CBCS SCHEME

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15MAT31

Third Semester B.E. Degree Examination, July/August 2021
Engineering Mathematics – III

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions.

1 a. Obtain the Fourier series for the function,

$$f(x)=\begin{cases}1+\dfrac{2x}{\pi} & -\pi\le x\le 0\\ 1-\dfrac{2x}{\pi} & 0\le x\le \pi\end{cases}$$

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

b. Find the constant term and first two harmonics in the Fourier series for f(x) given by the following table:

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

(08 Marks)

2 a. Expand $f(x)=\sqrt{1-\cos x}$ in $0\le x\le 2\pi$ in a Fourier series. Evaluate $\frac{1}{1.3}+\frac{1}{3.5}+\frac{1}{5.7}+.....$ **(08 Marks)**

b. Obtain the Fourier series for f(x) = |x| in (–ℓ, ℓ) and hence evaluate $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+.....=\frac{\pi^2}{8}$ **(08 Marks)**

3 a. Find the Fourier transform of $f(x)=\begin{cases}1-|x| & \text{for} & |x|\le 1\\ 0 & \text{for} & |x|>1\end{cases}$ and hence deduce that $\int_0^\infty \frac{\sin^2 t}{t^2}dt$ **(06 Marks)**

b. Find the Fourier sine transform of $e^{-|x|}$. Hence show that $\int_0^\infty \frac{x\sin mx}{1+x^2}dx=\frac{\pi}{2}e^{-m}$ where m > 0. **(05 Marks)**

c. Find the z-transform of (i) $(2n-1)^2$ (ii) $\cos\left(\frac{n\pi}{2}+\frac{\pi}{4}\right)$ **(05 Marks)**

4 a. Find the Fourier transform of $f(n)=\begin{cases}1 & |x|\le 1\\ 0 & |x|>a\end{cases}$. Hence deduce $\int_0^\infty \frac{\sin ax}{x}dx$. **(06 Marks)**

b. Find the inverse z-transform of $\frac{4z^2-2z}{z^3-5z^2+8z-4}$. **(05 Marks)**

c. Solve the differential equation $u_{n+2}+6u_{n+1}+9u_n=2^n$ with $u_0 = u_1 = 0$ using z-transform method. **(05 Marks)**

5 a. Find the coefficient of correlation and the two lines of regression for the following data:

x	1	3	4	2	5	8	9	10	13	15
y	8	6	10	8	12	16	16	10	32	32

(06 Marks)

b. Fit a curve of the form $y = ae^{bx}$ to the following data:

x	77	100	185	239	285
y	2.4	3.4	7.0	11.1	19.6

(05 Marks)

c. Use Regula Falsi method, find the root of the equation $x^2 - \log_e x - 12 = 0$. (05 Marks)

6 a. The two regression equations of the variables x and y are x = 19.13 − 0.87y and y = 11.64 − 0.5x. Find:
(i) Means of x
(ii) Means of y
(iii) The correlation coefficient (06 Marks)

b. Fit a parabola $y = a + bx + cx^2$ to the following data:

x	−3	−2	−1	0	1	2	3
y	4.63	2.11	0.67	0.09	0.63	2.15	4.58

(05 Marks)

c. Use Newton-Raphson method to find the real root of $3x = \cos x + 1$, take $x_0 = 0.6$ perform 2 iterations. (05 Marks)

7 a. Find the cubic polynomial by using Newton forward interpolating formula which takes the following values.

x	0	1	2	3
y	1	2	1	10

(06 Marks)

b. Apply Lagrange's formula inversely to obtain a root of the equation f(x) = 0 given that f(30) = −30, f(34) = −13, f(38) = 3, f(42) = 18. (05 Marks)

c. Use Weddle's rule to evaluate $\int_0^{\pi/2} \sqrt{\cos\theta}\, d\theta$ dividing the interval $\left[0, \frac{\pi}{2}\right]$ into six equal parts. (05 Marks)

8 a. A survey conducted in a slum locality reveals the following interpolating information as classified below:

Income/day in rupees : x	Under 10	10-20	20-30	30-40	40-50
Number of persons : y	20	45	115	210	115

