Total No. of Questions : 4]

SEAT No. :

P1268

[Total No. of Pages : 2

OCT/FE/INSEM-1
F.E. (Phase - I)
ENGINEERING MATHEMATICS - I
(2019 Pattern)

Time : 1 Hour] *[Max. Marks : 30*

Instructions to the candidates:

1) ***Attempt Q.1 or Q.2 and Q.3 or Q.4.***
2) ***Use of electronic pocket calculator is allowed.***
3) ***Assume suitable data, if necessary.***
4) ***Neat diagrams must be drawn wherever necessary.***
5) ***Figures to the right indicate full marks.***

Q1) a) For 0 < a < b, show that **[5]**

$$\left(\frac{b-a}{b}\right) < \log\left(\frac{b}{a}\right) < \left(\frac{b-a}{a}\right)$$

Hence show that $\frac{1}{4} < \log\left(\frac{4}{3}\right) < \frac{1}{3}$

b) By using Taylor's theorem, expand $f(x) = e^x$ in powers of $(x-2)$. **[5]**

c) Evaluate $\lim\limits_{x\to 0}\left(\frac{a^x + b^x}{2}\right)^{1/x}$ **[5]**

OR

Q2) a) Prove that $\log(1+\tan x) = x - \frac{x^2}{2} + \frac{2}{3}x^3 - - -$ **[5]**

b) Expand $7+(x+1)+3(x+1)^3+(x+1)^4$ in ascending powers of x by using Taylor's theorem. **[5]**

c) Find a and b if

$$\lim_{x\to 0}\left[\frac{a\cos x - a + bx^2}{x^4}\right] = \frac{1}{12}$$ **[5]**

P.T.O.

Q3) a) Find fourier series to represent the function

$f(x) = x$ for $-\pi < x < \pi$ and $f(x) = f(x + 2\pi)$. **[5]**

b) Find half range cosine series for $f(x) = x^2$, $0 < x < 2$. **[5]**

c) Obtain constant term and coefficients of the first sine and cosine terms in the Fourier expansion of y as given in the following table. **[5]**

(Given $f(x) = f(x + 2\pi)$)

x	0	$\frac{\Pi}{3}$	$\frac{2\Pi}{3}$	Π	$\frac{4\Pi}{3}$	$\frac{5\Pi}{3}$
y	1.0	1.4	1.9	1.7	1.5	1.2

OR

Q4) a) Find Fourier series for the function $f(x) = x^2 - 2, -2 \le x \le 2$ and $f(x) = f(x + 4)$. **[5]**

b) Find half-range sine series for $f(x) = \Pi x - x^2$ where $0 < x < \Pi$. **[5]**

c) Find first three terms in cosine series to represent y as given in the following table. **[5]**

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

❍❍❍

Total No. of Questions—**8**]

[Total No. of Printed Pages—**4+1**

Seat No.	

[5667]-1001

F.E. (I Semester) EXAMINATION, 2019

ENGINEERING MATHEMATICS—I

(Phase–II)

(2019 PATTERN)

Time : 2½ Hours **Maximum Marks : 70**

***N.B.* :—** (*i*) Attempt Q. No. **1** *or* Q. No. **2**, Q. No. **3** *or* Q. No. **4**, Q. No. **5** *or* Q. No. **6**, Q. No. **7** *or* Q. No. **8**.

(*ii*) Use of electronic pocket calculator is allowed.

(*iii*) Assume suitable data, if necessary.

(*iv*) Neat diagrams must be drawn wherever necessary.

(*v*) Figures to the right indicate full marks.

1. (*a*) If $z = \tan(y + ax) + (y - ax)^{3/2}$, find the value of

$$\frac{\partial^2 z}{\partial x^2} - a^2 \frac{\partial^2 z}{\partial y^2}.$$ [6]

(*b*) If $T = \sin\left(\frac{xy}{x^2 + y^2}\right) + \sqrt{x^2 + y^2}$, by using Euler's theorem find $x\frac{\partial T}{\partial x} + y\frac{\partial T}{\partial y}$. [6]

(*c*) If $u = x^2 - y^2$, $v = 2xy$ and $z = f(u, v)$, then show that

$$x\frac{\partial z}{\partial x} - y\frac{\partial z}{\partial y} = 2\sqrt{u^2 + v^2}\ \frac{\partial z}{\partial u}.$$ [6]

P.T.O.

Or

2. (*a*) If $x = u \tan v$, $y = u \sec v$, prove that : [6]

$$\left(\frac{\partial u}{\partial x}\right)_y \left(\frac{\partial v}{\partial x}\right)_y = \left(\frac{\partial u}{\partial y}\right)_x \left(\frac{\partial v}{\partial y}\right)_x .$$

(*b*) If $u = \sin^{-1}\left(\frac{x+y}{\sqrt{x}+\sqrt{y}}\right)$, by using Euler's theorem.

prove that : [6]

$$x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = \frac{1}{4}(\tan^3 u - \tan u).$$

(*c*) If $x = \frac{\cos \theta}{u}$, $y = \frac{\sin \theta}{u}$ and $z = f(x, y)$, then show that : [6]

$$u \frac{\partial z}{\partial u} - \frac{\partial z}{\partial \theta} = (y - x)\frac{\partial z}{\partial x} - (y + x)\frac{\partial z}{\partial y}.$$

3. (*a*) If $u = x + y + z$, $v = x^2 + y^2 + z^2$, $w = xy + yz + zx$ find $\frac{\partial(u, v, w)}{\partial(x, y, z)}$. [6]

(*b*) Examine whether $u = \frac{x-y}{1+xy}$, $v = \tan^{-1} x - \tan^{-1} y$ are functionally dependent, if so find the relation between them. [5]

(*c*) Find the extreme values of $x^2 + y^2 + \frac{2}{x} + \frac{2}{y}$. [6]

Or

4. (*a*) If $u = x + y^2$, $v = y + z^2$, $w = z + x^2$, using Jacobian find $\frac{\partial x}{\partial u}$. [6]

(b) A power dissipated in a resistor is given by $P = \frac{\varepsilon^2}{R}$. If errors of 3% and 2% are found in ε and R respectively, find the percentage error in P. [5]

(c) Using Lagrange's method find extreme value of xyz if $x + y + z = a$. [6]

5. (a) Examine for consistency of the system of linear equations and solve if consistent : [6]

$$x_1 + x_2 + x_3 = 0$$
$$-2x_1 + 5x_2 + 2x_3 = 1$$
$$8x_1 + x_2 + 4x_3 = -1$$

(b) Examine for linear dependence or independence the vectors (1, 1, 1, 3), (1, 2, 3, 4), (2, 3, 4, 7). Find the relation between them if dependent. [6]

(c) Determine the values of a, b, c when A is orthogonal where : [5]

$$A = \begin{bmatrix} 0 & 2b & c \\ a & b & -c \\ a & -b & c \end{bmatrix}.$$

Or

6. (a) Investigate for what values of a and b, the system of equations $2x - y + 3z = 2$, $x + y + 2z = 2$, $5x - y + az = b$ have :

