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1B3N25414 (Pages : 2) Reg. No:..........................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester B.Sc Degree Examination, November 2025

MAT3CJ201 – Multivariable Calculus

(FYUGP 2024 Admission onwards)

Time: 2 hours Max. Marks : 70

PART – A

All questions can be attended.

Each question carries **Three** mark.

Ceiling -24 Marks

		COs	Knowledge Level (KL)	Marks
1	Graph the sets of points whose polar coordinates satisfy $0 \leq \theta \leq {}^{\pi}/_{2}$ and $0 \leq r \leq 2$	CO1	Analyze	3
2	Find Cartesian equation of the curve whose parametric equation is $x = \sqrt{t+1}, y = \sqrt{t}$ and $t \geq 0$	CO1	Evaluate	3
3	Find parametric equations for the line through the point $P(3,-4,-1)$ parallel to the vector $i + j + k$	CO1	Evaluate	3
4	Find domain and range of the function $$f(x,y) = \frac{1}{\sqrt{16 - x^2 - y^2}}$$	CO1	Evaluate	3
5	Find $\lim\limits_{(x,y)\to(0,0)} \frac{x^2 - xy}{\sqrt{x} - \sqrt{y}}$	CO2	Evaluate	3
6	Find all first order partial derivatives of the function $f(x,y,z) = yz\ln(xy)$.	CO2	Evaluate	3
7	Find gradient of the function $f(x,y) = \ln(x^2 + y^2)$ at $(1,1)$.	CO2	Evaluate	3
8	Find derivative of the function $f(x,y) = 2xy - 3y^2$ at $(5,5)$ in the direction of the vector $u = \frac{1}{\sqrt{2}}i + \frac{1}{\sqrt{2}}j$	CO2	Evaluate	3
9	Sketch the region of integration and evaluate the integral $\int_0^3 \int_0^2 (4 - y^2)dydx$.	CO3	Evaluate	3
10	Find the average value of $f(x,y) = sin(x + y)$ over the rectangle $0 \leq x \leq \pi, 0 \leq y \leq \pi$.	CO3	Evaluate	3

PART – B

All questions can be attended.
Each question carries **six** marks.
Ceiling -36 Marks

		COs	Knowledge Level (KL)	Marks
11	Find the distance from $S(1,1,3)$ to the plane $$3x + 2y + 6z = 6.$$	CO1	Evaluate	6
12	Find equations for the plane through the points $(3,4,5), (1,5,7)$, and $(-1,6,8)$.	CO1	Evaluate	6
13	Find $\frac{\partial w}{\partial r}$ and $\frac{\partial w}{\partial t}$ if $w = 4e^x \ln y$, $x = \ln(r\cos t)$ and $y = r\sin t$ at $(r,t) = (2, \pi/4)$.	CO2	Evaluate	6
14	Find the linearization $L(x,y)$ of $$f(x,y) = x^2 - xy + \frac{1}{2}y^2 + 3$$ at the point $(3,2)$.	CO2	Evaluate	6
15	Find f_{yx} if $f(x,y) = xe^y + \frac{1+\sin y^2}{1+y^2}$.	CO2	Apply	6
16	Find the points on the ellipse $x^2 + 2y^2 = 1$ where $f(x.y) = xy$ has its extreme values.	CO2	Evaluate	6
17	Find the center of mass of a thin plate of density $\delta = 3$ bounded by the lines $x = 0, y = x$, and the parabola $y = 2 - x^2$ in the first quadrant.	CO3	Evaluate	6
18	Evaluate the integral $\int_0^1 \int_0^{\sqrt{1-y^2}} (x^2 + y^2)dxdy$	CO3	Evaluate	6

PART - C

Answer any *one* questions.
Each question carries **Ten** marks.