Estimate the probable number of persons in the income group 20 to 25. (06 Marks)

b. Using Newton divided difference formula fit an interpolating polynomial for the following data:

x	0	1	4	5
f(x)	8	11	68	123

(05 Marks)

c. Using Simpson's 1/3rd rule evaluate $\int_0^1 \frac{x^2}{1+x^3} dx$ taking four equal strips. (05 Marks)

9 a. Find the extremal of the functional $I = \int_0^{\pi/2} (y^2 - y'^2 - 2y\sin x)dx$ under the conditions $y(0) = y\left(\frac{\pi}{2}\right) = 0$. **(06 Marks)**

b. If $\vec{F} = x^2 i + xyj$ evaluate $\int_C \vec{F}.d\vec{r}$ from (0, 0) to (1, 1) along

(i) the line $y = x$ (ii) the parabola $y = \sqrt{x}$ **(05 Marks)**

c. Find the curve passing through the points (x_1, y_1) and (x_2, y_2) which when rotated about the x-axis gives a minimum surface area. **(05 Marks)**

10 a. Verify Green's theorem in a plane for $\oint_C (3x^2 - 8y^2)dx + (4y - 6xy)dy$ where c is the boundary of the region enclosed by $y = \sqrt{x}$ and $y = x^2$. **(06 Marks)**

b. Using divergence theorem evaluate $\int \vec{A} \cdot \hat{n}\, ds$ where $\vec{A} = x^3 i + y^3 j + z^3 k$ and s is the surface of the surface $x^2 + y^2 + z^2 = a^2$. **(05 Marks)**

c. Find the geodesics on a surface given that the arc length on the surface is $s = \int_{x_1}^{x_2} \sqrt{x(1 + y'^2)}dx$. **(05 Marks)**

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CBCS SCHEME

USN

15EE32

Third Semester B.E. Degree Examination, July/August 2021
Electric Circuit Analysis

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions.***

1 a. Define Ideal and practical voltage and current sources with the help of neat circuit diagram and characteristic curves. **(04 Marks)**

b. Find the equivalent Resistance between terminals A and B using Y-Δ transformation in the network shown in Fig Q1(b).

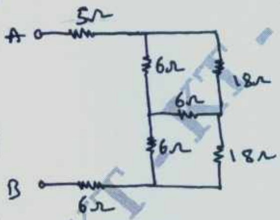

Fig Q1(b) **(06 Marks)**

c. Using mesh current analysis find the value of V_2 such that current through 4Ω resistance in zero.

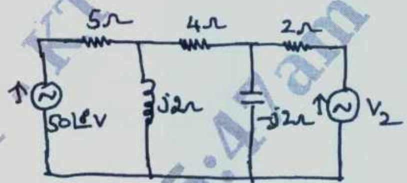

Fig Q1(c) **(06 Marks)**

2 a. For the Network shown in Fig Q2(a) find node voltage V_d and V_c

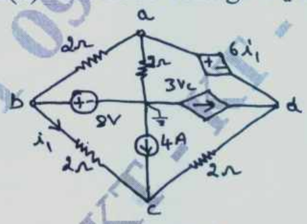

Fig Q2(a) **(08 Marks)**

b. With respect to series Resonant circuit define i) Resonant frequency (f_r) ii) Half power frequencies. **(04 Marks)**

c. For the network shown in Fig Q2(c) draw the dual circuit. Also write nodal equations for the dual network.

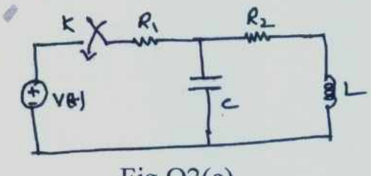

Fig Q2(c) **(04 Marks)**

3 a. State and explain Thevenin's theorem. **(05 Marks)**

b. Using Millman's Theorem find the current through $R_L = 10\Omega$ in the circuit shown in Fig Q3(b)

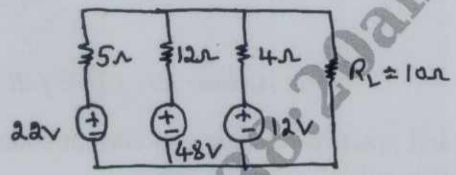

Fig Q3(b) **(05 Marks)**

c. Verify Reciprocity theorem for the circuit shown in Fig Q3(c).