(1) No solution

(2) A unique solution

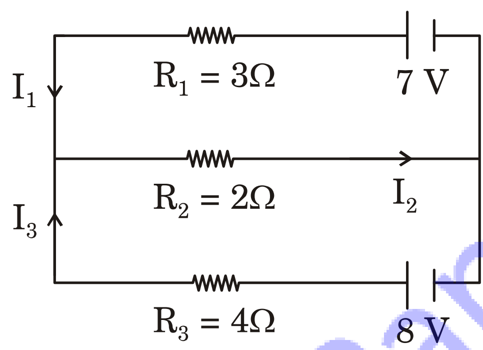
(3) An infinite number of solutions. [6]

(*b*) Examine for linear dependence or independence the vectors

$x_1 = (2, 3, 4, -2),\ x_2 = (1, 1, 2, -1),\ x_3 = \left(\frac{-1}{2}, -1, -1, \frac{1}{2}\right).$

Find the relation between them if dependent. [6]

(*c*) Determine the currents in the network given in figure below : [5]



7. (*a*) Find the eigen values and the corresponding eigen vectors for the following matrix : [6]

$$A = \begin{bmatrix} 4 & 0 & 1 \\ -2 & 1 & 0 \\ -2 & 0 & 1 \end{bmatrix}.$$

(*b*) Verify Cayley-Hemilton theorem for $A = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & -2 \\ -2 & 0 & 1 \end{bmatrix}$ and use it to find A^{-1}. [6]

(*c*) Find a matrix P that diagonalizes the matrix

$$A = \begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}.$$ [6]

Or

8. (*a*) Find the eigen values and the corresponding eigen vectors for the following matrix : [6]

$$A = \begin{bmatrix} 5 & 0 & 1 \\ 0 & -2 & 0 \\ 1 & 0 & 5 \end{bmatrix}.$$

(*b*) Verify Cayley-Hamilton theorem for $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & -3 & 3 \end{bmatrix}$ and use it to find A^{-1}. [6]

(*c*) Reduce the following quadratic form to the sum of the squares form : [6]

$$Q = 2x^2 + 9y^2 + 6z^2 + 8xy + 8yz + 6xz.$$

Total No. of Questions : 9]

SEAT No. :

P6485

[Total No. of Pages : 4

[5868]-101

F.E. (Semester- I & II)

ENGINEERING MATHEMATICS - I

(2019 Pattern) (107001)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) *Q. 1 is compulsory.*
2) *Attempt Q2 or Q3, Q4 or Q5,Q6 or Q7, Q8 or Q9.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Figures to the right indicate full marks.*
5) *Use of electronic pocket calculator is allowed.*
6) *Assume suitable data, if necessary.*

Q1) Write the correct option for the following multiple choice questions.

a) If eigen value of a square matrix A is zero then. **[1]**

i) A is non-singular ii) A is orthogonal

iii) A is singular iv) None of these

b) If u = y^x then $\frac{\partial u}{\partial x}$ is equal to **[1]**

i) 0 ii) xy^{x-1}

iii) $y^x \log y$ iv) None of these

c) The orthogonal transformation x = py transforms the quadratic form $Q = x_1^2 + 3x_2^2 + 3x_3^2 - 2x_2x_3$ to the canonical form $Q' = y_1^2 + 2y_2^2 + y_3^2$. The rank of quadratic from is **[2]**

i) 2 ii) 3

iii) 1 iv) 0

d) $u = \sec^{-1}\left[\frac{x^2 + y^2}{xy^2}\right]$. Find the value of $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ **[2]**

i) –tan u ii) –cot u

iii) tan u iv) cot u

P.T.O.

e) If u = $x^2 - y^2$ and v = $2xy$ then the value of $\frac{\partial(u,v)}{\partial(x,y)}$ is **[2]**

i) $4(x^2 + y^2)$ ii) $-4(x^2 + y^2)$

iii) $4(x^2 - y^2)$ iv) 0

f) A system of linear equations Ax = B, where B is a null (zero) matrix is **[2]**

i) Always consistent

ii) Consistent only if |A| = 0

iii) Consistent only if |A| ≠ 0

iv) In consistent if ρ (A) < No. of variables

Q2) a) If $z = \tan(y + ax) + (y - ax)^{3/2}$ find value of $\frac{\partial^2 z}{\partial x^2} - a^2 \frac{\partial^2 z}{\partial y^2}$. **[5]**

b) If $u = \tan^{-1}\left(\frac{x^3 + y^3}{x - y}\right)$ then prove that

$$x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = \left(1 - 4\sin^2 u\right)\sin 2u$$ **[5]**

c) If $u = f\left(x^2 - y^2; y^2 - z^2; z^2 - x^2\right)$ find value of $\frac{1}{x}\frac{\partial u}{\partial x} + \frac{1}{y}\frac{\partial u}{\partial y} + \frac{1}{z}\frac{\partial u}{\partial z}$ **[5]**

OR

Q3) a) If $u = ax + by; v = bx - ay$ find value of $\left(\frac{\partial u}{\partial x}\right)_y \left(\frac{\partial x}{\partial u}\right)_v \left(\frac{\partial y}{\partial v}\right)_x \left(\frac{\partial v}{\partial y}\right)_u$ **[5]**

b) If $u = \sin^{-1}\left(\sqrt{x^2 + y^2}\right)$ then find value of $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2}$ **[5]**

c) If $u = f(r,s)$ where $r = x^2 + y^2$; $S = x^2 - y^2$ then show that

$$y\frac{\partial u}{\partial x} + x\frac{\partial u}{\partial y} = 4xy\frac{\partial u}{\partial r}.$$ **[5]**

Q4) a) If $x = uv$ and $y = \dfrac{u+v}{u-v}$, find $\dfrac{\partial(u,v)}{x,y}$. **[5]**

b) Examine for functional dependence $u = \dfrac{x-y}{1+xy}, v = \tan^{-1}x - \tan^{-1}y$ and if depedent find the relation between them. **[5]**

c) Discuss maxima and minima of $f(x,y) = x^2 + y^2 + 6x + 12$ **[5]**

OR

Q5) a) Prove $JJ' = 1$ for $x = u \cos v$, $y = u \sin v$. **[5]**

b) In calculating the volume of a right circular cone, errors of 2% and 1% are made in measuring the height and radius of base respectively find the error in the calculated volume. **[5]**

c) Find maximum value of $u = x^2y^3z^4$ such that $2x + 3y + 4z = a$ by Langrange's method. **[5]**

Q6) a) Investigate for what values of μ & λ the equations $x+y+z = 6$, $x+2y+3z = 10$, $x+2y+\lambda z = \mu$ have i) No solution ii) Infinitely many solutions. **[5]**

b) Examine for linear dependence and independence the vectros (1,1,3), (1,2,4), (1,0,2). If dependent, find the relation between them. **[5]**

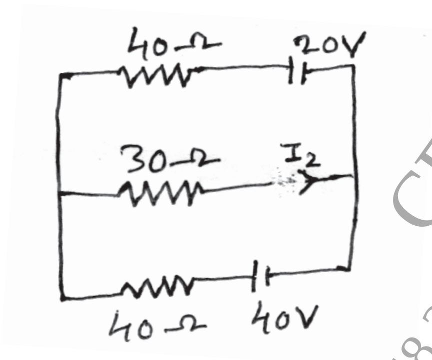
c) Verify whether matrix $A = \begin{bmatrix} \cos\theta & 0 & \sin\theta \\ 0 & 1 & 0 \\ -\sin\theta & 0 & \cos\theta \end{bmatrix}$ is orthogonal or not. **[5]**

