SRM VALLIAMMAI ENGEINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203.

(An Autonomous Institution)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

I SEMESTER

1918106 – APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS

Regulation – 2019

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SRM VALLIAMMAI ENGEINEERING COLLEGE

QUESTION BANK

DEPARTMENT OF MATHEMATICS

SUBJECT : 1918106 – APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS

SEM / YEAR : I / I year M.E. (PSE & CI)

UNIT I -MATRIX THEORY- Cholesky decomposition - Generalized Eigen vectors, Canonical basis - QR factorization - Least squares method - Singular value decomposition.

Q.No.	Question	Bloom's Taxonomy Level	Domain
	PART – A		
1.	Define Real Symmetric Matrix.	**BTL -1**	Remembering
2.	Write the necessary conditions for Cholesky decomposition of a matrix.	**BTL -1**	Remembering
3.	Find the Cholesky decomposition of $\begin{pmatrix} 4 & 2 \\ 2 & 10 \end{pmatrix}$	**BTL -2**	Understanding
4.	Find the sum and product of all Eigen values of $\begin{bmatrix} 1 & 2 & -2 \\ 1 & 0 & 3 \\ -2 & -1 & -3 \end{bmatrix}$	**BTL -2**	Understanding
5.	Define Least square method.	**BTL -1**	Remembering
6.	Find the least square solution to the system $x_1 + x_2 = 3 , -2x_1 + 3x_2 = 1 \; and \; 2x_1 - x_2 = 2$	**BTL -2**	Understanding
7.	Define Hermitian Matrix.	**BTL -1**	Remembering
8.	Write short note on Singular value decomposition of complex matrix A.	**BTL -1**	Remembering
9.	State Singular value decomposition theorem.	**BTL -1**	Remembering
10.	If A is a nonsingular matrix, then what is A^+?	**BTL -4**	Analyzing
11.	Define orthogonal and orthonormal vectors.	**BTL -1**	Remembering
12.	Define singular matrix with an example.	**BTL -1**	Remembering
13.	What is the advantage in matrix factorization methods?	**BTL -1**	Remembering
14.	If the sum of two eigenvalues and trace of a 3x3 matrix A are	**BTL -1**	Remembering

	equal find the value of |A|.		
15.	Let $A = \begin{pmatrix} 1 & 1 \\ 1 & 3 \end{pmatrix} = A_1$ .Compute A_2 using QR algorithm.	BTL -5	Evaluating
16.	Determine the canonical basis for the matrix A = $\begin{bmatrix} 3 & 5 \\ -2 & -4 \end{bmatrix}$.	BTL -3	Applying
17.	Define the generalized Eigen vector, chain of rank m, for a square matrix.	BTL -2	Understanding
18.	Find the generalized inverse of $\begin{bmatrix} 1 & 1 \\ 0 & 1 \\ 1 & 0 \end{bmatrix}$	BTL -5	Evaluating
19.	Check whether the given matrix is positive definite or not $\begin{pmatrix} 3 & 1 & -1 \\ 1 & 3 & -1 \\ -1 & -1 & 5 \end{pmatrix}$	BTL -4	Analyzing
20.	Give the nature of quadratic form without reducing into canonical form $x_1^2 - 2\, x_1\, x_2 + x_2^2 + x_3^2$	BTL -4	Analyzing
	PART – B		
1.	Determine the Cholesky decomposition of the matrix $\begin{bmatrix} 4 & 2i & -i \\ -2i & 10 & 1 \\ i & 1 & 9 \end{bmatrix}$	BTL -1	Remembering
2.	Find the Cholesky decomposition of the matrix $\begin{bmatrix} 4 & 2i & 2 \\ -2i & 10 & 1-i \\ 2 & 1+i & 9 \end{bmatrix}$	BTL -2	Understanding
3.	Find the QR factorization of A = $\begin{bmatrix} 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{bmatrix}$	BTL -2	Understanding
4.	Solve the following system of equations in the least square sense $2x_1 + 2x_2 - 2x_3 = 1, 2x_1 + 2x_2 - 2x_3 = 3, -2x_1 - 2x_2 + 6x_3 = 2$	BTL -5	Evaluating
5.	Determine the Cholesky decomposition of $\begin{bmatrix} 9 & -3 & 0 & -3 \\ -3 & 6 & 3 & 0 \\ 0 & 6 & 3 & 0 \\ -3 & 0 & -3 & 6 \end{bmatrix}$	BTL -3	Applying
6.	Fit a straight line in the least square sense to the following data **X: -3 -2 -1 0 1 2 3** **Y: 10 15 19 27 28 34 42**	BTL -6	Creating
7.	Find the QR factorization of A = $\begin{bmatrix} 1 & 1 & -1 \\ 1 & 0 & 0 \\ 1 & 0 & -2 \\ 1 & 1 & 1 \end{bmatrix}$	BTL -4	Analyzing
8.	Construct the singular value decomposition for $\begin{bmatrix} 2 & 2 & -2 \\ 2 & 2 & -2 \\ -2 & -2 & 6 \end{bmatrix}$	BTL -6	Creating

