**CBCS SCHEME**

USN | | | | | | | | | | |  **15MAT31**

## Third Semester B.E. Degree Examination, Aug./Sept. 2020
## Engineering Mathematics – III

Time: 3 hrs. Max. Marks: 80

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





### Module-1

1 a. Obtain the Fourier series of $f(x) = x(2\pi - x)$ in $0 \le x \le 2\pi$ and hence deduce that :

$$\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots.$$ (08 Marks)

b. Express y as a Fourier series upto the second harmonics given :

| | | | | | | |
|---|---|---|---|---|---|---|
| x | 0 | 1 | 2 | 3 | 4 | 5 |
| y | 4 | 8 | 15 | 7 | 6 | 2 |

(08 Marks)

**OR**

2 a. Obtain the Fourier series for $f(x) = e^{-x}$ in the interval $0 < x < 2$. (06 Marks)

b. Expand the function $f(x) = x\sin x$ as a Fourier series in the interval $-\pi \le x \le \pi$. (05 Marks)

c. Expand $f(x) = 2x - 1$ as a cosine half range Fourier series in $0 \le x < 1$. (05 Marks)

### Module-2

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 $\int_0^{10} \frac{\sin^2 t}{t^2} dt = \frac{\pi}{2}$ (06 Marks)

b. Find the Fourier cosine transform of

$$f(x) = \begin{cases} x & 0 < x < 2 \\ 0 & \text{else where} \end{cases}$$ (05 Marks)

c. Find the z – transform of : i) $\cos n\theta$ ii) $\sin n\theta$. (05 Marks)

**OR**

4 a. Obtain the Fourier transform of $f(x) = x e^{-|x|}$. (06 Marks)

b. If $u(z) = \frac{2z^2 + 3z}{(z+2)(z-4)}$, find the inverse z-transform. (05 Marks)

c. Solve the difference equation $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ with $y_0 = y_1 = 0$ using z – transforms. (05 Marks)

## Module-3

5 a. Compute the co-efficient of correlation and equation of lines of regression for the data :

| x | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| y | 9 | 8 | 10 | 12 | 11 | 13 | 14 |

**(06 Marks)**

b. Fit a best fitting parabola $y = ax^2 + bx + c$ for the following data :

| x | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| y | 10 | 12 | 13 | 16 | 19 |

**(05 Marks)**

c. Use the Regula – Falsi method to find a real root of the equation $x^3 - 2x - 5 = 0$ correct to three decimal places. **(05 Marks)**

**OR**

6 a. Find the co-efficient of correlation for the following data :

| x | 10 | 14 | 18 | 22 | 26 | 30 |
|---|---|---|---|---|---|---|
| y | 18 | 12 | 24 | 6 | 30 | 36 |

**(06 Marks)**

b. Fit a least square geometric curve $y = ae^{bx}$ for the following data :

| x | 0 | 2 | 4 |
|---|---|---|---|
| y | 8.12 | 10 | 31.82 |

**(05 Marks)**

c. Use Newton – Raphson method to find a real root of the equation : $x \log_{10}^{x} = 1.2$ correct to four decimal places that is near to 2.5. **(05 Marks)**

## Module-4

7 a. From the following table find the number of students who have obtained :
i) Less than 45 marks
ii) Between 40 and 45 marks.

| Marks | 30 – 40 | 40 – 50 | 50 – 60 | 60 – 70 | 70 – 80 |
|---|---|---|---|---|---|
| Number of students | 31 | 42 | 51 | 35 | 31 |

**(06 Marks)**

b. Find the Legrange's interpolation polynomial for the following values y(1) = 3, y(3) = 9, y(4) = 30 and y(6) = 132. **(05 Marks)**

c. Evaluate $\int_0^1 \frac{dx}{1+x}$ taking seven ordinates by applying Simpson's $\frac{3}{8}^{th}$ rule. **(05 Marks)**

**OR**

8 a. Give $u_{20} = 24.37$, $u_{22} = 49.28$, $u_{29} = 162.86$ and $u_{32} = 240.5$ find $u_{28}$ by Newton's divided difference formula. **(06 Marks)**

b. Extrapolate for 25.4 given the data using Newton's backward formula :

| x | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|
| y | 91 | 100.25 | 110 | 120.25 | 131 |

**(05 Marks)**

## Module-5

9 a. Verify Green's theorem for $\oint_C (xy + y^2)dx + x^2 dy$ where C is the closed curve of the region bounded by y = x and y = $x^2$. (06 Marks)

b. Derive Euler's equation in the form $\frac{\partial f}{\partial y} - \frac{d}{dx}\left(\frac{\partial f}{\partial y^1}\right) = 0$. (05 Marks)

c. If $\vec{F} = xyi + yzj + zxk$ evaluate $\int_C \vec{F} \cdot d\vec{r}$ where C is the curve represented by x = t, y = $t^2$, $z = t^3, -1 \le t \le 1$. (05 Marks)