OR

Q7) a) Solve the system of equations $x+y+2z = 0$, $x+2y+3z=0$, $x+3y+4z=0$. **[5]**

b) Examine following vectors for linear dependence and independence (1,–1,1), (2,1,1), (3,0,2). If dependent, find the relation between them. **[5]**

c) Determine the currents in the network given in the figure . **[5]**



Q8) a) Find the eigen values of the matrix $A = \begin{bmatrix} 1 & -2 \\ -5 & 4 \end{bmatrix}$. **[5]**

Find eigen vector corresponding to the highest eigen value.

b) Verify cayley-Hamilton theorem for $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$. Hence find A^{-1} if it exists. **[5]**

c) Find the modal matrix p which diagonalises $A = \begin{bmatrix} 5 & 3 \\ 3 & 5 \end{bmatrix}$. **[5]**

OR

Q9) a) Find the eigen values of $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 3 & 2 \\ 0 & 0 & -2 \end{bmatrix}$. **[5]**

Find eigen vector corresponding to the highest eigen value.

b) Verify cayley-Hamilton theorem for $A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$ **[5]**

c) Reduce the quadratic form $Q = x_1^2 + 2x_2^2 + x_3^2 + 2x_2x_3 - 2x_3x_1 + 2x_1x_2$ to canonical form by congruent transformations. **[5]**

❍❍❍❍

Total No. of Questions : 4]

SEAT No. :

PA-1678

[Total No. of Pages : 2

[5931]-1001

F.E.

ENGINEERING MATHEMATICS-I

(2019 Pattern) (Semester-I) (107001)

Time : 1 Hour] *[Max. Marks : 30*

Instructions to the candidates:

1) *Attempt Q1 or Q2 and Q3 or Q4.*
2) *Figures to the right indicate full marks.*
3) *Assume suitable data wherever necessary.*
4) *Use of electronic pocket calculator is allowed.*

Q1) a) If $f(x)=\sin^{-1}x$ then show that $\frac{b-a}{\sqrt{1-a^2}} < \mathrm{Sin}^{-1} b - \sin^{-1} a < \frac{b-a}{\sqrt{1-b^2}}$ where $0<a<b<1$. **[5]**

b) Using Taylor's theorem, expand $1+2x+3x^2+4x^3$ in powers of $x+1$ **[5]**

c) Evaluate $\lim_{x\to\frac{\pi}{2}} (\mathrm{Cos}\, x)^{\cos x}$ **[5]**

OR

Q2) a) Expand $\sqrt{1+\sin x}$ upto x^4 in ascending powers of x **[5]**

b) Expand logcosx in ascending powers of $\left(x-\frac{\pi}{3}\right)$ upto the term in $\left(x-\frac{\pi}{3}\right)^2$ by using Taylor's theorem. **[5]**

c) Find the values of a and b if $\lim_{x\to 0}\frac{\sin x + ax + bx^3}{x^3} = 0$ **[5]**

Q3) a) Find Fourier series for $f(x)=\left(\frac{\pi-x}{2}\right)^2, 0<x<2\pi$ and $f(x)=f(x+2\pi)$ **[5]**

b) Find half-range sine series for **[5]**

$f(x)=2x-1,\ 0 < x < 1$

c) Obtain the constant term and the coefficients of the first sine and cosine term in the fourier series of $f(x)$ as given in the following table. **[5]**

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

OR

Q4) a) Find the fourier series to represent **[5]**

$$f(x) = \begin{cases} -3, & -1 < x < 0 \\ 3, & 0 < x, < 1 \end{cases}, \ f(x) = f(x+2)$$

b) Find half-range consine series for $f(x) = x^2, 0 < x < \pi$ **[5]**

c) Find half-range sine series for $f(x) = 1, 0 < x < \pi$. Hence using parsevals identify, deduce that **[5]**

$$\frac{\pi^2}{8} = 1 + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} + \ldots\ldots..$$

● ● ●

Total No. of Questions : 9]

SEAT No. :

P-3926

[Total No. of Pages : 5

[6001]-4001
F.E.
ENGINEERING MATHEMATICS - I
(2019 Pattern) (Semester - I) (107001)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) *Question No. 1 is compulsory.*
2) *Solve Q. No. 2 or Q. No. 3, Q. No. 4 or Q. No. 5, Q. No. 6 or Q. No. 7, Q. No. 8 or Q. No. 9.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Figures to the right indicate full marks.*
5) *Electronic pocket calculator is allowed.*
6) *Assume suitable data, if necessary.*

Q1) Write the correct option for the following multiple choice questions :

a) If $u = \frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{x^2 + y^2}$ then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ is equal to **[2]**

i) 2u ii) –2u

iii) 0 iv) None

b) If $u = x^y$ then $\frac{\partial u}{\partial y}$ is equal to **[1]**

i) 0 ii) yx^{y-1}

iii) $x^y \log x$ iv) x^{y-1}

c) If $x = uv,\ y = \frac{u}{v}$ then the value of $\frac{\partial(u,v)}{\partial(x,y)}$ is **[2]**

i) $\frac{-2u}{v}$ ii) uv

iii) $\frac{v}{2u}$ iv) $\frac{-v}{2u}$

P.T.O.

d) A is orthogonal matrix then A^{-1} equal to **[1]**

i) A   ii) A^T

iii) A^2 iv) 1

e) For what value of K the homogeneous system $x + 2y - z = 0$, $3x + 8y - 3z = 0$; $2x + 4y + (k-3)z = 0$ has infinitely many solution. **[2]**

i) K = 0   ii) K = 1

iii) K = 2   iv) K = 3

f) Using Cayley Hamilton theorem A^{-1} for the matrix $A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$ is calculated from **[2]**

i) $\frac{1}{5}(-A - 4I)$ ii) $\frac{1}{5}(A - 4I)$

iii) $\frac{1}{5}(A + 4I)$ iv) $\frac{1}{5}(4I - A)$

Q2) a) If $u = ln(x^2 + y^2)$, show that $\frac{\partial^2 u}{\partial x \partial y} = \frac{\partial^2 u}{\partial y \partial x}$. **[5]**

b) If $e^{2u} = y^2 - x^2$, $\operatorname{cosec} v = \frac{y}{x}$ then find the value of **[5]**

$$\left(x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}\right).\left(x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}\right)$$

c) If $u = f(x - y, y - z, z - x)$ then find the value of $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z}$. **[5]**

OR

Q3) a) If $u = ax + by$, $v = bx - ay$ find the value of $\left(\frac{\partial u}{\partial x}\right)_y \cdot \left(\frac{\partial x}{\partial u}\right)_v$. **[5]**

b) If $T = \sin\left(\frac{xy}{x^2 + y^2}\right) + \sqrt{x^2 + y^2}$, find the value of $x\frac{\partial T}{\partial x} + y\frac{\partial T}{\partial y}$. **[5]**

c) If $u = f(r, s)$ where $r = x^2 + y^2$, $s = x^2 - y^2$ then show that $y\frac{\partial u}{\partial x} + x\frac{\partial u}{\partial y} = 4xy\frac{\partial u}{\partial r}$. **[5]**

Q4) a) If $x = u + v$, $y = v^2 + w^2$, $z = u^3 + w^3$ then find $\frac{\partial u}{\partial x}$. **[5]**

b) In calculating resistance R of a circuit by using the formula :

$$R = \frac{V}{I}$$

errors of 3% and 1% are made in measuring Voltage V and current I respectively. Find the % error in the calculated resistance. **[5]**

c) Discuss the maxima and minima of : **[5]**

$f(x, y) = x^2 + y^2 + xy + x - 4y + 5$

OR

Q5) a) If $u + v^2 = x$, $v + w^2 = y$, $w + u^2 = z$ find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$. **[5]**

b) Examine for functional dependence : **[5]**

$u = y + z$, $v = x + 2z^2$, $w = x - 4yz - 2y^2$

c) A space probe in the shape of the ellipsoid $4x^2 + y^2 + 4z^2 = 16$ enters the earth's atmosphere and it's surface begins to heat. After one hour, the temperature at the point (x, y, z) on the surface of the probe is

$T(x, y, z) = 8x^2 + 4yz - 16z + 600$.