9.	Solve the following system of equations in the least square sense $x_1 + x_2 + 3x_3 = 1$; $x_1 + x_2 + 3x_3 = 2$	**BTL -5**	Evaluating
10.	Obtain the singular value decomposition of $A = \begin{bmatrix} 1 & 2 \\ 1 & 1 \\ 1 & 3 \end{bmatrix}$	**BTL -2**	Understanding
11.	Determine the Cholesky decomposition of the matrix $\begin{bmatrix} 16 & -3 & 5 & -8 \\ -3 & 16 & -5 & -8 \\ 5 & -5 & 24 & 0 \\ 8 & -8 & 0 & 21 \end{bmatrix}$	**BTL -3**	Applying
12.	Obtain the singular value decomposition of $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 1 & 3 \end{bmatrix}$	**BTL -3**	Applying
13.	Find the QR factorization of $A = \begin{bmatrix} 1 & 1 & -1 \\ 1 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$	**BTL -1**	Remembering
14.	Solve the following system of equations in the least square sense **$x_1 + x_2 + x_3 = 1$; $x_1 + x_2 + x_3 = 2$; $x_1 + x_2 + x_3 = 3$.**	**BTL -5**	Evaluating
	PART –C		
15.	Solve the system of equations using Cholesky decomposition $4x_1 - x_2 - x_3 = 3$; $-x_1 + 4x_2 - x_3 = -0.5$; $-x_1 - 3x_2 + 5x_3 = 0$	**BTL -5**	Evaluating
16.	Obtain the singular value decomposition of $A = \begin{bmatrix} 2 & -1 \\ -2 & 1 \\ 4 & -2 \end{bmatrix}$	**BTL -2**	Understanding
17.	Obtain A^+ of $A = \begin{bmatrix} 2 & -1 \\ -1 & 1 \\ 4 & -3 \end{bmatrix}$ the generalized inverse.	**BTL -2**	Understanding
18.	Find the Unique solution of least square problem $A = \begin{bmatrix} 2 & -2 \\ 1 & 1 \\ 2 & 2 \end{bmatrix}$ $b = \begin{bmatrix} 500 \\ 600 \\ 900 \end{bmatrix}$	**BTL -6**	Creating

UNIT –II-CALCULUS OF VARIATION: Concept of variation and its properties–Euler's equation–Functional dependant on first and higher order derivatives–Functional dependant on functions of several independent variables–Variational problems with moving boundaries–Isoperimetric problems-Direct methods: Ritz and Kantorovich methods.

Q.No.	**Question**	**Bloom's Taxonomy Level**	**Domain**
	PART – A		
1.	Define functional with an example.	**BTL -1**	Remembering
2.	Define Extremals of a functional.	**BTL -1**	Remembering