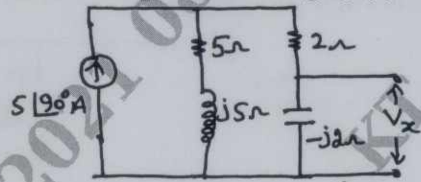

Fig Q3(c) **(06 Marks)**

4 a. State and Prove maximum power Transfer theorem for D.C circuits. **(05 Marks)**

b. In the circuit shown in Fig Q4(b). Find the value the current 667Ω resistor using Norton's theorem.

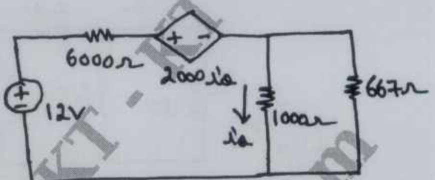

Fig Q4(b) **(06 Marks)**

c. Using super Position Theorem find the current through 2Ω resistor in Fig Q4(c).

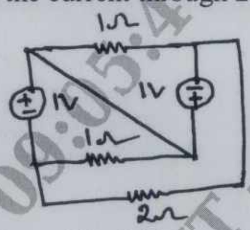

Fig Q4(c) **(05 Marks)**

5 a. Using classical method find and sketch i(t) for t > 0 in the circuit shown in Fig 5(a)

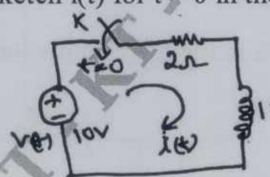

Fig Q5(a) **(08 Marks)**

b. In the network shown in Fig Q5(b) V = 10V, R = 10Ω, L = 1H, C = 10μF and $V_c(0) = 0$. Find $i(0^+)$, $\frac{di(0^+)}{dt}$ and $\frac{d^2i(0^+)}{dt^2}$, if switches is closed at t = 0

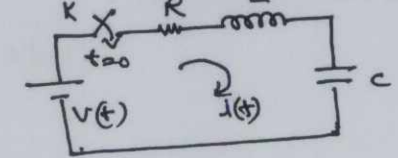

Fig Q5(b) **(08 Marks)**

6 a. In the circuit shown in Fig Q6(a) the switch 'S' is moved from 'a' to 'b' at t = 0. Find i, $\frac{di}{dt}$ and $\frac{d^2i}{dt^2}$ at $t = 0^+$. If $R = 1\Omega$, L = H, $C = 0.1\mu F$ and V = 100V, Assuming steady state has been achieved with switch 'S' at 'a'.

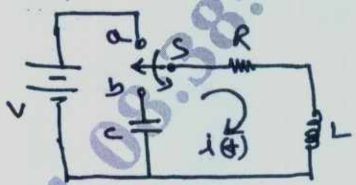

Fig Q6(a) **(08 Marks)**

b. Find and sketch voltage across capacitor $V_c(t)$ for $t \geq 0$ in the circuit shown in Fig Q6(b)

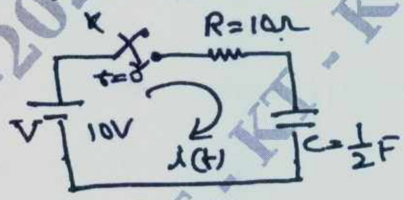

Fig Q6(b) **(08 Marks)**

7 a. Using convolution Integrals find the inverse Laplace transform of the following functions

i) $F(s) = \frac{1}{s(s+1)}$ ii) $F(s) = \frac{1}{(s-a)^2}$. **(08 Marks)**

b. Using Laplace transformation method find the expression for current i(t) when switch 'K' is closed at t = 0 in the network in Fig Q7(b).