Find the hottest point on the surface of the probe, by using Lagrange's method. **[5]**

Q6) a) Examine for consistency and if consistent then solve it **[5]**

$2x + 3y + 5z = 1$; $3x + y - z = 2$; $x + 4y - 6z = 1$

b) Examine whether the vectors **[5]**

$X_1 = (1, 1, -1, 1)$; $X_2 = (1, -1, 2, -1)$; $X_3 = (3, 1, 0, 1)$

are linearly independent or dependent. If dependent find relation between them.

c) If $A = \begin{bmatrix} 1/3 & 2/3 & a \\ 2/3 & 1/3 & b \\ 2/3 & -2/3 & c \end{bmatrix}$ is orthogonal **[5]**

Find a, b, c.

OR

Q7) a) Investigate for what values of k, the equations **[5]**

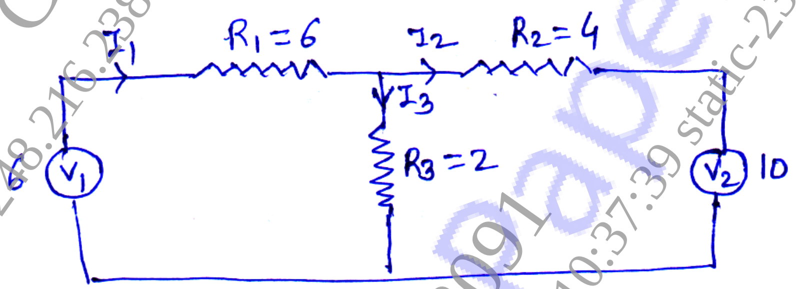
$x + y + z = 1$; $2x + y + 4z = k$; $4x + y + 10z = k^2$ have infinite number of solution? Hence find solution.

b) Examine whether the vectors. **[5]**

$X_1 = (2, 3, 4, -2)$; $X_2 = (-1, -2, -2, 1)$; $X_3 = (1, 1, 2, -1)$

are linearly independent or dependent. If dependent find relation between them.

c) Find the current I_1; I_2; I_3 in the circuit shown in the figure **[5]**



Q8) a) Find eigen values and eigen vectors of the following matrix **[5]**

$$A = \begin{bmatrix} 1 & 1 & -2 \\ -1 & 2 & 1 \\ 0 & 1 & -1 \end{bmatrix}$$

b) Verify Cayley-Hamilton theorem for $A = \begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$ and use it to find A^{-1}. **[5]**

c) Find the modal matrix p which transform the matrix $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ to the diagonal form. **[5]**

OR

Q9) a) Find eigen values and eigen vectors of the following matrix $\begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$. **[5]**

b) Verify Cayley-Hamilton theorem for $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$ and use it to find A^{-1}. **[5]**

c) Reduce the following quadratic form to the "sum of the squares form". **[5]**

$Q(x) = 2x^2 + 9y^2 + 6z^2 + 8xy + 8yz + 6xz$

□□□

Total No. of Questions : 9]

SEAT No. :

P9066

[Total No. of Pages : 4

[6178]-1

F.E.

ENGINEERING MATHEMATICS - I

(2019 Pattern) (Semester - I/II) (Credit System) (107001)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) *Q.1 is compulsory.*
2) *Attempt Q.2 or Q.3, Q.4 or Q.5, Q.6 or Q.7, Q.8 or Q.9.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Figures to the right indicate full marks.*
5) *Use of electronic pocket calculator is allowed.*
6) *Assume suitable data, if necessary.*

Q1) Write the correct option for the following multiple choice questions.

a) If $u = x^3 + y^3 - 3xy$ then $\frac{\partial^2 u}{\partial x \partial y}$ is equal to **[1]**

i) 3 ii) –3

iii) 2 iv) 0

b) If $x = r\cos\theta,\ y = r\sin\theta$ then the value of $\frac{\partial(x,y)}{\partial(r,\theta)}$ is **[1]**

i) $\frac{1}{r}$ ii) r

iii) r^2 iv) None

c) The vectors $X_1 = (-1,0,3),\ X_2 = (2,4,6)$ are **[2]**

i) linearly dependent ii) linearly independent

iii) mutually orthogonal iv) none of these

d) The characteristic equation for the square matrix A is **[2]**

i) $|A - \lambda I| = 0$ ii) $|A + \lambda I| = 0$

iii) $|A^2 - \lambda I| = 0$ iv) None

P.T.O.

e) If $u=\sin^{-1}\frac{\sqrt{x^2+y^2}}{x+y}$ then $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}$ is equal to **[2]**

i) u ii) $2u$

iii) 0 iv) None

f) If $x=u(1-v)$, $y=uv$ then $\frac{\partial(x,y)}{\partial(u,v)}$ **[2]**

i) u ii) $\frac{1}{u}$

iii) uv iv) $u-uv$

Q2) a) If $u=x^2\tan^{-1}\frac{y}{x}-y^2\tan^{-1}\frac{x}{y}$ then show that $\frac{\partial^2 u}{\partial x\partial y}=\frac{x^2-y^2}{x^2+y^2}$. **[5]**

b) If $f(x,y)=\frac{1}{x^2}+\frac{\ln x-\ln y}{x^2+y^2}$, using Euler's theorem find xf_x+yf_y. **[5]**

c) If $u=f\left(e^{y-z},e^{z-x},e^{x-y}\right)$, find the value of $\frac{\partial u}{\partial x}+\frac{\partial u}{\partial y}+\frac{\partial u}{\partial z}$. **[5]**

OR

Q3) a) If $x=u\tan v$, $y=u\sec v$, prove that $\left(\frac{\partial u}{\partial x}\right)_y\cdot\left(\frac{\partial v}{\partial x}\right)_y=\left(\frac{\partial u}{\partial y}\right)_x\cdot\left(\frac{\partial v}{\partial y}\right)_x$. **[5]**

b) If $u=\ln x+\ln y$ find the value of $x^2u_{xx}+2xyu_{xy}+y^2u_{yy}+xu_x+yu_y$. **[5]**

c) If $z=f(u,v)$ and $u=x\cos\theta-y\sin\theta$, $v=x\sin\theta+y\cos\theta$ where θ is a constant, show that $x\frac{\partial z}{\partial x}+y\frac{\partial z}{\partial y}=u\frac{\partial z}{\partial u}+v\frac{\partial z}{\partial v}$. **[5]**