		COs	Knowledge Level (KL)	Marks
19	Find the absolute maximum and minimum values of $$f(x,y) = 2 + 2x + 2y - x^2 - y^2$$ on the triangular plate in the first quadrant bounded by the lines $x = 0, y = 0, y = 9 - x$.	CO2	Evaluate	10
20	a) Find the volume of the region D enclosed by the surfaces $z = x^2 + 3y^2$ and $z = 8 - x^2 - y^2$. b) Sketch the region R enclosed by the parabola $y = x^2$ and the line $y = x + 2$ and find the area of the region R.	CO3	Evaluate	10

1 x 10 = 10 Marks

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester B.Sc Degree Examination, November 2025

MAT3CJ202 – Matrix Algebra

(FYUGP 2024 Admission onwards)

Time: 2 hours Max. Marks : 70

PART – A

All questions can be attended.
Each question carries **Three** mark.
Ceiling -24 Marks

		COs	Knowledge Level(KL)	Marks
1	Does there exists a linear system of equations with exactly two solutions? Justify your answer.	CO3	An, Ap	3
2	Let A be a 6 x 5 matrix. What must a and b be in order to define $T from R^a to R^b$ by $T(x) = Ax$?	CO3	Ap	3
3	Construct a 3x4 matrix with rank 1.	CO3	C	3
4	Define eigenvalue and eigenvector of an nxn matrix A.	CO2	R	3
5	State the rank theorem.	CO2	R	3
6	Find the characteristic equation of $A = \begin{pmatrix} 4 & 0 & -1 \\ 0 & 4 & -1 \\ 1 & 0 & 2 \end{pmatrix}$.	CO2	E	3
7	State the diagonalization theorem.	CO2	R	3
8	Find the inverse of $A = \begin{pmatrix} 3 & -4 \\ 5 & 6 \end{pmatrix}$.	CO1	E	3
9	Suppose P is invertible and $A = PBP^{-1}$. Solve for B in terms of A.	CO3	Ap	3
10	A is a 3 x 3 matrix with two eigenvalues. Each eigenspace is one dimensional. Is A digonalizable? Justify your answer.	CO3	An, Ap	3

PART – B

All questions can be attended.

Each question carries **six** marks.

Ceiling -36 Marks

		COs	Knowledge Level(KL)	Marks
11	Determine if the set $\{v_1, v_2, v_3\}$ where $v_1 = \begin{pmatrix}1\\2\\3\end{pmatrix}$, $v_2 = \begin{pmatrix}4\\5\\6\end{pmatrix}$ and $v_3 = \begin{pmatrix}2\\1\\0\end{pmatrix}$ is linearly independent.	CO2	E	6
12	For what values of h and k the system $2x_1 - x_2 = h$ $-6x_1 + 3x_2 = k$ Consistent ? Explain your answer.	CO2	Ap	6
13	Check whether $u = \begin{pmatrix}-5\\5\\3\end{pmatrix}$ is in Nul A where $A = \begin{pmatrix}-2 & -2 & 0\\0 & 3 & -5\\6 & 3 & 5\end{pmatrix}$.	CO1	An, Ap	6
14	Determine if $A = \begin{pmatrix}2 & 4 & 3\\-4 & -6 & -3\\3 & 3 & 1\end{pmatrix}$ is diagonalisable or not.	CO2	E	6
15	Find a basis for the eigenspace corresponding to $\lambda = 1,3$ of $A = \begin{pmatrix}3 & 0\\2 & 1\end{pmatrix}$	CO2	E	6
16	Find the inverse of $\begin{pmatrix}0 & 1 & 2\\1 & 0 & 3\\4 & -3 & 8\end{pmatrix}$ if it exists.	CO2	E	6
17	Determine if the system $2x_1 - 5x_2 + 8x_3 = 0$ $-2x_1 - 7x_2 + x_3 = 0$ $4x_1 + 2x_2 + 7x_3 = 0$ has a nontrivial solution.	CO1	E	6

18	Determine if b=$\begin{pmatrix} 2 \\ -1 \\ 6 \end{pmatrix}$ is a linear combination of $u = \begin{pmatrix} -1 \\ 2 \\ 0 \end{pmatrix}$ $v = \begin{pmatrix} 0 \\ 1 \\ 2 \end{pmatrix}$ and $w = \begin{pmatrix} 5 \\ -6 \\ 8 \end{pmatrix}$.	CO2	An	6

PART - C

Answer any *one* questions.
Each question carries **Ten** marks.