3.	State the necessary condition for the extremum of the functional I = $\int_{x_0}^{x_1} F(x, y, y')\,dx$.	**BTL -2**	Understanding
4.	Find the extremals of the functional $\int_{x_0}^{x_1}\left(\frac{y'^2}{x^3}\right)dx$.	**BTL -3**	Applying
5.	Write a formula for functional involving higher order derivatives.	**BTL -1**	Remembering
6.	Solve the Euler equation for $\int_{x_0}^{x_1}(1+x^2\,y')y'\,dx$	**BTL -5**	Evaluating
7.	Solve the Euler equation for $\int_{x_0}^{x_1}(x+y')y'\,dx$	**BTL -5**	Evaluating
8.	Write Euler's equation for functional.	**BTL -2**	Understanding
9.	Find the curve on which the functional straight line $\int_{x_0}^{x_1}[(y')^2+12xy]\,dx$ with y(0) = 0 and y(1) = 1can be extremised.	**BTL -6**	Creating
10.	Write Euler-Poisson equation.	**BTL -2**	Understanding
11.	Write the Ostrogradsky equation for the functional $\iint F(x,y,u,u_x,u_y)\,dxdy$.	**BTL -2**	Understanding
12.	Write other forms of Euler's equation.	**BTL -1**	Remembering
13.	If $\frac{d^2y}{dx^2} = 6x$ then find y.	**BTL -1**	Remembering
14.	Define Geodesic.	**BTL -1**	Remembering
15.	Define isoperimetric problems	**BTL -1**	Remembering
16.	Define several independent variables.	**BTL -2**	Understanding
17.	Write short note on Rayleigh - Ritz method.	**BTL -2**	Understanding
18.	Write the surface area of a curve which generates extremal values.	**BTL -4**	Analyzing
19.	Find the extremal of F = x y + y^2 - 2 y^2 y'.	**BTL -2**	Understanding
20.	If $\frac{d^2y}{dx^2} = \frac{-1}{2}$ then find y.	**BTL -2**	Understanding
	PART –B		
1.(a)	Find the extremals of (i) $\int_{x_0}^{x_1}(y'^2 + 2yy' - 16y^2)\,dx$.	**BTL -3**	Applying

1. (b)	Find the extremals of $\int_0^{\frac{\pi}{2}} [y^2 + (y')^2 - 2y\sin x]\,dx$ y(0) = y(π/2) = 0.	**BTL -3**	Applying
2. (a)	Solve the extremals $\boldsymbol{v[y(x)] = \int_{x0}^{x1} \frac{dy}{dx}\left(1 + x^2\frac{dy}{dx}\right)dx}$.	**BTL -5**	Evaluating
2.(b)	Find the extremals of $\int_0^{\frac{\pi}{2}} [y^2 - (y')^2 - 2y\sin x]\,dx$ y(0) = y(π/2) = 0.	**BTL -3**	Applying
3. (a)	Show that the straight line is the shortest distance between two points.	**BTL -2**	Understanding
3.(b)	Find the extremals of $\boldsymbol{\int_{x_0}^{x_1} (y^2 + {y_1}^2 - 2ye^x)\,dx}$	**BTL -2**	Understanding
4.	A curve c joining the points $(\boldsymbol{x_1, y_1})$ and $(\boldsymbol{x_2, y_2})$ is revolved about the x-axis. Find the shape of the curve, so that the surface area generated is a minimum.	**BTL -4**	Analyzing
5. (a)	Find the extremals of $\int_0^{\pi} [y'^2 - y^2 + 4y\cos x]\,dx$ y(0) = y(π) = 0.	**BTL -3**	Applying
5.(b)	On what curve the functional $\int_0^{\frac{\pi}{2}} [y'^2 - y^2 + 2xy]\,dx \; with \; y(0) = 0 \;\; y(\frac{\pi}{2}) = 0$ be extremised.	**BTL -2**	Understanding
6.	Find the curves on which the functionals $\int_0^1 [y'^2 + 12yx]\,dx$ with y(0) = 0 , y(1)=1 can be extremised.	**BTL -4**	Analyzing
7. (a)	Determine the extremals of the functional $\boldsymbol{I[y(x)] = \int_{-a}^{a} \left\{\frac{1}{2}\mu(y^{11})^2 + \rho y\right\} dx}$ that satisfies the boundary condition $\boldsymbol{y(-a) = 0, y(a) = 0, y^1(-a) = 0, y^1(a) = 0}$.	**BTL -3**	Applying
7. (b)	Find the extremals of $\int_{x_0}^{x_1} [y^2 + (y')^2 + 2y\,e^x]\,dx$	**BTL -3**	Applying
8.	Show that the functional $\int_0^{\frac{\pi}{2}} [2xy + \left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2]\,dt$ such that x(0) = 0 x(π/2) = -1 y(0) = 0 , y(π/2) = 1 is stationary for x = - sin t y = sin t.	**BTL -5**	Evaluating
9.	Find the curve on which an extremum of the function $\boldsymbol{I = \int_0^{\frac{\pi}{4}} \left\{y^2 - \left(\frac{dy}{dx}\right)^2\right\} dx, y(0) = 0}$ can be achieved if the second boundary point is permitted to move along the straight line $\boldsymbol{x = \frac{\pi}{4}}$.	**BTL -4**	Analyzing