**OR**

10 a. Verify Green's theorem in the plane for $\int_C (x^2 + y^2)dx + 3x^2 y\, dy$ where C is the circle $x^2 + y^2 = 4$ traced in the positive sence. (06 Marks)

b. Evaluate $\int_C (xydx + xy^2dy)$ by Stoke's theorem C is the square in the x-y plane with the vertices (1, 0), (–1, 0), (0, 1) and (0, 1). (05 Marks)

c. Prove that the geodesics on a plane are straight lines. (05 Marks)

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# CBCS SCHEME

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**15MATDIP31**

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

Time: 3 hrs. Max. Marks: 80

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

### Module-1

1 a. Express $\frac{5+2i}{5-2i}$ in the form $xi + iy$. **(06 Marks)**

b. Find the modulus and amplitude of $\frac{(1+i)^2}{3+i}$ **(05 Marks)**

c. If $\vec{a} = (3, -1, 4)$, $\vec{b} = (1, 2, 3)$, $\vec{c} = (4, 2, -1)$ find $\vec{a} \times (\vec{b} \times \vec{c})$ **(05 Marks)**

**OR**

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

b. Find the sine of angle between $\vec{a} = 2i - 2j + k$ and $\vec{b} = i - 2j + 2k$ **(05 Marks)**

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

### Module-2

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

b. Find the angle between the radius vector and tangent to the curve $r = a(1 - \cos\theta)$ **(05 Marks)**

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

**OR**

4 a. Find the pedal equation of the curve $r = 2(1 + \cos\theta)$ **(06 Marks)**

b. Find the total derivative of $u = x^3y^2$, where $x = e^t$, $y = \log t$. **(05 Marks)**

c. Obtain the Maclaurin's series expansion of the function sin x. **(05 Marks)**

### Module-3

5 a. Evaluate $\int_0^{\pi} x\cos^6 x\, dx$ **(06 Marks)**

b. Evaluate $\int_0^1\int_0^3 x^3y^3\,dx\,dy$ **(05 Marks)**

c. Evaluate $\int_0^1\int_0^1\int_0^1 (x+y+z)\,dx\,dy\,dz$ **(05 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.

OR

6 a. Evaluate $\int_0^{\pi/2} \sin^6 x \cos^5 x \, dx$ using Reduction formula. **(06 Marks)**

b. Evaluate $\int_0^1 \int_x^{\sqrt{x}} xy \, dy \, dx$ **(05 Marks)**

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

## Module-4

7 a. A particle moves along the curve $\vec{r} = (t^3 - 4t)i + (t^2 + 4t)j + (8t^2 - 3t^3)k$. Determine the velocity and acceleration at $t = 2$. **(06 Marks)**

b. Find the directional derivative of $\phi = x^2yz + 4xz^2$ at $(1, -2, -1)$ in the direction of $2i - j - 2k$. **(05 Marks)**

c. Find the constants a and b, such that $\vec{F} = (axy + z^3)i + (3x^2 - z)j + (bxz^2 - y)k$ is irrotational. **(05 Marks)**

OR

8 a. Find the angle between the tangents to the curve $x = t^2 + 1$, $y = 4t - 3$, $z = 2t^2 - 6t$ at $t = 1$ and $t = 2$. **(06 Marks)**

b. Find $\text{div}\vec{F}$ and $\text{curl}\vec{F}$ where $\vec{F} = (3x^2 - 3yz)i + (3y^2 - 3xz)j + (3z^2 - 3xy)k$ **(05 Marks)**

c. Find 'a' for which $\vec{F} = (x + 3y)i + (y - 2z)j + (x + az)k$ is solenoidal. **(05 Marks)**

## Module-5

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

b. Solve $x^2 \frac{dy}{dx} = 3x^2 - 2xy + 1$ **(05 Marks)**

c. Solve $(x^2 + y)dx + (y^3 + x)dy = 0$ **(05 Marks)**

OR

10 a. Solve $\frac{dy}{dx} = e^{x-y} + x^2 e^{-y}$ **(06 Marks)**

b. Solve $x \frac{dy}{dx} = y + x \cos^2\left(\frac{y}{x}\right)$ **(05 Marks)**

c. Solve $(x^4 + y^2)dy = 4x^3 y \, dx$ **(05 Marks)**

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CBCS SCHEME

USN [ | | | | | | | | | ]  **15EC32**

# Third Semester B.E. Degree Examination, Aug./Sept. 2020
## 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. Derive an expression for $A_v$, $Z_i$ and $Z_0$ for CE fixed bias using hybrid equivalent model. **(08 Marks)**

b. With a neat circuit explain hybrid – $\pi$ model for a transistor in CE configuration. **(08 Marks)**