Q4) a) If $x=u\cos v$, $y=u\sin v$, prove that $JJ'=1$. **[5]**

b) As certain whether the following functions are functionally dependent, if so find the relation between then $u=\frac{x+y}{1-xy}$, $v=\tan^{-1}x+\tan^{-1}y$. **[5]**

c) Find the maximum and minimum values of $3x^2-y^2+x^3$. **[5]**

OR

Q5) a) If $x=v^2+w^2$, $y=w^2+u^2$, $z=u^2+v^2$ find $\dfrac{\partial(u,v,w)}{\partial(x,y,z)}$. **[5]**

b) In calculating volume of right circular cylinder, errors of 2% and 1% are found in measuring height and base radius respectively. Find the percentage error in calculating volume of the cylinder. **[5]**

c) Use Lagrange's method to find the minimum distance from origin to the plane $3x+2y+z=12$. **[5]**

Q6) a) Examine following system for consistency $x+y-3z=1$; $4x-2y+6z=8$; $15x-3y+9z=20$. **[5]**

b) Examine for linear dependancy or independance of following set of vectors. If dependent, find the relation between them $X_1 \equiv (3,1,1)$, $X_2 \equiv (2,0,-1)$, $X_3 \equiv (1,1,2)$. **[5]**

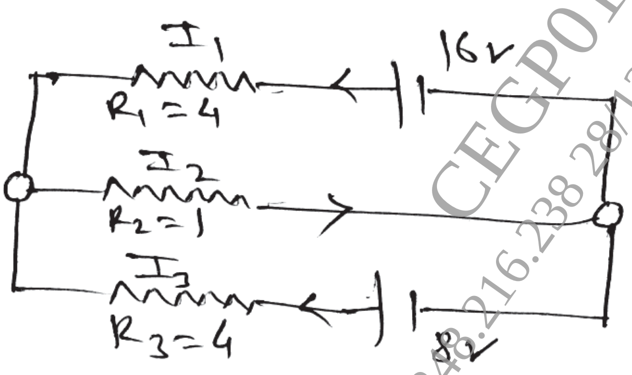
c) Show that $A = \begin{bmatrix} \frac{1}{\sqrt{2}} & 0 & \frac{1}{\sqrt{2}} \\ 0 & 1 & 0 \\ \frac{1}{\sqrt{2}} & 0 & \frac{-1}{\sqrt{2}} \end{bmatrix}$ is orthogonal matrix & hence find A^{-1}. **[5]**

OR

Q7) a) Determine values of k, for which following system have non-trivial solution. $5x+2y-3z=0$; $3x+y+z=0$; $2x+y+kz=0$ **[5]**

b) Show that following set of vectors are linearly dependant $X_1 \equiv (2,3,4,-2)$, $X_2 \equiv (-1,-2,-2,1)$, $X_3 \equiv (1,1,2,-1)$ **[5]**

c) Find the currents I_1, I_2, I_3 in the circuit, shown in the figure :- **[5]**



Q8) a) Find eigen values and corresponding eigen vectors of the following matrix

$$A = \begin{bmatrix} 1 & -2 \\ -3 & 0 \end{bmatrix}.$$ **[5]**

b) Verify Cayley Hamilton theorem for given matrix $A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$. **[5]**

c) Find the modal matrix P which diagonalises the given matrix $A = \begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$. **[5]**

OR

Q9) a) Find eigen values and eigen vector corresponding to largest eigen value of a following matrix $A = \begin{bmatrix} 15 & 0 & -15 \\ -3 & 6 & 9 \\ 5 & 0 & -5 \end{bmatrix}$. **[5]**

b) Verify Cayley Hamilton theorem and hence find A^{-1} for given matrix

$$A = \begin{bmatrix} 1 & 2 \\ 1 & 1 \end{bmatrix}.$$ **[5]**

c) Express the following quadratic form as "sum of the squares form" by consruent transformation. Write down the corresponding linear transformation $Q(x) = x_1^2 + 6x_2^2 + 18x_3^2 + 4x_1x_2 + 8x_1x_3 - 4x_1x_3$. **[5]**

✈ ✈ ✈

Total No. of Questions : 4]

SEAT No. :

PC373

[Total No. of Pages : 2

[6358]-101

F.E. (Insem)

ENGINEERING MATHEMATICS - I

(2019 Pattern) (Semester - I) (107001)

Time : 1 Hour] *[Max. Marks : 30*

Instructions to the candidates:

1) *Answer Q1 or Q2, Q3 or Q4.*
2) *Figures to the right indicate full marks.*
3) *Assume suitable data, if necessary.*
4) *Use of electronic pocket calculator is allowed.*

Q1) a) For the functions $f(x)=\sqrt{x}$ and $g(x)=\frac{1}{\sqrt{x}}$, prove that 'C' of Cauchy's mean value theorem is the geometric between a and b where $a, b > 0$. **[5]**

b) Expand $2x^3 + 7x^2 + x - 1$ in powers of $(x - 2)$. **[5]**

c) Find the values of a and b such that $\lim_{x\to 0}\frac{a\sin 2x - b\tan x}{x^3}=1$. **[5]**

OR

Q2) a) Using Lagrange's mean value theorem, prove that, $\frac{b-a}{b}<ln\left(\frac{b}{a}\right)<\frac{b-a}{a}$ for $0<a<b$. Hence show that, $\frac{1}{4}<ln\left(\frac{4}{3}\right)<\frac{1}{3}$. **[5]**

b) Prove that $e^x\cdot\cos x = 1 + x - \frac{x^3}{3}+.......$ **[5]**

c) Evaluate $\lim_{x\to 1}\left[(1-x^2)\right]^{\left[\frac{1}{ln(1-x)}\right]}$. **[5]**

P.T.O.

Q3) a) Find Fourier series to represent the function $f(x) = \pi^2 - x^2 \quad -\pi \leq x \leq \pi$ and $f(x) = f(x + 2\pi)$ **[5]**

b) Find half range sine series for the function $f(x) = x^2 \quad 0 \leq x \leq l$. **[5]**

c) The following table gives the variation of periodic current over a period. **[5]**

t sec	0	T/6	T/3	T/2	2T/3	5T/6	T
A amp.	1.98	1.30	1.05	1.3	–0.88	–0.25	1.98

Show by practical harmonic analysis that there is a direct current part of 0.75 ampere in the variable current and obtain the amplitude of the first harmonic.

OR

Q4) a) Find Fourier series for the function $f(x) = x \quad -2 \leq x \leq 2$ & $f(x) = f(x + 4)$. **[5]**

b) Find half range cosine series for $f(x) = x^2 \quad 0 \leq x \leq \pi$. **[5]**

c) Obtain the first two coefficient in the fourier sine series for y. **[5]**

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

☯☯☯☯

Total No. of Questions : 9]

SEAT No. :

PB3586

[Total No. of Pages : 5

[6260]-1

F.E.