10.	Solve the boundary value problem by Rayleigh Ritz method. $y^{11} - y + x = 0\ (0 \le x \le 1)\ y(0) = y(1) = 0$	**BTL -5**	Evaluating
11.	Show that the curve which extremize $I = \int_0^{\frac{\pi}{2}} [(y^{11})^2 - y^2 + x^2]dx$ given that $y(0) = 0, y^1(0) = 1, y\left(\frac{\pi}{4}\right) = \frac{1}{\sqrt{2}}, y^1\left(\frac{\pi}{4}\right) = \frac{1}{\sqrt{2}}$ $is\ y = \sin x$.	**BTL -4**	Analyzing
12.	Solve the problem y” = 3x+4y, y(0) = 0 , y(1) = 1 by Rayleigh Ritz method.	**BTL -5**	Evaluating
13.	Find an approximate solution to the problem of minimum of the functional $J(y) = \int_0^1 (y'^2 - y^2 + 2xy)dx, y(0) = 0 = y(1)$ by Ritz method.	**BTL - 3**	Applying
14.	Find the extremals of $\int_{x0}^{x1} [2yz - 2y^2 + y^2 - z'^2]dx$.	**BTL -3**	Applying
	PART – C		
15.	Prove that the sphere is the solid figure of a revolution which for a given surface has maximum volume.	**BTL -2**	Understanding
16.	Solve problem y” + (1+x^2)y +1 = 0 by Rayleigh Ritz method if y(-1) = y(1) = 0.	**BTL -5**	Evaluating
17.	Find the extremals of $\int_1^2 \frac{\sqrt{(1+y'^2)}}{x}$ y(1) = 0, y(2) = 1.	**BTL -3**	Applying
18.	Find the extremals of the functional $v[y(x), z(x)] = \int_0^{\frac{1}{2}\pi} \left(y^{1^2} + z^{1^2} + 2yz\right) dx$ *given that* $y(0) = 0$, $y\left(\frac{1}{2}\pi\right) = -1$, z(0)=0,$z\left(\frac{1}{2}\pi\right) = 1$.	**BTL -3**	Applying

UNIT – III PROBABILITY AND RANDOM VARIABLES: Probability–Axioms of probability–Conditional probability–Baye’s theorem-Random variables-Probability function–Moments–Moment generating functions and their properties–Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions–Function of a random variable.

Q.No.	**Question**	**Bloom’s Taxonomy Level**	**Domain**
	PART – A		
1.	Define conditional probability.	**BTL -1**	Remembering
2.	Define Random variable and mention its types.	**BTL -2**	Understanding
3.	If the mean of a Poisson variate is 2, then what is the standard deviation?	**BTL -2**	Understanding
4.	If f(x) = K $(x + x^2)$ in 1< x < 5 is a pdf of a continuous random variables. Find the value of K.	**BTL -2**	Understanding
5.	The mean of Binomial distribution is 20 and standard deviation is	**BTL -6**	Creating

