generator. **(06 Marks)**

Module-4

7 a. Explain in detail the working of Wien bridge oscillator and find the parallel R and C that causes a Wien bridge to null with the following components values:
$R_1 = 2.7\ K\Omega$, $R_2 = 22\ K\Omega$, $C_1 = 5\ \mu F$, $R_4 = 100\ K\Omega$ and the operating frequency is 2.2 kHz. (08 Marks)

b. Explain and derive the balance equation of wheat stone bridge and mention the limitation. (04 Marks)

c. What is Meggar? Explain basic Meggar circuit. (08 Marks)

OR

8 a. Explain and derive expression for Maxwell's bridge. If bridge constants are $C_1 = 0.5\ \mu F$, $R_1 = 1200\ \Omega$, $R_2 = 700\Omega$, $R_3 = 300\ \Omega$. Find the resistance and inductance of coil. (08 Marks)

b. Explain Wagner's earth connection. (06 Marks)

c. Explain with a diagram the operation of stroboscope. (06 Marks)

Module-5

9 a. List the factors to be considered while selecting transducers. (05 Marks)

b. Derive expression for the gauge factor $K = 1 + 2\mu$ and explain the bonded resistance wire strain gauges with a neat diagram. (10 Marks)

c. What is transistor? Explain different form of thermistor. (05 Marks)

OR

10 a. List the advantages of LVDT. (04 Marks)

b. Explain the construction, principle and operation of LVDT. (08 Marks)

c. Explain with a diagram the operation of resistive pressure transducer. (08 Marks)

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17EC33

Third Semester B.E. Degree Examination, Aug./Sept.2020
Analog Electronics

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. Derive expressions for Z_i, Z_o, A_v and A_I for common emitter fixed bias configuration using hybrid equivalent model. **(10 Marks)**

b. Draw and explain the hybrid-π model of transistor in CE configuration mentioning significance of each component in model. **(06 Marks)**

c. Calculate DC bias voltage and currents for the Darlington configuration shown in Fig.Q1(c).

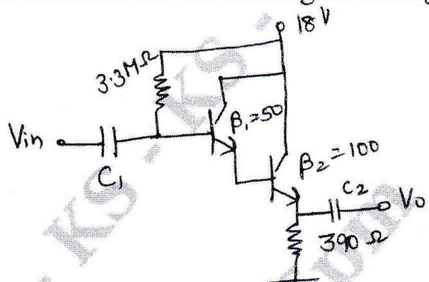

Fig.Q1(c) **(04 Marks)**

OR

2 a. Derive the expression for Z_i, Z_o and A_v for emitter follower configuration using r_e model. **(10 Marks)**

b. Define h parameters and derive h parameters model of CE-BJT. **(10 Marks)**

Module-2

3 a. Explain the construction and working principle of n-channel JFET and draw the characteristics. **(08 Marks)**

b. Derive an expression for Z_i, Z_o and A_v of FET self bias configuration with bypassed R_S. **(08 Marks)**

c. Distinguish between JFET and MOSFET. **(04 Marks)**

OR

4 a. Draw the JFET common gate configuration circuit. Derive Z_i, Z_o and A_v using small signal model. **(10 Marks)**

b. The fixed bias configuration of Fig.Q4(b) has an operating point defined by $V_{GSQ} = -2V$ and $I_{DQ} = 5.625$ mA with $I_{DSS} = 10$ mA and $V_P = -8V$. Determine : (i) g_m (ii) r_d (iii) Z_i (iv) Z_o (v) A_V

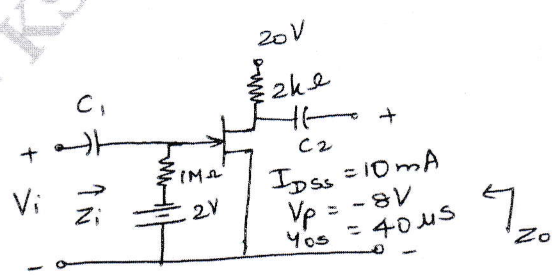

Fig.Q4(b) **(10 Marks)**

Module-3

5 a. Describe Miller effect and derive an equation for miller input and output capacitance. **(10 Marks)**

b. Explain high-frequency response of FET amplifier and derive expression for cut off frequencies defined by input and output circuits (f_{Hi} and f_{Ho}). **(10 Marks)**