**OR**

2 a. Derive an expression for $Z_i$, $Z_0$ and $A_v$ for emitter – Follower configuration using $r_e$ model. **(08 Marks)**

b. For the network shown in Fig Q2(b). Determine :
i) $r_e$  ii) $Z_i$  iii) $Z_0$ ($r_0 = \alpha\Omega$)  iv) $A_V$ ($r_0 = \alpha\Omega$)  v) $A_i$ ($r_0 = \alpha\Omega$).

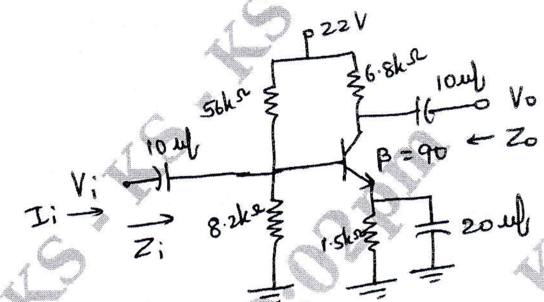


Fig Q2(b) **(08 Marks)**

## Module-2

3 a. Derive an expression for $Z_i$, $Z_0$ and $A_v$ of FET self bias configuration with bypassed $R_s$. **(08 Marks)**

b. Explain the construction and working principle of n-channel depletion type MOSFET and draw the characteristic curves. **(08 Marks)**

**OR**

4 a. The fixed bias configuration of Fig Q4(a) has an operating point defined by $V_{GSQ} = -2V$ and $I_{DQ} = 5.625mA$ with $I_{DSS} = 10mA$ and $V_P = -8V$. Determine :
i) $g_m$  ii) $r_d$  iii) $Z_i$  iv) $Z_0$  v) $A_V$.

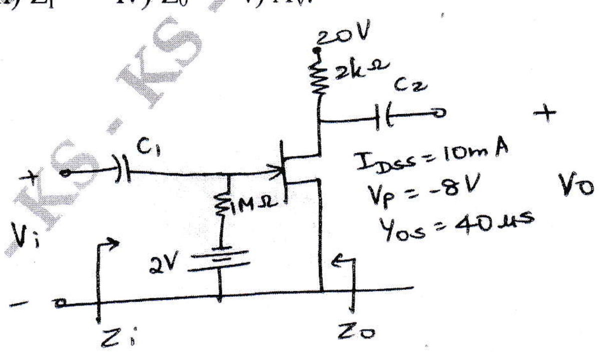


Fig Q4(a) **(08 Marks)**

b. Draw the JFET common drain configuration circuit. Derive $Z_i$, $Z_0$ and $A_v$ using small signal model. **(08 Marks)**

## Module-3

5 a. The i/p power to a device is 10,000w at a voltage of 1000V. The output power is 500W and the output impedance is 20Ω.
   i) Find power gain in db
   ii) Find voltage gain in db
   iii) Find input impedance. **(06 Marks)**

b. Describe Miller's effect and derive an equation for Miller input and output capacitance. **(10 Marks)**

**OR**

6 a. Explain high frequency response of FET amplifier. **(06 Marks)**

b. Determine $A_v$, $Z_i$, $A_{vs}$, $F_{LS}$ for the low frequency response of the BJT amplifier circuit shown in Fig Q6(b). Assume $r_0 = \alpha$.

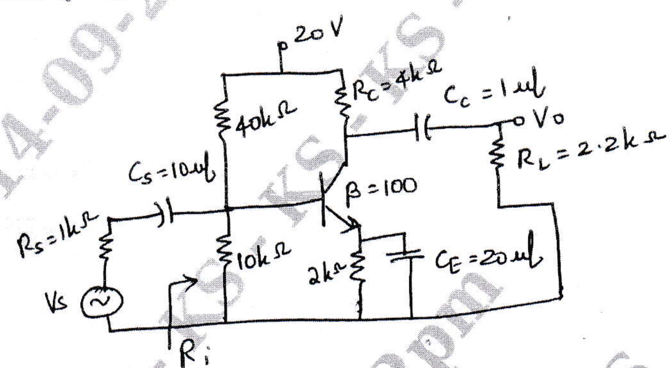


Fig Q6(b) **(10 Marks)**

## Module-4

7 a. Explain with neat circuit diagram the operation of transistor Colpitt's oscillator. **(08 Marks)**

b. What are the effects of negative feedback in an amplifier? Show how bandwidth of an amplifier increases with negative Feedback. **(08 Marks)**