		COs	Knowledge Level(KL)	Mar ks
19	Solve the system $x_1 - 3x_3 = 8$ $2x_1 + 2x_2 + 9x_3 = 7$ $x_2 + 5x_3 = -2$	CO1	Ap, E	10
20	a) Find the parametric equations of the line through $a = \begin{pmatrix} -2 \\ 0 \end{pmatrix}$ parallel to $b = \begin{pmatrix} -5 \\ 3 \end{pmatrix}$ b) Determine if the columns of $\begin{pmatrix} 0 & -3 & 9 \\ 2 & 1 & -7 \\ -1 & 4 & -5 \\ 1 & -4 & -2 \end{pmatrix}$ is linearly independent.	CO3	An, Ap, E	10

1 x 10 = 10 Marks

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Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester B.Sc Degree Examination, November 2025

MAT3MN201 – Calculus of Several Variables

(FYUGP 2024 Admission onwards)

Time: 2 hours Max. Marks : 70

PART – A

All questions can be attended.

Each question carries Three mark.

Ceiling -24 Marks

		COs	Knowledge Level(KL)	Marks
1	Find the domain of the vector function $$r(t) = \langle 1/t, \sqrt{t-1}, ln(t) \rangle.$$	CO1	Apply	3
2	Find r'(t) if $r(t) = 2e^{3t}\, i + ln\, t\, j + sin\, t\, k$.	CO1	Apply	3
3	Show that the function $u(x,y) = e^x \cos y$ is harmonic in the xy-plane.	CO1	Understand	3
4	Let $z = f(x,y) = 2x^2 - xy$. Compute the value of dz if (x,y) changes from (1,1) to (0.98,1.03).	CO1	Apply	3
5	Find the gradient vector field of $f(x,y) = x^2 + xy + y^2z^3$.	CO1	Apply	3
6	Define divergence of a vector field.	CO1	Remember	3
7	State Green's theorem.	CO3	Remember	3
8	Find f_x if $f(x,y,z) = x^2y + y^2z + xz$.	CO1	Apply	3
9	Let $z = f(x,y) = 2x^2 - xy$. Find the differential dz.	CO1	Apply	3
10	Find the area of the part of the plane $y + z = 2$ inside the cylinder $x^2 + z^2 = 1$.	CO2	Apply	

PART – B

All questions can be attended.

Each question carries six marks.

Ceiling -36 Marks

		COs	Knowledge Level(KL)	Marks
11	Find the tangent vectors to the plane curve C defined by the vector function $$r(t) = 3\, cos\, t\, i + 2\, sin\, t\, j$$ at the points where $t = 0$ and $t = \pi/3$.	CO1	Apply	6

12	Find $\int r(t)dt$ if $r(t) = (t+1)i + \cos 2t\, j + e^{3t}k$.	**CO1**	**Apply**	**6**
13	Evaluate $\iiint_B (x^2y + yz^2)dV$, where $B = \{(x,y,z);\ -1 \le x \le 1, 0 \le y \le 3, 1 \le z \le 2\}$.	**CO2**	**Apply**	**6**
14	Let f be a scalar function, and let F be a vector field. If f and the components of F have first-order partial derivatives, show that $$div(fF) = f\, div\, F + F \cdot \nabla f$$	**CO1**	**Apply**	**6**
15	Find the gradient vector field of the function $f(x,y,z) = \frac{-k}{\sqrt{(x^2+y^2+z^2)}}$ and hence deduce that the inverse square field F is conservative.	**CO1**	**Apply**	**6**
16	Evaluate the iterated integral $\int_1^2 \int_0^1 3x^2y\, dx\, dy$.	**CO1**	**Apply**	**6**
17	Evaluate $\iint_R (1 - 2xy^2)dA$ where $$R = \{(x,y): 0 \le x \le 2, -1 \le y \le 1\}$$	**CO3**	**Evaluate**	**6**
18	Evaluate $\oint_C x^2dx + (xy + y^2)dy$ where C is the boundary of the region R bounded by the graphs of $y = x$ and $y = x^2$ and is oriented in a positive direction.	**CO4**	**Apply**	**6**

PART - C

Answer any *one* questions.
Each question carries **Ten** marks.