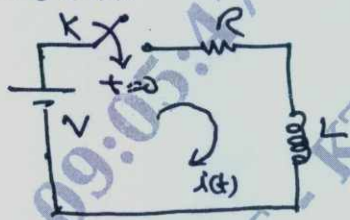

Fig Q7(b) **(08 Marks)**

8 a. State and prove Initial value theorem and find value theorem. **(08 Marks)**

b. Find the Laplace transform of i) $\delta(t)$ ii) e^{-at}. **(04 Marks)**

c. Find the Laplace Transform of saw tooth waveform shown in Fig Q8(c)

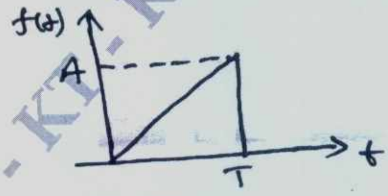

Fig Q8(c) **(04 Marks)**

9 a. A delta connected three phase load with the impedances of $(28 + j0)\Omega$, $(25 + J45)\Omega$ and $(0 - J65)\Omega$ are connected across a 3 phase 230V, 50Hz symmetrical RYB supply. Find the line and phase currents in magnitude and phase. Draw the necessary circuit diagram. **(08 Marks)**

b. Define Poles and Zeros of network functions. **(04 Marks)**

c. Determine Z-parameters for the circuit shown in Fig Q9(c)

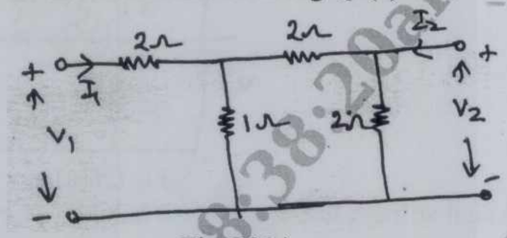

Fig Q9(c) **(04 Marks)**

10 a. Find out transmission parameters for the network shown in Fig Q10(a).

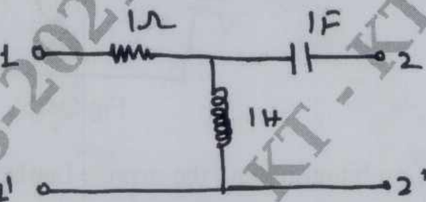

Fig Q10(a) **(08 Marks)**

b. For the network shown in Fig Q10(b) find the driving point function Z(s) and plot the poles and zeros on s-plane.

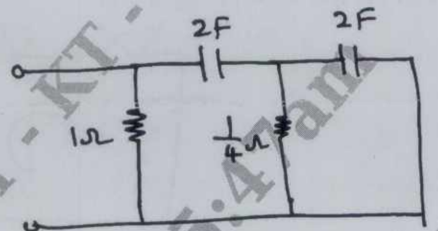

Fig Q10(b) **(08 Marks)**

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15EE34

Third Semester B.E. Degree Examination, July/August 2021
Analog Electronics Circuits

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions.***

1 a. What is transistor biasing? With neat circuit diagram, explain emitter stabilized bias, write the necessary equations. **(06 Marks)**

b. Explain the operation of positive clamper circuit. **(05 Marks)**

c. Analyze the circuit shown in Fig Q1(c), and draw the output waveforms. Assume $V_k = 0.7V$.

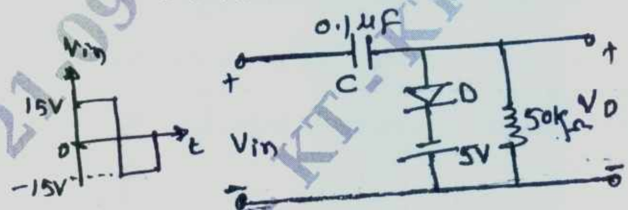


Fig Q1(c) **(05 Marks)**

2 a. Explain the operation of two way parallel symmetrical clipper circuit, draw its transfer characteristics, input and output waveforms. **(06 Marks)**

b. Explain the transistor switching circuit being used as an inverter. **(05 Marks)**

c. Explain the transistor inverter shown in below Fig Q2(c), determine the values of R_B and R_c. Take $I_c(sat) = 12mA$, $\beta_{dc} = h_{FE} = 200$.