**OR**

8 a. Mention the types of Feedback connections. Draw their block diagrams indicating i/p and o/p signal. **(08 Marks)**

b. With a neat circuit and waveforms, explain the working operation of UJT relaxation oscillator. **(08 Marks)**

## Module-5

9 a. Explain the operation of class B push pull amplifier and show that maximum conversion η is 78.5% **(10 Marks)**

b. The Following distortion readings are available for a power amplifier $D_2 = 0.1$, $D_3 = 0.02$, $D_4 = 0.01$ with $I_1 = 4A$, $R_c = 8Ω$.
   i) Calculate the THD
   ii) Determine the fundamental power component
   iii) Calculate the total power. **(06 Marks)**

**OR**

10 a. Explain series voltage regulator using transistor. **(08 Marks)**

b. Explain series Fed class A power amplifier. Show that its maximum conversion η is 25%. **(08 Marks)**

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# CBCS SCHEME

USN | | | | | | | | | | |  **15EC33**

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

Time: 3 hrs. Max. Marks: 80

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

### Module-1

1 a. i) Convert the following expression in standard SOP and also represent in decimal notation form f(A, B, C) = AC + BC + AB
ii) Convert the following expression in standard POS form and also represent in decimal notation f(A, B, C) = (A + B) (B + C) (A + C) **(08 Marks)**

b. Reduce the following using K-map and draw the logic diagram using NAND gates for the reduced expression: $f(a, b, c, d) = \sum m(6, 7, 9, 10, 13) + dc(1, 4, 5, 11, 15)$ **(08 Marks)**

**OR**

2 a. Reduce the following function using K-map technique and Implement using NOR-gates $f(a, b, c, d) = \pi M(0, 3, 4, 7, 8, 10, 12, 14) + dc(2, 6)$ **(06 Marks)**

b. Simplify the following using Quine-$M_C$ Cluskey method and draw the logic diagram using NAND gates for the reduced expression:
$f(w, x, y, z) = \sum m(1, 2, 3, 5, 9, 12, 14, 15) + \sum dc(4, 8, 11)$ **(10 Marks)**

### Module-2

3 a. Write and explain 2 to 4 decoder. **(06 Marks)**

b. Implement the following functions using ICS 74 × 138
$f_1(a, b, c, d) = \sum m(0, 4, 8, 10, 14, 15)$
$f_2(a, b, c, d) = \sum m(3, 7, 9, 13)$ **(10 Marks)**

**OR**

4 a. Implement the following Boolean function with 8:1 MUX
$F(A, B, C, D) = \sum m(0, 2, 6, 10, 11, 12, 13) + dc(3, 8, 14)$ **(08 Marks)**

b. Explain the look ahead carry generator. **(08 Marks)**

### Module-3

5 a. Write and explain JK Flip-Flop by Truth table and logic diagram. **(06 Marks)**

b. Write the excitation table of JK Flip-Flop. **(04 Marks)**

c. Write the characteristic equation of SR Flip-Flop. **(06 Marks)**

**OR**

6 a. Explain the Master-slave JKFF with logic diagram and truth table. **(10 Marks)**

b. Explain the Negative Edge triggered JK Flip-Flop. **(06 Marks)**

### Module-4

7 a. Write and explain parallel in serial out shift register by writing logic diagram and timing diagram. **(10 Marks)**

b. Write and explain 3-bit asynchrous counter. **(06 Marks)**

**OR**

8 a. Design a mod-6 synchronous counter using JK Flip-Flop. (10 Marks)
b. Write and explain counter applications. (06 Marks)

**Module-5**

9 a. Write the difference between Moore model and Mealy model. (06 Marks)
b. Design a mealy type sequence detector to detect a serial input sequence of 101. (10 Marks)

**OR**

10 a. Design a clocked sequence circuit that operates according to the state diagram shown in Fig.Q.10(a). Implement the circuit using D-Flip-Flop.

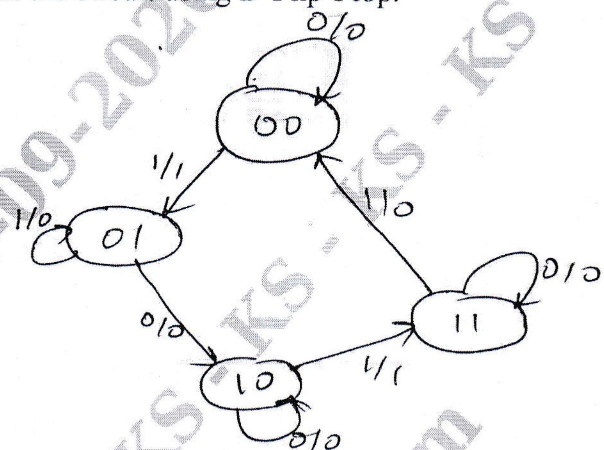


Fig.Q.10(a) State diagram

(08 Marks)

b. Obtain the transition table for the given state diagram shown in Fig.Q.10(b) and design the sequential network using JK Flip-Flop.