	4. Find the parameters of the distribution.		
6.	If the pdf of a RV is $f(x) = \frac{x}{2}, 0 \le x \le 2,$ find $P(X > 1.5)$.	**BTL -3**	Applying
7.	The mean variances of binomial distribution are 4 and 3 respectively. Find P(X=0).	**BTL -3**	Applying
8.	Find the moment generating function of Poisson distribution.	**BTL -3**	Applying
9.	Define Exponential distribution.	**BTL -2**	Understanding
10.	Obtain the moment generating function of Geometric distribution.	**BTL -1**	Remembering
11.	The probability that a candidate can pass in an examination is 0.6. What is the probability that he will pass in third trial?	**BTL -4**	Analyzing
12.	If the RV X takes the values 1 ,2,3 , 4 such that 2P(X = 1) =3P(X =2) =P (X =3) = 5 P (X =4) find the probability distribution.	**BTL -4**	Analyzing
13.	State the memory less property of an exponential distribution.	**BTL -1**	Remembering
14.	If a RV has the pdf $f(x) = \begin{cases} e^{-2x} & for\ x > 0 \\ 0, & for\ x \le 0 \end{cases}$, find the mean variance of RV X.	**BTL -5**	Evaluating
15.	Derive the mean of Uniform distribution.	**BTL -4**	Analyzing
16.	$If\ f(x) = \begin{cases} kx^2, & 0 < x < 3 \\ 0, & otherwise \end{cases}$ Find the value of X ,then find the value of K.	**BTL -5**	Evaluating
17.	Define uniform distribution.	**BTL -5**	Evaluating
18.	If a RV has the probability density $(x) = \begin{cases} 2e^{-2x} & for\ x > 0 \\ 0, & for\ x \le 0 \end{cases}$, find the probabilities that will take a value between 1 and 3.	**BTL -4**	Analyzing
19.	The pdf of a continuous random variable X is $f(x) = k(1+x), 2 < x < 5$, Find k.	**BTL -4**	Analyzing
20.	For a continuous distribution $f(x) = k(x - x^2), 0 \le x \le 1$, where k is a constant. Find k.	**BTL -1**	Remembering
	PART –B		
1.(a)	The mean and variance of a Binomial variate are 8 and 6, Find $P(x \ge 2)$	**BTL -6**	Creating
1. (b)	Derive the MGF of Poisson distribution and hence deduce its mean and variance.	**BTL -1**	Remembering
2.	The probability density function of a random variable X is given	**BTL -4**	Analyzing

<table>
<tr><td></td><td>by $f(x) = \begin{cases} x & 0 < x < 1 \\ k(2-x) & 1 \le x \le 2 \\ 0 & otherwise \end{cases}$ (i)Find the value of k
(ii) P (0.2<x<1.2) (iii) What is P[0.5 < x < 1.5/x ≥1 (iv) Find the distribution function of f(x).</td><td></td><td></td></tr>
<tr><td>3. (a)</td><td>If X has a Poisson distribution, if P(x = 2) = 2/3 P(x=1); Evaluate (i) P(x = 0) and (ii) P(x =3)</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>3.(b)</td><td>Let the random variable X has the p.d.f. $f(x) = \begin{cases} \frac{1}{2} e^{-\frac{x}{2}}, x > 0 \\ 0 . otherwise \end{cases}$
Find the mean and variance.</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>4.</td><td>Find the MGF, mean and variance of the Exponential distribution.</td><td>BTL -1</td><td>Remembering</td></tr>
<tr><td>5. (a)</td><td>State and prove Memoryles property of Exponential distribution.</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>5.(b)</td><td>The number of hardware failures of a computer system ina week of operations has the following P.d.f, Deduce P(X<5 / X>1), K.
<table><tr><td>No.of failures</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>Probability</td><td>K</td><td>2 K</td><td>2 K</td><td>K</td><td>3 K</td><td>K</td><td>4 K</td></tr></table></td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>6.</td><td>Find the MGF, mean and variance of the Binomial distribution.</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>7. (a)</td><td>If X is Uniformly distributed in (0,10) ,find probability (i) X < 2 (ii)X > 8 (iii) 3 <X <9?</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>7. (b)</td><td>VLSI chips, essential to the running condition of a computer system, fail in accordance with a Poisson distribution with the rate of one chip in about 5 weeks .if there are two spare chips on hand and if a new supply will arrive in 8 weeks .Evaluate the probability that during the next 8 weeks the system will be down for a week or more, owing to a lack of chips?</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>8.</td><td>A discrete RV X has the probability function given below
X : 0 1 2 3 4 5 6 7
P(x) : 0 a 2a 2a 3a a^2 $2a^2$ $7a^2 + a$
Find (i) Value of a (ii) p (X <6) , P (X ≥ 6) , P (0 < X < 4) (iii) Distribution function.</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>9.</td><td>Find the MGF, mean and variance of the Uniform distribution.</td><td>BTL -1</td><td>Remembering</td></tr>
<tr><td>10.(a)</td><td>The daily consumption of milk in a city,in excess of 20,000 gallons ,in approximately distributed as a Gamma variate with the parameters k = 2 and $\lambda = \frac{1}{10,000}$.The city has a daily stock of 30,000 gallons. What is the probability that the stock is insufficient on a particular day?</td><td>BTL -3</td><td>Applying</td></tr>
</table>