ENGINEERING MATHEMATICS-I

(2019 Credit Pattern) (Semester -I/II) (107001)

Time :2½Hours] *[Max. Marks :70*

Instructions to the candidates:

1) *Q.1 is Compulsory.*
2) *Answer Q.2 or Q.3, Q.4 or Q.5, Q.6 or Q.7, Q.8 or Q.9.*
3) *Figures to the right indicate full marks.*
4) *Assume suitable data, if necessary.*
5) *Neat diagrams must be drawn wherever necessary.*
6) *Use of electronic pocket calculator is allowed.*

Q1) Write the correct option for the following MCQs. **[10]**

a) If $u = x^3 + y^3$ then $\frac{\partial^2 u}{\partial x \partial y} = \cdots ?$ **[2]**

i) 3 ii) -3

iii) 2 iv) 0

b) If $x = uv$, $y = \frac{u}{v}$ the $\frac{\partial(x,y)}{\partial(u,v)} = \cdots ?$ **[2]**

i) $\frac{-2u}{v}$ ii) uv

iii) $\frac{v}{2u}$ iv) $\frac{-v}{2u}$

c) Rank of matrixA= $\begin{bmatrix} 1 & 1 & 1 \\ 0 & -1 & 0 \\ 1 & 1 & 1 \end{bmatrix}$ is ....? **[2]**

i) 0 ii) 1

iii) 2 iv) 3

P.T.O.

d) Using Cayley Hamilton theorem A^{-1} for the matrix A= $\begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$ is given by; **[2]**

i) $\frac{1}{5}(A+4I)$ ii) $\frac{1}{4}(A+5I)$

iii) $\frac{1}{4}(A-5I)$ iv) $\frac{1}{5}(A-4I)$

e) If $A^{-1}=A'$ then matrix A is ....? **[1]**

i) Orthogonal ii) Singular

iii) Non-Singular iv) None of above

f) If $u = x^3 + 4y - 3x$, $\frac{\partial u}{\partial x}$=....? **[1]**

i) 4 ii) $3x^2 - 3$

iii) $3x^2 + 4y$ iv) $3x^2 + 1$

Q2) a) If $u = x^y + y^x$,find $\frac{\partial^2 u}{\partial x \partial y}$ **[5]**

b) If $u = \log\left(\frac{x^3 + y^3}{x^2 + y^2}\right)$, find the value of $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2}$ **[5]**

c) If $u = f(y-z, z-x, x-y)$, Prove that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$ **[5]**

OR

Q3) a) If $x^2 = au + bv$ and $y^2 = au - bv$, prove that $\left(\frac{\partial u}{\partial x}\right)_y \left(\frac{\partial x}{\partial u}\right)_v = \frac{1}{2}$ **[5]**

b) If $u = \sin^{-1}\left(\frac{y}{x}\right) + \sqrt{x^2 + y^2}$, find the value of $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$ **[5]**

c) If $x = \frac{\cos\theta}{u}, y = \frac{\sin\theta}{u}$ and $z = f(x, y)$, then show that $u \frac{\partial z}{\partial u} - \frac{\partial z}{\partial \theta} = (y - x) \frac{\partial z}{\partial x} - (y + x) \frac{\partial z}{\partial y}$ **[5]**

Q4) a) If $x = uv$ and $y = \frac{u+v}{u-v}$, find $\frac{\partial(u,v)}{\partial(x,y)}$ **[5]**

b) Examine for functional dependence:

$u = \frac{x+y}{1-xy}, v = \tan^{-1} x + \tan^{-1} y$. If dependent find the relation between them. **[5]**

c) Discuss maxima and minima of $f(x,y) = x^3 + y^3 - 3axy \quad a > 0$. **[5]**

OR

Q5) a) Prove that $JJ' = 1$ for the transformation $x = u\cos v, y = u\sin v$ **[5]**

b) Find the percentage error in computing the parallel resistance r of two resistances r_1 and r_2 from the formula $\frac{1}{r} = \frac{1}{r_1} + \frac{1}{r_2}$ where r_1 and r_2 are both in error by +2% each. **[5]**

c) Find maximum value of $u = x^2 y^3 z^4$ such that $2x + 3y + 4z = a$ by langrange's method. **[5]**

Q6) a) Find for what values of k, the set of equations **[5]**

$2x - 3y + 6z - 5t = 3$

$y - 4z + t = 1$

$4x - 5y + 8z - 9t = k$

has i) No solution

ii) An intinite number of solutions.

b) Examine for linear dependence of vectors **[5]**

$(1,-1,1)$, $(2,1,1)$ and $(3,0,2)$

c) Show that $A = \frac{1}{3}\begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ 2 & -2 & 1 \end{bmatrix}$ is orthogonal. **[5]**

OR

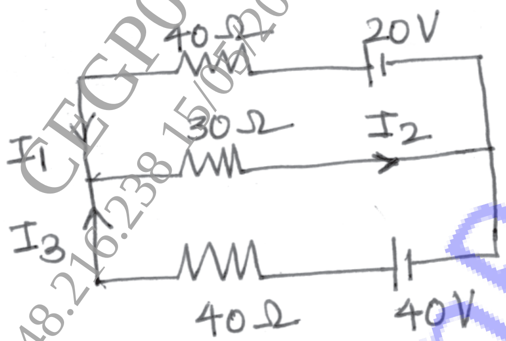
Q7) a) Examine for consistency the following set of equations and obtain the solution if consistent. **[5]**

$$2x-y-z=2$$
$$x+2y+z=2$$
$$4x-7y-5z=2$$

b) Examine for linear dependence of vectors **[5]**

(1,2,4),(2,−1,3),(0,1,2).

c) Determine the currents in the network given in figure below. **[5]**



Q8) a) Find the eigen values and eigen vectors of the following matrix. **[5]**

$$A=\begin{bmatrix} 1 & 1 & 1 \\ 0 & 2 & 1 \\ 0 & 0 & 3 \end{bmatrix}.$$

b) Verify Cayley - Hamilton theorem for $A=\begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$ and use it to

Find A^{-1} **[5]**

c) Find the modal matrix P which transform the matrix

$A=\begin{bmatrix} 1 & 1 & -2 \\ -1 & 2 & 1 \\ 0 & 1 & -1 \end{bmatrix}$ to the diagonal form. **[5]**

OR

Q9) a) Find the eigen values and eigen vectors of the following matrix

$$A=\begin{bmatrix} 1 & -2 \\ -5 & 4 \end{bmatrix}.$$ **[5]**

b) Verify cayley Hamilton theorem for $A=\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & -3 & 3 \end{bmatrix}$. Hence find A^{-1}. **[5]**

c) Reduce the following quadratic form to the Sum of the squares form.
$3x^2+3y^2+3z^2+2xy+2xz-2yz.$ **[5]**

ꙮꙮꙮ

Total No. of Questions : 9]

SEAT No. :

PE-895

[Total No. of Pages : 4

[6581]-1901
F.E.
ENGINEERING MATHEMATICS - I
(2019 Pattern) (Semester - I) (107001)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates :

1) *Q. 1 is compulsory.*
2) *Attempt Q.2 or Q.3, Q.4 or Q.5, Q.6 or Q,7, Q.8 or Q.9.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Figure to the right indicates full marks.*
5) *Use of electronic pocket calculator is allowed.*
6) *Assume suitable data, if necessary.*