OR

6 a. Determine the lower cut off frequencies for the voltage divider bias BJT amplifier with C_S = 10 μf, C_C = 1 μf, C_E = 20 μf, R_S = 1 kΩ, R_1 = 40 kΩ, R_2 = 10 kΩ, R_E = 2 kΩ, R_0 = 4 kΩ, R_L = 2.2 kΩ, β = 100, r_0 = αΩ, V_{CC} = 20 V. **(10 Marks)**

b. Obtain the expressions for overall lower and higher cut-off frequencies for a multistage amplifier. **(10 Marks)**

Module-4

7 a. Derive the expressions for Z_{if} and Z_{of} for voltage series feedback connection type. **(06 Marks)**

b. Draw the circuit diagram of uni-junction oscillator and explain the principle of operation and draw the characteristic curve. **(08 Marks)**

c. The following component values are given for the Wein-bridge oscillator of the circuit of $R_1 = R_2$ = 33 kΩ, $C_1 = C_2$ = 0.001μb, R_3 = 47 kΩ, R_4 = 15 kΩ.
(i) Will this circuit oscillate?
(ii) Calculate the resonant frequency. **(06 Marks)**

OR

8 a. Briefly explain characteristics of negative feedback amplifier. **(08 Marks)**

b. Determine the voltage gain, input and output impedance with feedback for voltage series feedback having A = –100, R_1 = 10 kΩ and R_0 = 20 kΩ for feedback of β = –0.1. **(04 Marks)**

c. Explain characteristics of quartz crystal. With a neat diagram, explain the crystal oscillator in parallel resonant mode. **(08 Marks)**

Module-5

9 a. Explain series fed class A power amplifier. Show that its maximum conversion η is 25%. **(10 Marks)**

b. For a class B amplifier providing a 20 V peak signal to a 16Ω load (speaker) and a power supply of V_{CC} = 30 V. Determine the input power, output power and circuit η. **(10 Marks)**

OR

10 a. Derive an expression for second harmonic distortion. **(05 Marks)**

b. Define voltage regulator. Explain the series voltage regulator using transistor. **(08 Marks)**

c. Derive an expression for conversion gain of class B push pull amplifier with neat circuit diagram and waveform. **(07 Marks)**

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17EC35

Third Semester B.E. Degree Examination, Aug./Sept. 2020
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. Briefly explain the classification of electrical networks. **(08 Marks)**

b. Find the current through 2 Ω resistor for the network shown in the Fig. Q1 (b) by making use of source transformation technique. **(06 Marks)**

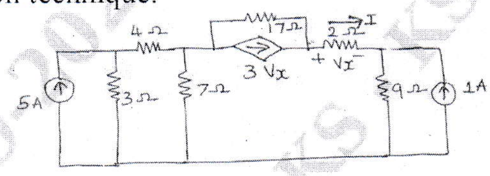

Fig. Q1 (b)

c. Three impedances are connected in delta, obtain the star equivalent of one network. **(06 Marks)**

OR

2 a. Using mesh current method, find the power delivered by the dependent voltage source in the circuit shown in Fig. Q2 (a). **(10 Marks)**

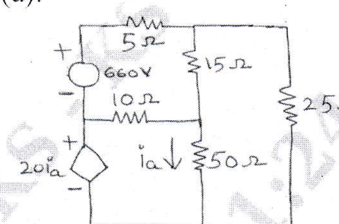

Fig. Q2 (a)

b. Find the current i_1 for the circuit shown in Fig. Q2 (b) using nodal analysis. **(10 Marks)**

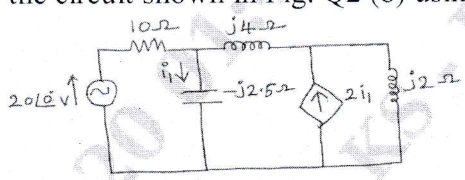

Fig. Q2 (b)

Module-2

3 a. State and explain reciprocity theorem. **(05 Marks)**

b. For the circuit shown in Fig. Q3 (b), find the voltage Vx using super position theorem. **(08 Marks)**

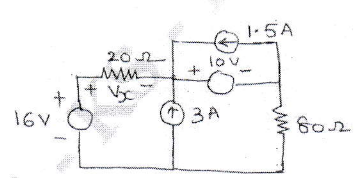

Fig. Q3 (b)

c. Find the voltage across the load of 1 KΩ connected between the terminals a and b, for the circuit shown in Fig. Q3 (c) using Millman's theorem. **(07 Marks)**