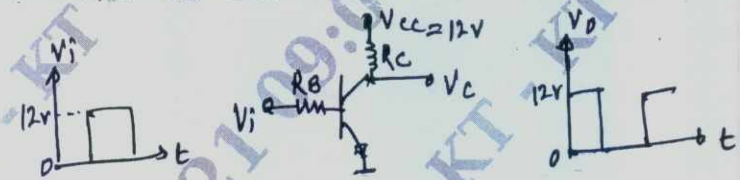


Fig Q2(c) **(05 Marks)**

3 a. Define h- parameter. Draw the h-parameter models of CE, CB and CC transistor configurations. **(06 Marks)**

b. For the emitter follower circuit shown in Fig Q3(b), calculate Z_i, Z_0, A_V and A_I.

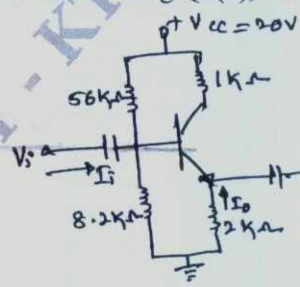


Fig Q3(b)

Take $\beta = 200$, $h_{ie} = 1.1K$, $h_{re} = 2.5 \times 10^{-4}$, $h_{fe} = 50$, $h_{oe} = 24\ \mu A/V$. **(10 Marks)**

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

b. An amplifier consists of 3identical stages in cascade the bandwidth of overall amplifier extends from 20Hz to 20KHz. Calculate the bandwidth of individual stage. **(06 Marks)**

5 a. What are the advantages and cascading amplifiers? Obtain the expression of overall voltage gain for 3-stages cascaded amplifier. **(06 Marks)**

b. With block diagram, explain the concept of feedback amplifier. **(06 Marks)**

c. Write the advantages of negative feedback in amplifier. **(04 Marks)**

6 a. With necessary equivalent circuit, derive on expression for Z_i, A_V and A_I for Darlington emitter follower circuit. **(10 Marks)**

b. Mention the types of feedback connections. Draw their block diagram indicating input and output signals. **(06 Marks)**

7 a. Explain the operation of the transformer coupled class A power amplifier, derive its maximum efficiency. **(08 Marks)**

b. What is Brakhansen criterian? Explain how oscillations start in an oscillator. **(04 Marks)**

c. A power amplifier has harmonics distortions $D_2 = 0.1$, $D_3 = 0.02$, $D_4 = 0.01$, the fundamental current $I = 4A$ and $R_L = 8\Omega$. Calculate the i) Total harmonic distortion ii) fundamental power iii) Total power. **(04 Marks)**

8 a. Draw the circuit diagram and explain the operation of a class B push pull amplifier with relevant waveforms, derive its maximum conversion efficiency is 78.5%. **(07 Marks)**

b. With the help of neat circuit diagram, explain the operation of transistor colpitts oscillator. Write the expression for the frequency of oscillation. **(05 Marks)**

c. A quartz crystal has the following constants $L = 50mH$, $C_1 = 0.02pF$, $R = 500\Omega$ and $C_2 = 12pF$, find series and parallel resonant frequency. **(04 Marks)**

9 a. With relevant diagram and V-I characteristics, explain the operation of JFET. **(07 Marks)**

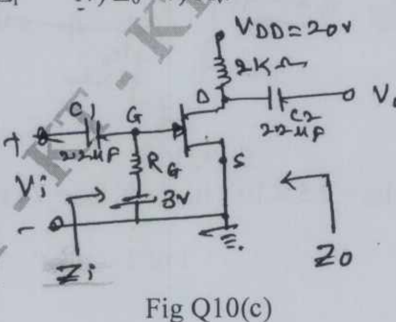
b. Discuss the differences between FET and BJT. **(05 Marks)**

c. Calculate the trans-conductance g_m of a JFET having values of $I_{DSS} = 12mA$ and $V_P = -4V$ at bias points i) $V_{GS} = 0V$ ii) $V_{GS} = -1.5V$. **(04 Marks)**

10 a. Explain the operation of common source JFET amplifier using fixed bias configuration. Write the equation of Z_i, Z_0 and A_v. **(06 Marks)**

b. Give the comparison between JFET and MOSFET. **(05 Marks)**

c. For the JFET amplifier shown in below Fig Q10(c). Calculate:
i) g_m ii) r_d iii) Z_i iv) Z_0 v) A_v.