		COs	Knowledge Level(KL)	Marks
19	Evaluate $\iiint_T \sqrt{x^2+y^2}\, dV$, where T is the region bounded by the cylinder $x^2 + z^2 = 1$ and the planes $y + z = 2$ and $y = 0$.	**CO2**	**Apply**	**10**
20	Find the flux of the vector field $F(x,y,z) = y\,\mathrm{i} + x\,\mathrm{j} + 2z\,\mathrm{k}$ across the unit sphere $x^2 + y^2 + z^2 = 1$.	**CO3**	**Evaluate**	**10**

1 x 10 = 10 Marks

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester B.Sc Degree Examination, November 2025

MAT3MN202 – Differential Equations and Fourier Series

(FYUGP 2024 Admission onwards)

Time: 2 hours

Max. Marks : 70

PART-A

All questions can be attended
Each question carries Three mark
Ceiling-24 Marks

		COs	Knowledge Level	Marks
1	Solve $x\frac{dy}{dx} = 4y$.	3	C	3
2	Verify that $y = xe^x$ is a solution of $y'' - 2y' + y = 0$.	3	C	3
3	Solve $y'' - 6y' + 5y = 0$.	3	C	3
4	Solve $x^2y'' + 5xy' + 4y = 0$	3	C	3
5	Verify that $y_1 = x$, $y_2 = x + 1$, $y_3 = x^2 + 2x$ are linearly independent .	3	C	3
6	Determine the Fourier series expansion of $f(x) = x$, $-\pi < x < \pi$.	4	C	3
7	Classify $3\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial y}$ as hyperbolic ,parabolic or elliptic .	4	C	3
8	Determine product solution of $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} = 0$.	3	C	3
9	If $z_1 = 2 - 3i$ *and* $z_2 = 4 + 6i$ compute $a)\frac{1}{z_1}$ $b) z_1 + 2z_2$.	2	C	3
10	Compute $\lim_{z \to i} \frac{z^4 - 1}{z - i}$.	2	C	3

PART-B

All questions can be attended
Each question carries six mark
Ceiling-36 Marks

11	Solve $x\frac{dy}{dx} - 4y = x^6 e^x$.	3	C	6
12	Solve the IVP $(x^2 + 2xy + y^2)dx + (2xy + x^2 - 1)dy = 0$, $y(1) = 1$.	3	C	6
13	Solve $\frac{dy}{dx} = (-2x + y)^2 + 7,\ y(0) = 0$.	3	C	6
14	Solve $y'' - 16y = 2e^{4x}$.	3	C	6
15	Determine the cosine series of $f(x) = x^2, 0 < x < 1$.	4	C	6
16	Verify that $u(x, y) = x^3 - 3xy^2 - 5y$ is harmonic in the entire complex plane and determine harmonic conjugate of u	3	C	6
17	Determine the three cube roots of $z = i$	3	C	6
18	Show that $f(x) = (x + \sin x \cos hy) + i(y + \cos x \sin hy)$ is analytic in an appropriate domain .	3	C	6

PART-C

Answer any one question
Each question carries Ten marks

19	a)State Superposition principle for non-homogeneous equation. b)Solve $y'' - 2y' - 3y = 4x - 5 + 6xe^{2x}$.	1 3	C C	10
20	Determine the Fourier series of $f(x) = \left\{ \begin{cases} 0, & -\pi < x < 0 \\ \pi - x, & 0 < x < \pi \end{cases} \right\}$	4	C	10

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Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester B.Sc Degree Examination, November 2025

MAT3MN203 – Matrix Algebra and Vector Calculus

(FYUGP 2024 Admission onwards)

Time: 2 hours Max. Marks : 70

Course Outcome Mapping Scheme

Q.NO	1	2	3	4	5	6	7	8	9	10
COS	CO1	CO1	CO1	CO1	CO1	CO1	CO1	CO1	CO1	CO2
Q.NO	11	12	13	14	15	16	17	18	19	20
COS	CO1	CO1	CO1	CO1	CO1	CO1	CO2	CO2	CO1	CO3

Section A

Answer any number of questions.
Each question carries **3** marks. Ceiling is **24**.