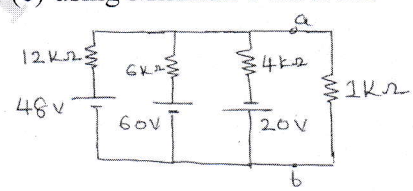

Fig. Q3 (c)

OR

4 a. State and prove Thevinin's theorem. **(05 Marks)**

b. Find the value of R_L for the circuit shown in Fig. Q4 (b) for which the power transferred to the loading maximum and also find the maximum power transferred. **(07 Marks)**

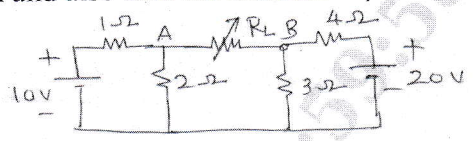

Fig. Q4 (b)

c. For the circuit shown in Fig. Q4 (c), find the Norton's equivalent circuit across the terminal's x and y. **(08 Marks)**

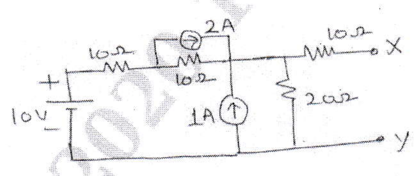

Fig. Q4 (c)

Module-3

5 a. For the network shown in Fig. Q5 (a), the switch is moved from position a to b at t = 0 and steady state is reached at position a. Find i, $\frac{di}{dt}$, $\frac{d^2i}{dt^2}$ at $t = 0^+$. Assume that the capacitor is initially uncharged. **(08 Marks)**

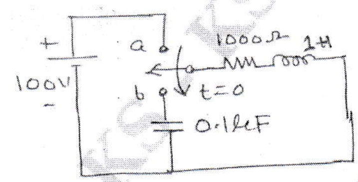

Fig. Q5 (a)

b. In the network shown in Fig. Q5 (b), the switch is closed at t = 0 with the capacitor uncharged. Find the values of i, $\frac{di}{dt}$, $\frac{d^2i}{dt^2}$ at $t = 0^+$. **(06 Marks)**

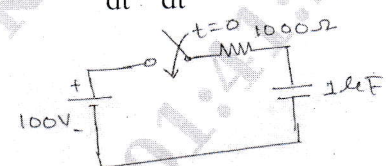

Fig. Q5 (b)

c. In the network shown in Fig. Q5 (c), find $i_1(0^+)$ and $i_L(0^+)$. The circuit is in steady state for $t < 0$. **(06 Marks)**

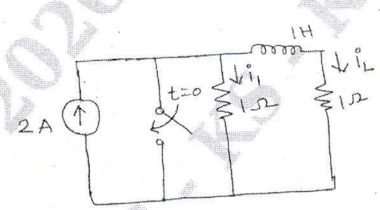

Fig. Q5 (c)

OR

6 a. Obtain the Laplace transform of (i) Unit step function (ii) Unit Ramp function (iii) Unit impulse function. **(09 Marks)**

b. Find the Laplace transform of the periodic function shown in Fig. Q6 (b). **(07 Marks)**

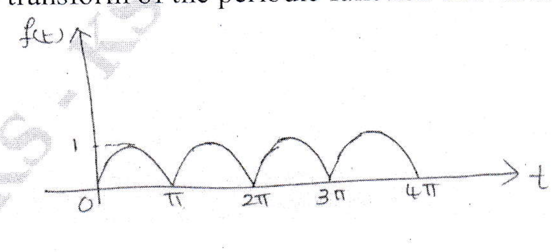

Fig. Q6 (b)

c. Find the Laplace transform of the non-sinusoidal periodic waveform shown in Fig. Q6 (c). **(04 Marks)**

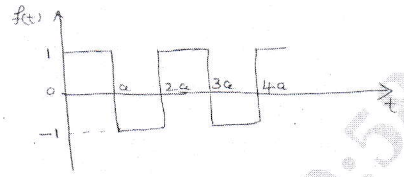

Fig. Q6 (c)