Q1) Write the correct option for the following multiple choice questions. **[10]**

a) If z is a homogeneous function of x and y and if $z = f(u)$ then $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y}$ is **[1]**

i) $\dfrac{f(u)}{f'(u)}$ ii) $n\dfrac{f(u)}{f'(u)}$

iii) $\dfrac{f'(u)}{f(u)}$ iv) $n\dfrac{f'(u)}{f(u)}$

b) The product of eigen values of a matrix A is equal to **[1]**

i) Trace of A ii) Determinant of A

iii) Rank of A iv) None of the

c) The eigen values of $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ are **[2]**

i) 0,0,0 ii) 0,0,1

iii) 0,0,3 iv) 1,1,1

d) The rank of the matrix $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & -1 & 0 \\ 1 & 1 & 1 \end{bmatrix}$ is **[2]**

i) 2 ii) 0

iii) 1 iv) 3

e) If $u = x^2 + y^2$, $v = 2xy$ then $\dfrac{\partial(u,v)}{\partial(x,y)}$ is **[2]**

i) $x^2 - y^2$ ii) $2(x^2 - y^2)$

iii) $4(x^2 + y^2)$ iv) $4(x^2 - y^2)$

f) If $x = r\cos\theta$ and $y = r\sin\theta$ then $\left(\dfrac{\partial y}{\partial r}\right)_x$ is **[2]**

i) $\dfrac{r^2}{y}$ ii) $\dfrac{r}{y^2}$

iii) $\dfrac{r^2}{y^2}$ iv) $\dfrac{r}{y}$

Q2) a) If $v = \dfrac{c}{\sqrt{t}} e^{\left(-x^2/4a^2t\right)}$ then show that $\dfrac{\partial v}{\partial t} = a^2 \dfrac{\partial^2 v}{\partial x^2}$. **[5]**

b) If $u = f\left(\dfrac{y}{x}\right) + \sqrt{x^2 + y^2}$ prove that $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y} = \left(x^2 + y^2\right)^{1/2}$. **[5]**

c) If $u = f(x^2 - y^2, y^2 - z^2, z^2 - x^2)$ then find the value of $\dfrac{1}{x} f_x + \dfrac{1}{y} f_y + \dfrac{1}{z} f_z$. **[5]**

OR

Q3) a) If $x^2 = au + bv$, $y^2 = au - bv$ prove that $\left(\dfrac{\partial u}{\partial x}\right)_y \cdot \left(\dfrac{\partial x}{\partial u}\right)_v = \left(\dfrac{\partial v}{\partial y}\right)_x \cdot \left(\dfrac{\partial y}{\partial v}\right)_u$ **[5]**

b) If $u = \sec^{-1}\left(\dfrac{x^3 + y^3}{x + y}\right)$ prove that $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y} = 2\cot u$. **[5]**

c) If $z = f(x,y)$ and $x = e^u + e^{-v}$, $y = e^{-u} - e^v$ show that $\dfrac{\partial z}{\partial u} - \dfrac{\partial z}{\partial v} = x\dfrac{\partial z}{\partial x} - y\dfrac{\partial z}{\partial y}$. **[5]**

Q4) a) If $x = u(1 - v)$, $y = uv$, prove that $JJ' = 1$. **[5]**

b) Prove that the functions $u = y + z$, $v = x + 2z^2$, $w = x - 4yz - 2y^2$ are functionally dependent and find the relation between them. **[5]**

c) Find the maximum and minimum values of $x^2 + y^2 + 8y + 15$. **[5]**

OR

Q5) a) If $u^3+v^3 = x + y$, $u^2 + v^2 = x^3+y^3$ Find $\dfrac{\partial(x,y)}{\partial(u,v)}$. **[5]**

b) A power dissipated in a resistor is given by $P = \dfrac{E^2}{R}$. Using calculus, find the approximate percentage error in P when E is increased by 3% and R is increased by 2%. **[5]**

c) Divide 24 into three parts such that the continued product of the first, square of the second and cube of the third may be maximum. **[5]**

OR

Q6) a) Determine values of k for which the equations **[5]**

$2x - 3y + 5z = k$, $3x + y - z = 2$, $x + 4y - 6z = 1$ are consistent.

b) Examine following set of vectors for linearly dependance. **[5]**

$X_1 = (1,2,4)$, $X_2 = (2,-1,3)$, $X_3 = (0,1,2)$, $X_4 = (-3,7,2)$.

c) Show that $A = \begin{bmatrix} 1/\sqrt{3} & 0 & 2/\sqrt{6} \\ 1/\sqrt{3} & 1/\sqrt{2} & -1/\sqrt{6} \\ -1/\sqrt{3} & 1/\sqrt{2} & 1/\sqrt{6} \end{bmatrix}$ is an orthogonal matrix. **[5]**

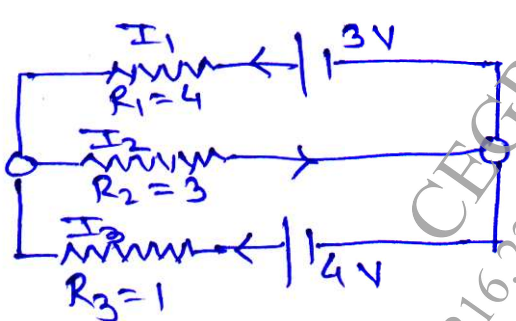
OR

Q7) a) Solve the system of equations **[5]**

$x + y + 3z = 0$; $x - y + z = 0$; $-x + 2y = 0$; $x - y + 2z = 0$

b) Examine whether the set of vectors $X_1 \equiv (5,3,2)$, $X_2 \equiv (2,1,1)$, $X_3 \equiv (-3,1,6)$ are linearly independent. **[5]**

c) Find the current I_1, I_2, I_3 in the circuit shown in the figures : **[5]**



Q8) a) Find eigen values and eigen vectors for the given matrix $A = \begin{bmatrix} 3 & 5 \\ -2 & -4 \end{bmatrix}$. **[5]**

b) Verify Cayley Hamilton theorem for following matrix $A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$. **[5]**

c) Find the modal matrix P which diagonalises the following matrix $A = \begin{bmatrix} 1 & -2 \\ -5 & 4 \end{bmatrix}$. **[5]**

OR

Q9) a) Find eigen values and eigen vector corresponding to largest eigen value of a following matrix $A = \begin{bmatrix} 15 & 0 & -15 \\ -3 & 6 & 9 \\ 5 & 0 & -5 \end{bmatrix}$ **[5]**

b) Verify Cayley Hamilton theorem for following matrix and hence find A^{-1} $A = \begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$. **[5]**

c) Express the following quadratic form as "Sum of the squares form" by congruent transformation. Write down the corresponding linear transformation. **[5]**

$$Q(x) = 6x_1^2 + 3x_2^2 + 3x_3^2 - 4x_1x_2 + 4x_1x_3 - 2x_2x_3$$

♦ ♦ ♦

Total No. of Questions : 4]

SEAT No. :

PE-528

[Total No. of Pages : 2

[6578]-1

S.E. (Civil) (Insem.)

BUILDING TECHNOLOGY AND ARCHITECTURAL PLANNING

(2019 Pattern) (Semester - III) (201001)

Time : 1 Hour] *[Max. Marks : 30*

Instructions to the candidates:

1) *Answer Q.1 or Q.2, Q.3 or Q.4.*
2) *Figures to the right indicate full marks.*
3) *Neat figures must be drawn wherever necessary.*
4) *Assume suitable data if required.*

Q1) a) Explain the characteristics of good building bricks. **[5]**

b) What is Masonry? Explain any two types of it. **[5]**

c) Explain casting procedure for reinforced concrete columns. **[5]**

OR

Q2) a) What is Underpinning. Enlist different methods of underpinning & Explain any one in brief. **[5]**

b) Write short note on: Slip form work. **[5]**

c) List out types of building as per National Building Code. **[5]**

Q3) a) What is building bye-laws? Explain the necessity of bye-laws. **[5]**

b) Distinguish between: **[5]**

i) Grouping vs Privacy

ii) Roominess vs Circulation

c) Define any two terms from following: **[5]**

i) Picture plane

ii) Vanishing Point

iii) Building Line

OR

P.T.O.