$I_{DSS} = 5mA$
$V_P = -6V$
$Y_{DS} = 40\mu s$
$V_{GSQ} = -3V$
$R_G = 2m\Omega$

Fig Q10(c)

(05 Marks)

CBCS SCHEME

USN | | | | | | | | | | | **15EE35**

Third Semester B.E. Degree Examination, July/August 2021
Digital System Design

Time: 3 hrs.   Max. Marks: 80

Note: ***Answer any FIVE full questions.***

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.

1 a. Express the following equations into proper canonical forms and in decimal notations
i) $F_1(a, b, c) = a\overline{b} + a\overline{c} + bc$
ii) $f_2\ (A, B, C) = \overline{A}\,\overline{B} + C$. **(06 Marks)**

b. Simply the following equations using K Map and implement using logic gates
i) $f(a, b, c, d) = \pi M\ (0, 3, 4, 7, 8, 10, 12, 14) + d\ (2, 6)$
ii) $f(w, x, y, z) = \Sigma m(0, 2, 8, 10, 11, 12, 14, 15)$ **(10 Marks)**

2 a. Simplify using Quine Mc Cluskey method.
$P = f(a, b, c, d) = \Sigma m(2, 3, 4, 5, 13, 15) + \Sigma(8, 9, 10, 11)$. **(10 Marks)**

b. Solve using 3 variable MEV Kmap with d as MEV.
$f(a, b, c, d) = \Sigma m\ (0, 1, 3, 5, 6, 11, 13) + d(4, 7)$. **(06 Marks)**

3 a. What is a magnitude comparator? Design a 2 bit binary comparator. **(10 Marks)**

b. Realize the following function using 8:1MUX with a, b, c as select lines
$f(a, b, c, d) = \Sigma m(0, 1, 5, 6, 7, 9, 10, 15)$ **(06 Marks)**

4 a. Write the function table and draw the interfacing diagram of ten key keypad interfaces to a digital system using decimal to BCD encoder. **(08 Marks)**

b. Using active high output 3:8 line decoder, implement the following functions.
$F_1\ (A, B, C, D) = \Sigma m(0, 1, 2, 5, 7, 11, 15)$ and $f_2 = (A, B, C, D) = \pi(3, 7, 9, 13)$. **(08 Marks)**

5 a. Explain the working of Master Slave JK flip-flop with the help of logic diagram, function table, logic symbol and timing diagram. **(10 Marks)**

b. Obtain the characteristics equation of JK flip-flop and T flip-flop. **(06 Marks)**

6 a. Design a synchronous Mod 6 counter using JK flip-flop. **(08 Marks)**

b. Design a 4bit register using positive edge triggered DFF to operate as indicated in the table below.

Mode a_1	Select a_0	Register Operation
0	0	Hold
0	1	Clear
1	0	Complement
1	1	Circular right shift

(08 Marks)

7 a. Compare Mealy and Moore models of a clocked synchronous sequential circuit. **(04 Marks)**

b. Construct the excitation table, transition table and state diagram for the Moore sequential logic circuit given below in Fig Q7(b).

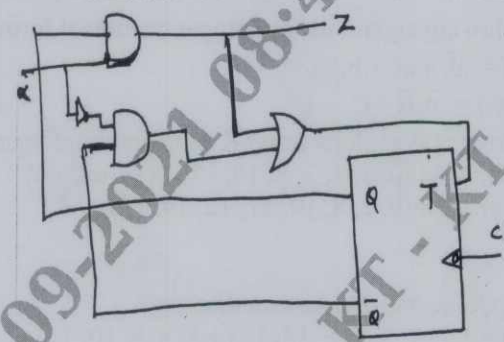


Fig Q7(b) **(12 Marks)**

8 a. Construct a sequential logic circuit single input single output by obtaining the state and excitation table for the given diagram using JK flip – flop. (Ref. Q8(a)

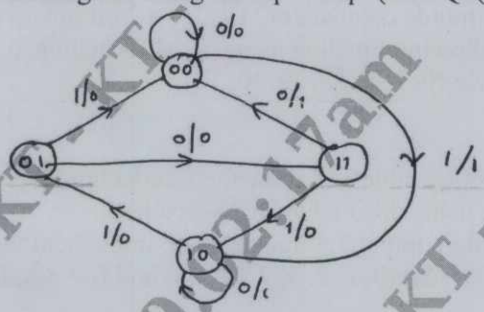


Fig Q8(a) **(10 Marks)**

b. Draw the state diagram for a sequence detector to detect the sequence 110. **(06 Marks)**