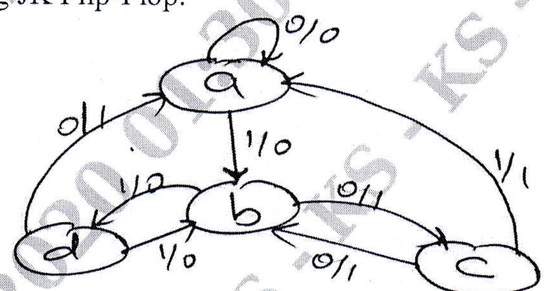


Fig.Q.10(b) State diagram

(08 Marks)

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# CBCS SCHEME

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

## Third Semester B.E. Degree Examination, Aug./Sept.2020
## 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 circuit shown in Fig.Q1(a) into single voltage source with series resistance between terminals A and B.

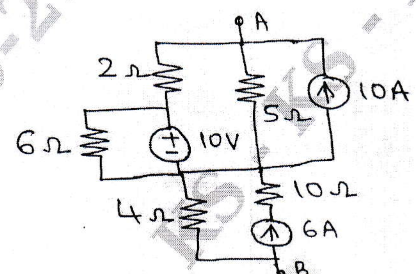


Fig.Q1(a) **(06 Marks)**

b. Using Mesh analysis, find the current $I_1$ for the circuit shown in Fig.Q1(b).

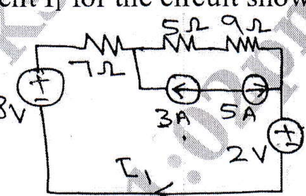


Fig.Q1(b) **(06 Marks)**

c. Explain the concept of Super node. **(04 Marks)**

**OR**

**2** a. Determine the resistance between terminals A and B of the circuit shown in Fig.Q2(a) using Star to Delta conversion.

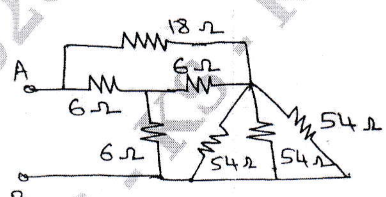


Fig.Q2(a) **(06 Marks)**

b. Using Nodal analysis, find the value of $V_x$ in the circuit shown in Fig.Q2(b), such that the current through $(2 + j3)\Omega$. Impedance is zero.

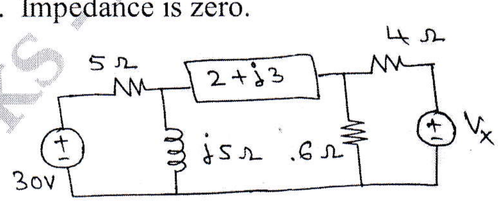


Fig.Q2(b) **(06 Marks)**

c. Explain the Dependent sources. **(04 Marks)**

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## Module-2

3 a. For the circuit shown in Fig.Q3(a), find the current through 20 Ω resistor using super position theorem.

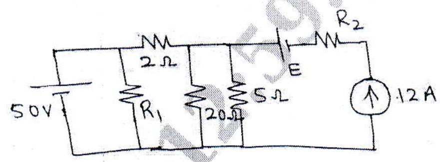


Fig.Q3(a) **(08 Marks)**

b. For ac circuits, prove that the maximum power deliver to load is $\frac{(V_{th})^2}{8R_{th}}$, where $V_{th}$ – Thevenin's equivalent voltage and $R_{th}$ – Thevenins equivalent resistance. **(08 Marks)**

**OR**

4 a. State the Millman's theorem. Using Millman's theorem, determine the current through (2+j2)Ω impedance for the network shown in Fig.Q4(a).

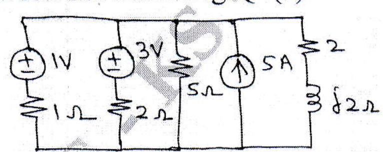


Fig.Q4(a) **(08 Marks)**

b. State the Thevinin's Theorem and obtain the Thevinin's equivalent circuit for the circuit shown in Fig.Q4(b).