Module-4

7 a. What is resonance? Derive an expression for half power frequencies in series RLC circuit. **(08 Marks)**

b. Define Q-factor, selectivity and bandwidth. **(03 Marks)**

c. A series RLC circuit has a resistance of 10 Ω, an inductance of 0.3 H and a capacitance of 100 μF. The applied voltage is 230 V. Find
   (i) The resonant frequency and quality factor.
   (ii) Current at resonance and currents at lower and upper cutoff frequencies.
   (iii) Voltage across the inductor and capacitor at resonance.
   (iv) Band width. **(09 Marks)**

OR

8 a. For the circuit shown in Fig. Q8 (a), derive an expression for resonant frequency. **(07 Marks)**

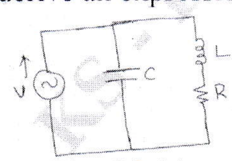

Fig. Q8 (a)

b. Show that a two branch parallel resonant circuit is resonant at all frequencies. If $R_L = R_C = \sqrt{\frac{L}{C}}$, where R_L = resistance in inductor branch, R_C = Resistance in the capacitor branch. **(07 Marks)**

c. An inductance coil of resistance 6 Ω and inductance 1 mH is connected in parallel with another branch consisting of a resistance of 4 Ω with a capacitance of 20 μF. Find (i) The resonant frequency (ii) Current at resonance. The applied voltage is 200 V. **(06 Marks)**

Module-5

9 a. Derive the z parameters in terms of y parameters. **(08 Marks)**

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

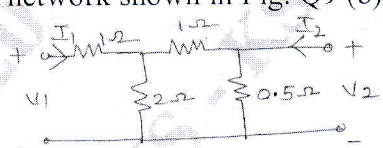

Fig. Q9 (b)

OR

10 a. Derive y parameters in terms of ABCD parameters. **(08 Marks)**

b. Determine the h parameters, for the circuit shown in Fig. Q10 (b). **(06 Marks)**

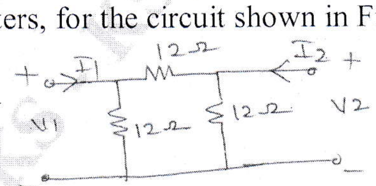

Fig. Q10 (b)

c. Find the ABCD parameters, for the circuit shown in Fig.Q10 (c). **(06 Marks)**

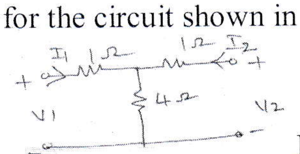

Fig. Q10 (c)

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CBCS SCHEME

USN | | | | | | | | | | **17EC36**

Third Semester B.E. Degree Examination, Aug./Sept. 2020
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. **(05 Marks)**

b. Define electric field intensity and electric flux density. **(05 Marks)**

c. Let a point charge $Q_1 = 25nC$ be located at $P_1(4, -2, 7)$ and a charge $Q_2 = 60nC$ be at $P_2(-3, 4, -2)$.

i) If $\in = \in_0$, find electric field intensity (E) at $P_3(1, 2, 3)$

ii) At what point on the Y axis is $E_X = 0$. **(10 Marks)**

OR

2 a. Given a $60\mu C$ point charge located at the origin, find the total electric flux passing through

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

ii) The closed surface defined by $\rho = 26cm$ and $z = \pm 26cm$. **(07 Marks)**

b. Derive an expression for electric field intensity at a distant point due to infinite line charge distribution. **(08 Marks)**

c. A uniform volume charge density of $80\mu C/m^3$ is present throughout the region $8mm < r < 10mm$. Let $\rho_r = 0$ for $0 < r < 8mm$.

i) Find the total charge inside the spherical surface $r = 10mm$

ii) Find D_r at $r = 10mm$

iii) If there is no charge for $r > 10mm$, find D_r at $r = 20mm$. **(05 Marks)**

Module-2

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

b. Determine the work done in carrying a $2\mu C$ charge from (2, 1, –1) to (8, 2, –1) in the field $\vec{E} = ya_x + xa_y$ along

i) the parabola $x = 2y^2$

ii) the hyperbola $x = \frac{8}{(7-3y)}$. **(08 Marks)**

c. Determine an expression for the volume charge density associated with each $\vec{D}$ field following :

i) $\vec{D} = \frac{4xy}{z}a_x + \frac{2x^2}{z}a_y + \frac{2x^2y}{z^2}a_z$

ii) $\vec{D} = z\sin\phi a_\rho + z\cos\phi a_\phi + \rho\sin\phi a_z$

iii) $\vec{D} = \sin\theta\sin\phi a_\gamma + \cos\theta\sin\phi a_\theta + \cos\phi a_\phi$. **(07 Marks)**