9 a. Explain the structure of VHDL module and verilog module with an example of half adder. **(08 Marks)**

b. Explain shift operators of VHDL and verilog with an example of 4bit vector 1101. **(08 Marks)**

10 a. Draw the block diagram of a 4bit look ahead carry adder and write the data flow description for its boolean functions in verilog. **(08 Marks)**

b. Draw the logic diagram, of a D latch and write the VHDL code description. **(08 Marks)**

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CBCS SCHEME

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15EE36

Third Semester B.E. Degree Examination, Aug./Sept.2020
Electrical and Electronic Measurements

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. Derive the dimensional equation for
(i) EMF
(ii) Magnetizing force
(iii) Capacitance in the SI units **(06 Marks)**

b. Expression for mean torque of an electrodynamometer type of wattmeter is given by
$T_d \alpha M^a E^b Z^c$
M = Mutual inductance between fixed and moving coils.
E = Applied voltage
Z = Impedance of load circuit.
Determine values of a, b and c using dimensional analysis. **(06 Marks)**

c. Write about sources and detectors used in A.C. bridges. **(04 Marks)**

OR

2 a. Explain in brief fall of potential method for earth resistance measurement. **(06 Marks)**

b. Explain how capacitance is measured using Schering bridge. **(05 Marks)**

c. The bridge is shown in Fig.Q2(c).

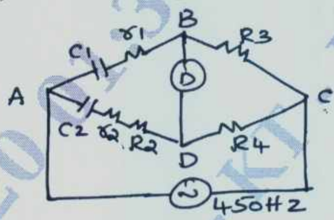

Fig.Q2(c)

At balance $R_2 = 4.8\ \Omega$, $R_3 = 200\ \Omega$, $R_4 = 2850\ \Omega$, $C_2 = 0.5\ \mu F$, $r_2 = 0.4\ \Omega$. Calculate the value of C_1 and r_1 **(05 Marks)**

Module-2

3 a. Explain in brief low power factor wattmeter. **(06 Marks)**

b. Explain the adjustments to be made in single phase energy meter. **(04 Marks)**

c. The constant of an energy meter is 750 rev/KWH. Calculate the number of revolutions made by it, when connected to a load carrying 100A at 230V and 0.8 power factor in 30 seconds. If it makes 110 revolutions in 30 seconds, find the percentage error. **(06 Marks)**

OR

4 a. Explain how 3-ϕ reactive power is measured. **(05 Marks)**

b. Explain the method of calibration of single phase energy meter. **(05 Marks)**

c. With a neat figure explain Weston frequency meter. **(06 Marks)**

Module-3

5 a. Explain construction of CT with its phasor diagram. (08 Marks)
b. With figure, explain the measurement of flux density. (08 Marks)

OR

6 a. List and explain the advantages of Instrument transformers. (08 Marks)
b. Explain measurement of iron loss by Wattmeter method. (08 Marks)

Module-4

7 a. Write the advantages of electronic instruments. (04 Marks)
b. Explain with neat figure TRUE RMS reading voltmeter. (06 Marks)
c. Explain the operation of successive approximation type of digital voltmeter. (06 Marks)

OR

8 a. With neat figure explain Ramp type Digital Voltmeter. (06 Marks)
b. Write a note on Q meter. (04 Marks)
c. With block diagram explain principle of working of electronic energy meter. (06 Marks)

Module-5

9 a. With a neat figure explain Cathode Ray tube. (08 Marks)
b. With a neat sketch, explain the working of X-Y recorder. (08 Marks)

OR

10 a. With figure explain the working principle of Nixie tube. (08 Marks)
b. Explain the Galvanometer type recorder. (08 Marks)

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CBCS SCHEME

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15MATDIP31

Third Semester B.E. Degree Examination, July/August 2021

Additional Mathematics - I

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions.***

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.