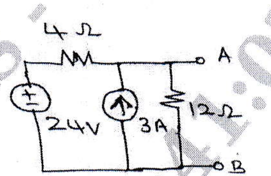


Fig.Q4(b) **(08 Marks)**

## Module-3

5 a. Explain the behavior of a inductor and capacitor under switching conditions in detail. **(08 Marks)**

b. The switch is changed from position to position 2 at t = 0. Steady State condition have been reached in position 1. Find the value i , $\frac{di}{dt}$ and $\frac{d^2i}{dt^2}$ at t = $0^+$ for the circuit shown in Fig.Q5(b).

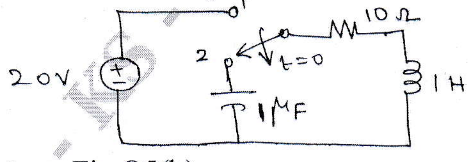


Fig.Q5(b) **(08 Marks)**

**OR**

6 a. Find the Laplace of f(t) shown in Fig.Q6(a).

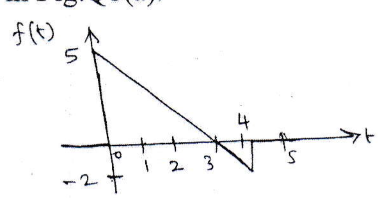


Fig.Q6(a) **(08 Marks)**

b. Find the impulse response of the circuit shown in Fig.Q6(b). Assuming that all initial conditions to be zero.

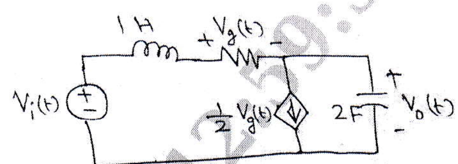


Fig.Q6(b) **(08 Marks)**

## Module-4

7 a. Derive the expression for frequency at which voltage across the capacitor is maximum of a series resonance circuit. **(08 Marks)**

b. Show that the circuit shown in Fig.Q7(b) can have more than one resonant condition.

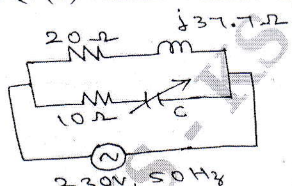


Fig.Q7(b) **(08 Marks)**

**OR**

8 a. Determine the parallel resonance circuit parameters whose response curve is shown in Fig.Q8(a). What are the new values of $W_r$ and bond width if 'c' is increased 4 times?

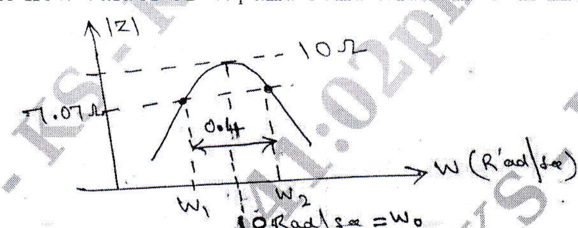


Fig.Q8(a) **(08 Marks)**

b. Prove that the bandwidth of a series resonance circuit $f_2 - f_1 = \dfrac{R}{2\pi L}$. **(08 Marks)**

## Module-5

9 a. Express the z-parameters in terms of Y-parameter. **(08 Marks)**

b. For the network shown in Fig.Q9(b), find the transmission parameters.

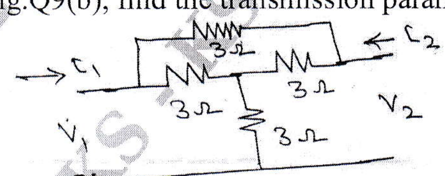


Fig.Q9(b) **(08 Marks)**

**OR**

10 a. Express the h-parameter in terms of Z-parameters. **(08 Marks)**

b. Find the z-parameter for the two-port network shown in Fig.Q10(b).

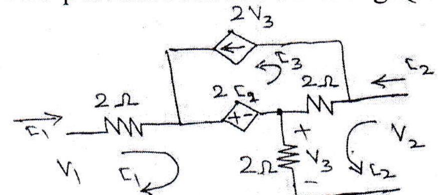


Fig.Q10(b) **(08 Marks)**

CBCS SCHEME

USN | | | | | | | | | | 15EC35

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

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. Explain the following with examples.
   i) Accuracy
   ii) Resolution
   iii) Significant Figures. **(06 Marks)**

b. Explain the working of True RMS voltmeter with the help of a suitable block diagram. **(08 Marks)**

c. What is loading effect in voltmeters? **(02 Marks)**

**OR**

2 a. Convert a basic D'Arsonval movement with internal resistance of 50Ω and full scale deflection current of 2mA into a multirange dc voltmeter with voltage range of 0-10V, 0-50V, 0-100V and 0-250V. Connect the multiplier resistances in series with D'Arsonval movement. **(10 Marks)**

b. Explain the operation of a Transistor voltmeter with a neat sketch. **(06 Marks)**