1. Find the distance between the points $(2, -3, 6)$ and $(4, 6, 8)$.
2. Prove that the triangle, with vertices $A(0,0,0), B(3,6,-6)$ and $B(2,1,2)$, is isosceles.
3. Check whether the vectors $\langle -3, -1,4 \rangle$ and $\langle 2,14,5 \rangle$ are orthogonal or not.
4. Find the parametric and symmetric equations for the line through $(4, -11, -7)$ that is parallel to the line $x = 2 + 5t, y = -1 + 2t, z = 9 - 2t$.
5. Find the directional cosines and the direction of angles of the vector $\boldsymbol{a} = 2\boldsymbol{i} + 5\boldsymbol{j} + 4\boldsymbol{k}$.
6. Find the vector function that describes the curve C of intersection of the plane $y = 2x$ and the paraboloid $z = 9 - x^2 - y^2$.
7. Find the vector function $\boldsymbol{r}(t)$ that satisfies $\boldsymbol{r}'(t) = t\boldsymbol{i} + t^3\boldsymbol{j} + t\boldsymbol{k}; \boldsymbol{r}'(0) = \boldsymbol{i} - 2\boldsymbol{j} + \boldsymbol{k}$.
8. Find the curl and divergence of the function $F(x, y, z) = xz\boldsymbol{i} + yz\boldsymbol{j} + xy\boldsymbol{k}$.
9. Evaluate $\int_C xy^2 ds$ where C is the quarter unit circle in the first quadrant.
10. Let $A = \begin{bmatrix} 1 & -2 \\ -2 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} -1 & 6 \\ 3 & 2 \end{bmatrix}$. Then show that $AB \neq BA$.

Section B

Answer any number of questions.

Each question carries **6** marks. Ceiling is **36**

11. Find the parametric equations for the line of intersection of the plane $5x - 4y - 9z = 8$ and the plane $x + 4y + 3z = 4$.

12. If $z = u^2 - v^2$ and $u = e^{2x-3y}, v = \sin(x^2 - y^2)$, then find $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$.

13. Find the length of the curve traced by the vector function $\boldsymbol{r}(t) = a\cos t\,\boldsymbol{i} + a\sin t\,\boldsymbol{j} + ctk;\ 0 \le t \le 2\pi$.

14. Evaluate $\iint_R x^3y^2 dA$ where R is the region bounded by the graphs of the lines $y = x \;\; y = 0,\;\; x = 1$.

15. Evaluate $\iint_S xz^2 dS$, where S is the cylinder $y = 2x^2 + 1$in the first octant bounded by $x = 0, x = 2, z = 4, z = 8$.

16. Change the order of integration $\int_{x=0}^{2}\int_{y=x^3}^{y=8}\int_{z=0}^{z=4} F(x,y,z)dzdydx$ in to $dxdydz$.

17. Find the rank of the matrix $\begin{bmatrix} 1 & -2 & 3 & 4 \\ 1 & 4 & 6 & 8 \\ 0 & 1 & 0 & 0 \\ 2 & 5 & 6 & 8 \end{bmatrix}$.

18. Solve $x_1 + 2x_2 - x_3 = 0,\ 2x_1 + x_2 + 2x_3 = 9,\ x_1 - x_2 + x_3 = 3$ by Gauss-Jordan elimination.

Section C

Answer any one question.

Each Question carries **10** marks.

19. Find the surface area of that portion of the sphere $x^2 + y^2 + z^2 = a^2$ that is above the xy-plane and within the cylinder $x^2 + y^2 = b^2, 0 < b < a$.