10.(b)	Let X be Uniformly distributed in (-1,1), Find (i) P(|X| <1/3) and (ii) P(|X| ≥ ¾	**BTL -5**	Evaluating
11.	Find the MGF, mean and variance of the Geometric distribution.	**BTL -1**	Remembering
12.(a)	Buses arrive at a specific stop at 15 min intervals starting at 7am, they arrive at 7, 7.15, 7.30, and so on. If a passenger time that is uniformly distributed between 7 and 7.30. Find the probability that he waits, (i) Less than 5 min for a bus and (ii) at least 12 min for a bus.	**BTL -3**	Applying
12.(b)	If P(X= x) = Kx, x = 1,2,3….Find the value of K, mean and variance of X.	**BTL -4**	Analyzing
13.	If the probability mass function of a random variable X is given by $P[X = x] = kx^3, x = 1,2,3,4,$ Identify the value of k, $P[\left(\frac{1}{2} < X < \frac{5}{2}\right) / X > 1]$, mean and variance of X.	**BTL -3**	Applying
14.	The number of monthly breakdown of a computer is a random variable having a Poisson distribution with mean equal to 1.8. Find the probability that this computer will function for a month (i)Without breakdown (ii) With only one breakdown and (iii)With at least one breakdown.	**BTL -5**	Evaluating
	Part – C		
15.	A dicrete RV X hass the following probability distribution. X: 0 1 2 3 4 5 6 7 8 P(x): a 3a 5a 7a 9a 11a 13a 15a 17a Find the value of a , Mean, variance P(X<3) ,P(X<5/X>3) and CDF of X.	BTL -3	Applying
16.	Let X be a continuous random variable with p.d.f $f(x) = \begin{cases} ax, & 0 \le x \le 1 \\ a, & 1 \le x \le 2 \\ -ax + 3a, & 2 \le x < 3 \\ 0, & otherwise \end{cases}$ (i)Find a, (ii) Compute P(X≤ 1.5) (iii) Find the c.d.f of X.	BTL -2	Understanding
17.	Out of 800 families with 4 children each , how many would you expect to have (i) at least 1 boy (ii) 2 boys (iii) 1 or 2 girls (iv) no girls.	BTL -2	Understanding
18.	Find the mean and variance of Normal distribution.	BTL -1	Remembering

UNIT – IV LINEAR PROGRAMMING: Formulation–Graphical solution–Simplex method–Big M method-Two phase method-Transportation and Assignment models.

Q.No.	Question	Bloom's Taxonomy Level	Domain
PART – A			
1.	What is degeneracy in a transportation model?	**BTL -1**	Remembering
2.	Differentiate between balanced and unbalanced cases in Assignment model	**BTL -2**	Understanding
3.	List any two basic differences between a transportation and assignment problem	**BTL -2**	Understanding
4.	What do you mean by degeneracy?	**BTL -1**	Remembering
5.	Explain optimal solution in L.P.P.	**BTL -1**	Remembering
6.	Solve the following L.P.P by using graphical method $\boldsymbol{Maximize\ Z = 3x_1 - 2x_2}$, Subject to $\boldsymbol{x_1 + x_2 \le 1, 3x_1 + 3x_2 \ge 6, x_1, x_2 \ge 0}$	**BTL -5**	Evaluating
7.	What is the difference between feasible solution and basic feasible solution?	**BTL -2**	Understanding
8.	Obtain an initial basic feasible solution to the following transportation problem by using Matrix Minima method D_1 D_2 D_3 D_4 capacity O_1 1 2 3 4 6 O_2 4 3 2 0 8 O_3 0 2 2 1 10 Demand 4 6 8 6	**BTL -3**	Applying
9.	What is an assignment problem? Give two applications.	**BTL -1**	Remembering
10.	Write down the mathematical formulation of L.P.P.	**BTL -1**	Remembering
11.	Enumerate the methods to find the initial basic feasible solution for transportation problem.	**BTL -1**	Remembering
12.	When will you say a transportation problem is said to be unbalanced?	**BTL -2**	Understanding
13.	Write short note on North west corner rule.	**BTL -2**	Understanding
14.	What is a travelling sales man problem?	**BTL -2**	Understanding