Q4) a) Explain shortly following Architectural principals. **[5]**

i) Accentuation

ii) Rhythm

b) Distinguish between: **[5]**

i) Building Planning Principles and Building bye laws

ii) Built up area vs carpet area

c) Write a short note on necessity of Abbreviations & Perspective drawing. **[5]**

❖ ❖ ❖

Total No. of Questions : 9]

SEAT No. :

PD-4024

[Total No. of Pages : 4

[6401]-1901
F.E
ENGINEERING MATHEMATICS - I
(2019 Pattern)(Semester - I) (107001)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates :

1) *Attempt Q.1, Q.2 or Q.3, Q.4 or Q.5, Q.6 or Q.7, Q.8 or Q.9.*
2) *Figures to the right indicate full marks.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Assume suitable data, if necessary.*
5) *Use of electronic pocket calculator is allowed.*

Q1) **Write the correct option for the following MCQ's.**

i) If $u=\dfrac{1}{x^2+y^2}$ then $x\dfrac{\partial u}{\partial x}+y\dfrac{\partial u}{\partial y}=$...... **[2]**

a) 0 b) $-2u$

c) $2u$ d) none

ii) If $x=uv, y=\dfrac{u}{v}$ then $\dfrac{\partial(x,y)}{\partial(u,v)}=$...... **[2]**

a) $-\dfrac{2u}{v}$ b) uv

c) $\dfrac{v}{2u}$ d) $-\dfrac{v}{2u}$

iii) Rank of a matrix $A=\begin{bmatrix}2 & 2 & 2\\ 0 & -2 & 0\\ 2 & 2 & 2\end{bmatrix}$ is .... **[2]**

a) 0 b) 1

c) 2 d) 3

iv) For the matrix $A=\begin{bmatrix}1 & 0 & 0\\ -1 & 2 & 0\\ 1 & 0 & 3\end{bmatrix}$ the eigenvalues of A^2 are ..... **[2]**

a) 1,2,3 b) 1,4,9

c) –1, –2, –3 d) –1, –4, –9

P.T.O.

v) If $z = xy$ then $\frac{\partial^2 z}{\partial x \partial y} = ...$ **[1]**

a) x b) y

c) 1 d) 0

vi) If $A^{-1} = A^T$ then matrix A is ________ **[1]**

a) Singular b) Non-singular

c) Orthogonal d) None

Q2) a) If $u = \tan^{-1}\left(\frac{x}{y}\right)$, then show that $u_{xy} = u_{yx}$. **[5]**

b) If $u = \ln(x) + \ln(y)$, find the value of $x^2 u_{xx} + 2xy\, u_{xy} + y^2 u_{yy} + x u_x + y u_y$. **[5]**

c) If $u = f\left(e^{y-z}, e^{z-x}, e^{x-y}\right)$, find the value of $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z}$. **[5]**

OR

Q3) a) If $ux + vy = 0$ and $\frac{u}{x} + \frac{v}{y} = 1$, then show that $\left(\frac{\partial u}{\partial x}\right)_y - \left(\frac{\partial v}{\partial y}\right)_x = \frac{x^2 + y^2}{y^2 - x^2}$ **[5]**

b) If $f(x, y) = x^2 + \left(x^2 + y^2\right)[\ln(x) - \ln(y)]$, then find the value of $x f_x + y f_y$ **[5]**

c) If $x = u + v + w$, $y = uv + vw + wu$, $z = uvw$ and F is a function of x,y,z show that $uF_u + vF_v + wF_w = xF_x + 2y\, F_y + 3z\, F_z$. **[5]**

Q4) a) If $x = r\cos\theta$, $y = r\sin\theta$, then find $\frac{\partial(r,\theta)}{\partial(x,y)}$ **[5]**

b) Examine for functional dependence : **[5]**

$u = \frac{x-y}{x+y}$, $v = \frac{x+y}{x}$. If functionally dependent find the relation between them.

c) Discuss maxima and minima of $f(x,y) = x^2 + y^2 + 6x + 12$. **[5]**

OR

Q5) a) Verify $JJ' = 1$ for the transformation $x = uv,\ y = \frac{u}{v}$. **[5]**

b) In calculating the volume of a right circular cone, errors of 2% and 1% are made in measuring the height and radius of base respectively. Find the error in the calculated volume. **[5]**

c) By using Langrange's method, divide 24 into three parts such that the continued product of the first, square of the second and cube of the third is maximum. **[5]**

Q6) a) Show that the system **[5]**

$3x + 4y + 5z = \alpha$

$4x + 5y + 6z = \beta$

$5x + 6y + 7z = \gamma$

is consistent only when α, β, γ are in arithmetic progression.

b) Examine for linear dependence or independence, if dependent find the relation between them. $X_1 = (1, 1, 1, 3)$, $X_2 = (1,2,3,4)$, $X_3 = (2,3,4,7)$ **[5]**

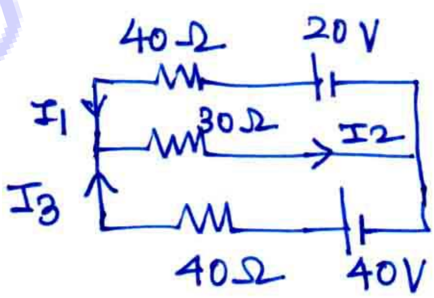
c) If $A = \begin{bmatrix} \frac{1}{3} & \frac{2}{3} & a \\ \frac{2}{3} & \frac{1}{3} & b \\ \frac{2}{3} & \frac{-2}{3} & c \end{bmatrix}$ is orthogonal. Find a,b,c. **[5]**

OR

Q7) a) Examine the consistency of the linear system of the following equations. If consistent solve it $x + y + z = 3$, $x + 2y + 3z = 4$, $x + 4y + 9z = 6$. **[5]**

b) Examine for linear dependence or independence of the following vectors. It dependent, Find the relation among vectors (1,1,1) (1,2,3) (2,3,8). **[5]**

c) Determine the currents in the network given in figure below **[5]**



Q8) a) Find eigen values and eigen vectors of the matrix $A = \begin{bmatrix} 1 & 1 & -2 \\ -1 & 2 & 1 \\ 0 & 1 & -1 \end{bmatrix}$. **[5]**

b) Verify the Cayley Hamilton theorem for $A = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & -2 \\ -2 & 0 & 1 \end{bmatrix}$ and use it to find A^{-1}. **[5]**

c) Find the modal matrix p such that $p^{-1}AP$ is diagonal matrix for

$$A = \begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$$ **[5]**

OR

Q9) a) Find the eigen values and eigen vectors of the matrix $A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$. **[5]**

b) Reduce the following quadratic form to the "sum of the squares form" $2x^2 + 9y^2 + 6z^2 + 8xy + 8yz + 6xz$. **[5]**

c) Verify the Cayley Hamilton theorem for $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -3 \end{bmatrix}$ Hence find A^{-1}. **[5]**

♦ ♦ ♦