20. Find the eigen values and eigen vectors of $A = \begin{bmatrix} 9 & 1 & 1 \\ 1 & 9 & 1 \\ 1 & 1 & 9 \end{bmatrix}$.

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Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Third Semester B.Sc Degree Examination, November 2025

MAT3MN204 – Boolean Algebra and System of Equations

(FYUGP 2024 Admission onwards)

Time: 2 hours Max. Marks : 70

Course Outcome Mapping Scheme

Q.NO	1	2	3	4	5	6	7	8	9	10
COS	CO1	CO1	CO1	CO1	CO1	CO2	CO2	CO2	CO2	CO2
Q.NO	11	12	13	14	15	16	17	18	19	20
COS	CO1	CO1	CO1	CO1	CO2	CO2	CO2	CO2	CO1	CO3

Section A
Answer any number of questions.
Each question carries 3 marks. Ceiling – 24 marks.

1. Define linearly ordered set. Give an example for a linearly ordered set.
2. Write the dual of the statement $(a \wedge b) \vee c = (b \vee c) \wedge (c \vee a)$
3. Define complemented lattice. Give an example of complemented lattice.
4. Reduce the Boolean products
   i) $xyz'sy'ts$
   ii) $xyz'ty't$
   to either 0 or a fundamental product.
5. Consider the Boolean algebra D_{24}={1,2,3,4,6,8,12,24}, with respect the Boolean operations corresponding to division of 24. Find $2 + 3$, and $8*12$.
6. Show by an example that the matrix multiplication is not commutative.
7. If $A = \begin{bmatrix} 4 & 9 \\ 0 & 2 \\ 1 & 6 \end{bmatrix}, B = \begin{bmatrix} 3 & 7 \\ 2 & 8 \end{bmatrix}$. Then find $(AB)^T$
8. What are the elementary row operations of a matrix.
9. Find the determinant of the matrix $A = \begin{bmatrix} \cos n\theta & \sin n\theta \\ -\sin n\theta & \cos n\theta \end{bmatrix}$.
10. Find the rank of the matrix $A = \begin{bmatrix} 8 & 4 \\ -2 & -1 \\ 6 & 3 \end{bmatrix}$.

Section B

Answer any number of questions.

Each question carries **6** marks. Ceiling – **36** marks

11. Let $\boldsymbol{N}$ be the set of positive integers. Define $a|b$ by if there exists an integer c such that $ac = b$. Prove that this relation is partial order but not linear order on $\boldsymbol{N}$.
12. Prove that the set $\boldsymbol{Q}$ of rational number with the usual order $\leq$ is linearly ordered, but no element in $\boldsymbol{Q}$ has immediate successor or an immediate predecessor.
13. Let $\boldsymbol{N} = \{1,2,3,\cdots\}$ be ordered by divisibility. Find elements of join irreducible and atoms.
14. Consider the partially ordered set $D_{36} = \{1,2,3,4,6,9,12,18,36\}$, the divisors of 36, with partial order divisibility. D_{36} is a Boolean algebra with respect to the operations $+$, $*$, and $'$ defined by $a + b = \text{lcm}(a, b)$,
    $a * b = \text{gcd}(a, b)$ and $a' = \frac{36}{a}$. Then
    (a) Find two subalgebras of D_{36} with four elements.
    (b) Is $A = \{1,2,3,6,36\}$ a sublattice of D_{36}? Is A a subalgebra? Justify your answer.
15. Show that the system of equations $3x_1 + 2x_2 + x_3 = 3,\ 2x_1 + x_2 + x_3 = 0,\ 6x_1 + 2x_2 + 4x_3 = 6$ has no solution.
16. Check whether the vectors $[-1,\ 5, 0]$, $[16,\ 8, -3]$, $[-64,\ 56, 9]$ are linearly independent or dependent.
17. Solve the system of equation $x + 2y + 3z = 20,\ x + 6y + 2z = 0, 7x + 3y + z = 13$ by Cramer's rule.
18. Calculate the inverse by Gauss-Jordan elimination of the matrix $A = \begin{bmatrix} 4 & -1 & -5 \\ 15 & 1 & -5 \\ 5 & 4 & 9 \end{bmatrix}$

Section C

Answer any one question.

Question carries **10** marks.

19. (i) Express the Boolean expression $E = ((xy)'z)'((x' + z)(y' + z'))$ as a sum of products.
    (ii) Express the Boolean expression $E(x, y, z) = x'z + yz + y'$ in its complete sum of products.
20. Find the eigenvalues and eigenvectors of the matrix $A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$.