<table>
<tr><td>15.</td><td>Define transshipment problem.</td><td>BTL -1</td><td>Remembering</td></tr>
<tr><td>16.</td><td>What is meant by Unbalanced Assignment Problem?</td><td>BTL -1</td><td>Remembering</td></tr>
<tr><td>17.</td><td>Explain Row, Column, minima methods to find initial solution of transportation problem.</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>18.</td><td>Solve by graphical method $Z = 5x_1 + 4x_2$, Subject to
$4x_1 + 5x_2 \le 10, 3x_1 + 2x_2 \le 9, 8x_1 + 3x_2 \le 12, x_1, x_2 \ge 0$</td><td>BTL -5</td><td>Evaluating</td></tr>
<tr><td>19.</td><td>Solve the assignment problem
<table>
<tr><td></td><td>P</td><td>Q</td><td>R</td><td>S</td></tr>
<tr><td>A</td><td>5</td><td>7</td><td>11</td><td>6</td></tr>
<tr><td>B</td><td>8</td><td>5</td><td>9</td><td>6</td></tr>
<tr><td>C</td><td>4</td><td>7</td><td>10</td><td>7</td></tr>
<tr><td>D</td><td>10</td><td>4</td><td>8</td><td>3</td></tr>
</table></td><td>BTL -5</td><td>Evaluating</td></tr>
<tr><td>20.</td><td>Find the initial solution to the following TP using Vogel's approximation method
<table>
<tr><td></td><td>D_1</td><td>D_2</td><td>D_3</td><td>D_4</td><td>Supply</td></tr>
<tr><td>F_1</td><td>3</td><td>3</td><td>4</td><td>1</td><td>100</td></tr>
<tr><td>F_2</td><td>4</td><td>2</td><td>4</td><td>2</td><td>125</td></tr>
<tr><td>F_3</td><td>1</td><td>5</td><td>3</td><td>2</td><td>75</td></tr>
<tr><td>Demand</td><td>120</td><td>80</td><td>75</td><td>25</td><td>300</td></tr>
</table></td><td>BTL -5</td><td>Evaluating</td></tr>
<tr><td colspan="4">PART –B</td></tr>
<tr><td>1.(a)</td><td>Solve the L.P.P by Simplex method
$Maximize\ Z = 3x + 2y$ Subject to
$2x + y \le 6, x + 2y \le 6, x, y \ge 0$</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>1. (b)</td><td>Solve the assignment problem
<table>
<tr><td></td><td>P</td><td>Q</td><td>R</td><td>S</td></tr>
<tr><td>A</td><td>18</td><td>26</td><td>17</td><td>11</td></tr>
<tr><td>B</td><td>13</td><td>28</td><td>14</td><td>26</td></tr>
<tr><td>C</td><td>38</td><td>19</td><td>18</td><td>15</td></tr>
<tr><td>D</td><td>19</td><td>26</td><td>24</td><td>10</td></tr>
</table></td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>2. (a)</td><td>Solve by Simplex method Maximize $Z = 5x_1 + 4x_2$, Subject to
$4x_1 + 10x_2 \le 10, 3x_1 + 2x_2 \le 9, 8x_1 + 3x_2 \le 12, x_1, x_2 \ge 0$</td><td>BTL -5</td><td>Evaluating</td></tr>
<tr><td>2.(b)</td><td>Solve the following transportation problem:
<table>
<tr><td></td><td>A</td><td>B</td><td>C</td><td>α_i</td></tr>
<tr><td>F_1</td><td>10</td><td>8</td><td>8</td><td>8</td></tr>
<tr><td>F_2</td><td>10</td><td>7</td><td>10</td><td>7</td></tr>
<tr><td>F_3</td><td>11</td><td>9</td><td>7</td><td>9</td></tr>
<tr><td>F_4</td><td>12</td><td>14</td><td>10</td><td>4</td></tr>
</table></td><td>BTL -3</td><td>Applying</td></tr>
</table>