OR

4 a. Two uniform line charges, 8nC/m each, are located at x= 1, z = 2 and at x = –1, y = 2 in free space. If the potential at the origin is100V, find V at P(4, 1, 3). (08 Marks)

b. Within the cylinder $\rho = 2$, $0 < z < 1$, the potential is given by $v = 100 + 50\rho + 150\rho \sin\phi$ V. Find $V, \vec{E}, \vec{D}$ and ρ_V at P(1, 60°, 0.5) in free space. (08 Marks)

c. Derive equation of continuity. (04 Marks)

Module-3

5 a. Derive Poisson's and Laplaces equation. (05 Marks)

b. A uniform volume charge has constant density $\rho_V = \rho_0$ C/m^3, and fills the region r < a, in which permittivity '$\in$' is assumed. A conducting spherical shell is located at r = a and is held at ground potential. Find :

i) the potential everywhere

ii) the electric field intensity, $\vec{E}$ everywhere. (09 Marks)

c. Explain Biot-Savart's law. (06 Marks)

OR

6 a. State and prove Stoke's theorem. (05 Marks)

b. A solid conductor of circular cross-section with a radius of 5mm has a conductivity that varies with radius. The conductor is 20m long, and there is a potential difference of 0.1V DC between its two ends. Within conductor, $H = 10^5\rho^2 a_\phi$ A/m.

i) Find 'σ' conductivity as a function ρ charge density

ii) What is the resistance between the two ends? (08 Marks)

c. A straight conductor of length '2L' carrying a current 'I' coincides with z direction. Obtain an expression for vector magnetic potential at a point in a bisecting plane of the conductor. Also find magnetic flux density $\vec{B}$ at that point. (07 Marks)

Module-4

7 a. The point charge Q = 18nC has a velocity of 5×10^6m/s in the direction :

$a_V = 0.60a_x + 0.75a_y + 0.30a_z$

Calculate the magnitude of the force exerted on the charge by the field :

i) $\vec{B} = -3a_x + 4a_y + 6a_z$mT

ii) $\vec{E} = -3a_x + 4a_y + 6a_z$kV/m

iii) $\vec{B}$ and $\vec{E}$ acting together. (07 Marks)

b. Obtain an expression for the force between differential current elements. (07 Marks)

c. Write a note on magnetic boundary conditions. (06 Marks)

OR

8 a. Find the magnetic field intensity 'H' inside a magnetic material, given the following :

i) $M = 100$ A/m, $\mu = 1.5 \times 10^{-5}$ H/m

ii) $B = 200\mu T$, $\chi_m = 15$. **(06 Marks)**

b. Derive an expression for energy stored in the magnetic field. **(06 Marks)**

c. A current element $I_1 dl_1 = 10^{-4} a_z$ A.m is located at $P_1(2, 0, 0)$ another current element $I_2 dl_2 = 10^{-6}[a_x - 2a_y + 3a_z]$ A.m is located at $P_2(-2, 0, 0)$ and both are in free space :

i) Find force exerted on $I_2 dl_2$ by $I_1 dl_1$

ii) Find force exerted on $I_1 dl_1$ by $I_2 dl_2$. **(08 Marks)**

Module-5

9 a. Define Faraday's law. Derive Maxwell's equation from Faraday's law in point form. **(07 Marks)**

b. Let $\mu = 3 \times 10^{-5}$H/m, $\epsilon = 1.2 \times 10^{-10}$F/m, and $\sigma = 0$ everywhere. If $\vec{H} = 2\cos(10^{10}t - \beta x)a_z A/m$, use Maxwell's equations to obtain expressions for $\vec{D}$ and $\vec{E}$ **(06 Marks)**

c. Derive wave equations in free space for a uniform plane wave. **(07 Marks)**

OR

10 a. State and prove Poynting's theorem. **(08 Marks)**

b. Discuss wave propagation in good conductor. **(07 Marks)**

c. A certain lossless material has $\mu_r = 4$ and $\epsilon_r = 9$. A 10MHz uniform plane wave is propagating in the α_y direction with $E_{x_0} = 400V/m$ and $E_{y_0} = E_{z_0} = 0$ at P(0.6,0.6,0.6) at $t = 60$ns. Find 'β', λ, v_p and η. **(05 Marks)**

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