1 a. Express $\dfrac{(3+i)(1-3i)}{(2+i)}$ in the form x + iy. **(06 Marks)**

b. Find the modulus and amplitude of the complex number $1+\cos\alpha + i\sin\alpha$. **(05 Marks)**

c. If $\vec{a} = \hat{i} + 2\hat{j} - 2\hat{k}$, $\vec{b} = -\hat{i} + 2\hat{j} + \hat{k}$, $\vec{c} = \hat{i} - 2\hat{j} + 2\hat{k}$, then find $\vec{a} \times (\vec{b} \times \vec{c})$. **(05 Marks)**

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

b. Find the cube root of $1 + i\sqrt{3}$. **(05 Marks)**

c. Show that the vectors $\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}$, $\vec{b} = -2\hat{i} + 3\hat{j} - 4\hat{k}$ and $\vec{c} = \hat{i} - 3\hat{j} + 5\hat{k}$ are coplanar. **(05 Marks)**

3 a. Find the n^{th} derivative of $e^{ax}\sin(bx+c)$. **(06 Marks)**

b. With usual notations prove that $\tan\phi = r \cdot \frac{d\theta}{dr}$. **(05 Marks)**

c. If $u = \tan^{-1}\left(\dfrac{x^3+y^3}{x-y}\right)$ then show that $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y} = \sin 2u$. **(05 Marks)**

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

b. Find the angle between the curves $r = a(1+\cos\theta)$ and $r = b(1-\cos\theta)$. **(05 Marks)**

c. Given $u = x^2+y^2+z^2$, $v = xy+yz+zx$, $w = x+y+z$, find $\dfrac{\partial(u,v,w)}{\partial(x,y,z)}$. **(05 Marks)**

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

b. Evaluate $\int_0^{\pi/16} \cos^5(8x)\sin^6(16x)\,dx$. **(05 Marks)**

c. Evaluate $\int_1^2\int_1^3 x y^2 \,dx\,dy$. **(05 Marks)**

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

b. Evaluate $\int_0^{\pi} \dfrac{\sin^4\theta}{(1+\cos\theta)^2}\,d\theta$. **(05 Marks)**

c. Evaluate $\int_{-3}^{3}\int_0^1\int_1^2 (x+y+z)\,dx\,dy\,dz$. **(05 Marks)**

7 a. Find velocity and acceleration of a particle moving along the curve $\vec{r} = e^{-2t}\,\hat{i} + 2\cos 5t\,\hat{j} + 5\sin t\,\hat{k}$ at anytime t. Find their magnitudes at t = 0. **(06 Marks)**

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

c. Show that $\vec{F} = (x + 3y)\,\hat{i} + (y - 3z)\,\hat{j} + (x - 2z)\,\hat{k}$ is Solenoidal. **(05 Marks)**

8 a. Find the unit tangent vector of the space curve $\vec{r} = \cos t\,\hat{i} + \sin t\,\hat{j} + t\,\hat{k}$. **(06 Marks)**

b. If $\vec{F} = x^2y\,\hat{i} + yz^2\,\hat{j} + zx^2\,\hat{k}$, then find div (curl $\vec{F}$). **(05 Marks)**

c. Find the constants a, b and c such that the vector $\vec{F} = (x + y + az)\,\hat{i} + (x + cy + 2z)\,\hat{j} + (bx + 2y - z)\,\hat{k}$ is irrotational. **(05 Marks)**

9 a. Solve $\dfrac{dy}{dx} = 1 + y/x + \left(y/x\right)^2$. **(06 Marks)**

b. Solve $\dfrac{dy}{dx} + y\cot x = \sin x$. **(05 Marks)**

c. Solve $\dfrac{dy}{dx} = \dfrac{x^2 - 2xy}{x^2 - \sin y}$. **(05 Marks)**

10 a. Solve $(2x^3 - xy^2 - 2y + 3)dx - (x^2y + 2x)dy = 0$. **(06 Marks)**

b. Solve $(1 + xy)y\,dx + (1 - xy)\,x\,dy = 0$. **(05 Marks)**

c. Solve $x\dfrac{dy}{dx} + y = x^3y^6$. **(05 Marks)**

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