## Module-2

3 a. With a block schematic, explain the principle and working of Dual slope integrating type DVM. **(08 Marks)**

b. Explain the working of a Digital, Tachometer. **(06 Marks)**

c. Determine the resolution of $3\frac{1}{2}$ digit display on 1V and 10V ranges. **(02 Marks)**

**OR**

4 a. Explain the working of a successive Approximation DVM with its block diagram. **(08 Marks)**

b. With neat circuit diagrams, explain its operation of Digital Frequency Meter. **(08 Marks)**

## Module-3

5 a. Explain the CRT features briefly. **(06 Marks)**

b. List the advantages of using –ve supply in CRO? **(02 Marks)**

c. Explain the operation of an AF sine/square generator with the help of block diagram. **(08 Marks)**

**OR**

6 a. Explain in detail the working of Digital Storage Oscilloscope. **(08 Marks)**

b. Explain in detail the working of function generator with a neat block diagram. **(08 Marks)**

## Module-4

7 a. Explain the working of a Meggar instrument with a neat sketch. (07 Marks)
b. Write a note on Stroboscope principle and working. (05 Marks)
c. A capacitance comparison bridge is used to measure a capacitive impedance at a frequency of 2KHz. The bridge constants at balance are $C_3 = 100\mu F$, $R_1 = 10\ K\Omega$, $R_2 = 50\ K\Omega$, $R_3 = 100\ K\Omega$. Find the equivalent series circuit of the unknown impedance. (04 Marks)

**OR**

8 a. With a neat circuit diagram, explain the operation of a Q-meter. (06 Marks)
b. Derive the balance condition of Whetstone's bridge. (05 Marks)
c. Explain in detail the circuit of Wagner's earth connection. (05 Marks)

## Module-5

9 a. List atleast five designed properties of electrical transducers. (03 Marks)
b. What are the factors to be considered for the selection of transducer? (03 Marks)
c. Explain the construction, principle and operation of LVDT. (10 Marks)

**OR**

10 a. Explain the principle of working of a resistive position transducer with a block diagram. (06 Marks)
b. Write a note on Piezoelectric transducer with a neat sketch. (04 Marks)
c. Define the term Thermistor. Explain the various configurations of thermistor. Mention its advantages and limitations. (06 Marks)

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CBCS SCHEME

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15EC36

# Third Semester B.E. Degree Examination, Aug./Sept.2020
# 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. Define Electric Field Intensity , $\vec{E}$. Find $\vec{E}$ at $(2, \frac{\pi}{2}, \frac{\pi}{6})$ due to a point charge located at origin. Let Q = 40nC. **(04 Marks)**

b. Point charges of 120nC are located at A (0, 0, 1) and B(0, 0, -1) in free space. Find $\vec{E}$ at P(x, 0, 0). Also find the maximum value of $\vec{E}$. **(06 Marks)**

c. Uniform line charges of 120 nC/m each lie along the entire extent of the three co-ordinate axes. Assuming free space conditions, find $\vec{E}$ at P(-3, 2, -1)m. **(06 Marks)**

**OR**

2 a. Derive an expression for electric field intensity at a point in cylindrical coordinate system due to an infinite line charge distribution on Z - axis. **(06 Marks)**

b. A point charge $Q_1$ = 10 μC is located at $P_1$(1, 2, 3)m in free space while $Q_2$ = -5μC is at $P_2$(1, 2, 10)m. i) Find vector force exerted on $Q_2$ by $Q_1$ ii) Also, find the co-ordinates of $P_3$ at which a point charge $Q_3$ experiences no force. **(07 Marks)**

c. Find the total electric flux crossing an infinite plane at y = 0 due to the following charge distributions : • a point charge, 30nC located at (1, 2, 3).
• Two line charge distributions of 10nC/m each located in x = 0 plane at y = ± 2m extending over a length of 4m. **(03 Marks)**

## Module-2

3 a. Define 'Divergence of a Vector' and 'Gradient of a Scalar'. **(04 Marks)**

b. Derive the point form of Gauss's law. **(06 Marks)**

c. Give the flux density , $\vec{D} = \frac{5\sin\theta\cos\phi}{r}\hat{a}_r$, c/m$^2$. Find • Volume charge density
• Total charge contained in the region, r < 2m.
• Total electric flux leaving the surface, r = 2m. **(06 Marks)**

**OR**

4 a. The value of $\vec{E}$ at $P(\rho = 2\ , \phi = 40^0\ , Z = 3)$ is given by $\vec{E} = 100\ \hat{a}_\rho - 200\,\hat{a}_\phi + 300\,\hat{a}_z$, V/m. Determine the incremental work required to move a 20μC charge a distance of 6μm in the direction of : i) $\hat{a}_\rho$ ii) $\vec{E}$ iii) $\vec{G} = \hat{a}_\rho + 3\,\hat{a}_\phi - 2\,\hat{a}_z$. **(06 Marks)**

b. State and explain continuity equation of current. **(05 Marks)**

c. Given the potential field $V = 2x^2y - 80$ , and a point, P(2, 3, -4) in free space, find at 'P'.
i) V ii) $\vec{E}$ iii) $\frac{dV}{dN}$ iv) $\hat{a}_N$.
Where $\hat{a}_N$ is the unit vector normal to equipotential surface? **(05 Marks)**

## Module-3

5 a. Conducting plates at Z = 2cm and Z = 8cm are held at potentials of -3V and 9V respectively. The region between the plates is filled with a perfect dielectric of $\epsilon = 5\epsilon_0$. Find V, $\vec{E}$ and $\vec{D}$ in the region between the plates. **(06 Marks)**

b. Let $V = \frac{\cos 2\phi}{\rho}$ volts in free space. Find volume charge density at P(5, $60^0$, 1) using Poisson's equation. **(05 Marks)**

c. State the following : i) Uniqueness theorem ii) Ampere's law iii) Stoke's theorem. **(05 Marks)**

**OR**

6 a. Explain Scalar and Vector magnetic potentials. **(05 Marks)**

b. Verify Stoke's theorem for $\vec{H} = 2r \cos \theta \; \hat{a}_r + r \; \hat{a}_\phi$ for the path defined by $0 \le r \le 1$ and $0 \le \theta \le 90^0$. **(06 Marks)**

c. The magnetic field intensity is given by $\vec{H} = 0.1 \; y^3 \; \hat{a}_x + 0.4 \; x \; \hat{a}_z$, A/m. Determine the current flow through the path $P_1(5, 4, 1)$ to $P_2(5, 6, 1)$ to $P_3(0, 6, 1)$ to (0, 4, 1). Also find current density, $\vec{J}$. **(05 Marks)**

## Module-4

7 a. Obtain an expression for magnetic force between differential current elements. **(05 Marks)**

b. A point charge, Q = 18nC has a velocity of $5 \times 10^6$ m/s in the direction $\hat{a} = 0.6 \; \hat{a}_x + 0.75 \, \hat{a}_y + 0.3 \, \hat{a}_z$. Calculate the magnitude of the force exerted on the charge by the field $\vec{B} = -3 \, \hat{a}_x + 4 \, \hat{a}_y + 6 \, \hat{a}_z$, mT. **(05 Marks)**

c. Three infinitely long parallel filaments each carry 50A in the $\hat{a}_z$ direction. If the filament lie in the plane, x = 0 with a 2cm spacing between wires, find the vector fore per meter on each filament. **(06 Marks)**

**OR**

8 a. Obtain the boundary conditions at the interface between two magnetic materials. **(05 Marks)**

b. Find Magnetization in magnetic material where
i) $\mu = 1.8 \times 10^{-5}$ H/m and H = 120 A/m ii) B = 300μT and $X_m = 15$. **(05 Marks)**

c. Explain briefly the following as applicable to magnetic materials :
i) Magnetization ii) Permeability iii) Potential energy. **(06 Marks)**

## Module-5

9 a. Write Maxwell's equations in integral form and word statement form for free space. **(06 Marks)**

b. In a certain dielectric medium, $\epsilon_r = 5$, $\sigma = 0$ and displacement current density $\vec{J}_d = 20 \cos(1.5 \times 10^8 \, t - bx) \; \hat{a}_y$, μA/m$^2$. Determine electric flux density and electric field intensity. **(06 Marks)**

c. A radial magnetic field $\vec{H} = \frac{2.239 \times 10^6}{r} \cos \phi \; \hat{a}_r$, a/m exists in free space. Find the magnetic flux, φ crossing the surface defined by $-\frac{\pi}{4} \le \phi \le \frac{\pi}{4}$; $0 \le z \le 1$, m. **(04 Marks)**

**OR**

10 a. Discuss the wave propagation of a uniform plane wave in a good conducting medium. **(06 Marks)**

b. Derive the relation between $\vec{E}$ and $\vec{H}$ for a perfect dielectric medium. **(05 Marks)**

c. Determine the skin depth for copper with conductivity of $58 \times 10^6$, S/m at a frequency, 10 MHz. Also find α, β and $V_p$. **(05 Marks)**