	<table><tr><td>b_i</td><td>10</td><td>10</td><td>8</td><td></td></tr></table>		
3.	Solve by Simplex method. Maximize $Z = 5x_1 + 3x_2$, Subject to $5x_1 + 2x_2 \leq 10, 3x_1 + 8x_2 \leq 12, x_1 + x_2 \leq 2, x_1, x_2 \geq 0$.	**BTL -5**	Evaluating
4. (a)	Solve by Simplex method. Maximize $Z = 3x_1 + 2x_2$, Subject to $4x_1 + 3x_2 \leq 12, 4x_1 + x_2 \leq 8, 4x_1 - x_2 \leq 8, x_1, x_2 \geq 0$.	**BTL -5**	Evaluating
5. (a)	Solve by Graphical method , Maximize $Z = 3x_1 + 4x_2$, Subject to $5x_1 + 4x_2 \leq 200, 3x_1 + 5x_2 \leq 150, 5x_1 + 4x_2 \geq 100, 8x_1 + 4x_2 \geq 80 \;\; x_1, x_2 \geq 0$.	**BTL -2**	Understanding
5.(b)	Find the initial feasible solution for the following transportation problem <table><tr><td></td><td>D1</td><td>D2</td><td>D3</td><td>D4</td><td>D5</td><td>Supply</td></tr><tr><td></td><td>3</td><td>2</td><td>3</td><td>4</td><td>1</td><td>100</td></tr><tr><td></td><td>4</td><td>1</td><td>2</td><td>4</td><td>2</td><td>125</td></tr><tr><td></td><td>1</td><td>0</td><td>5</td><td>3</td><td>2</td><td>75</td></tr><tr><td>Total</td><td>100</td><td>60</td><td>40</td><td>75</td><td>25</td><td></td></tr></table>	**BTL -3**	Applying
6. (a)	Solve by Graphical method Maxi$Z = 40x_1 + 30x_2$, Subject to $3x_1 + x_2 \leq 30{,}000$; $x_1 \leq 8000$,; $x_2 \leq 12{,}0000$,; $x_1, x_2 \geq 0$	**BTL -2**	Understanding
6.(b)	Solve the assignment problem for optimal job assignment Job Machine $\begin{bmatrix} 10 & 3 & 3 & 2 & 8 \\ 9 & 7 & 8 & 2 & 7 \\ 7 & 5 & 6 & 2 & 4 \\ 3 & 5 & 8 & 2 & 4 \\ 9 & 10 & 9 & 6 & 10 \end{bmatrix}$	**BTL -4**	Analyzing
7. (a)	Using Simplex method Maximize $Z = x_1 + 2x_2 + 3x_3 - x_4$, Subject to $x_1 + 2x_2 + 3x_3 = 15$; $2x_1 + x_2 + 5x_3 = 20$; $x_1 + 2x_2 + x_3 + x_4 = 10$ and $x_1, x_2, x_3, x_4 \geq 0$	**BTL -4**	Analyzing
8.	Solve the assignment problem Job Machine $\begin{bmatrix} 13 & 8 & 16 & 18 & 19 \\ 9 & 15 & 24 & 9 & 12 \\ 12 & 9 & 4 & 4 & 4 \\ 6 & 12 & 10 & 8 & 13 \\ 15 & 17 & 18 & 12 & 20 \end{bmatrix}$	**BTL -4**	Analyzing
9.	Solve by Simplex method Maximize $Z = x_1 + x_2 + 3x_3$, Subject to$3x_1 + 2x_2 + x_3 \leq 2$; $2x_1 + x_2 + 2x_3 \leq 2$ and $x_1, x_2, x_3 \geq 0$	**BTL -5**	Evaluating
10.	Solve the transportation problem Supply	**BTL -4**	Analyzing

<table>
<tr><td></td><td>$\begin{bmatrix} & 15 & 51 & 42 & 33 & 23 \\ & 80 & 42 & 26 & 81 & 44 \\ & 90 & 40 & 66 & 60 & 33 \\ Demand & 23 & 31 & 16 & 30 & 100 \end{bmatrix}$</td><td></td><td></td></tr>
<tr><td>11.</td><td>Solve by Simplex method Maximize $\mathbf{Z = 4x_1 + 10x_2}$, Subject to
$\mathbf{2x_1 + x_2 \leq 10 \; ; \; 2x_1 + 5x_2 \leq 20 \text{ and } 2x_1 + 3x_2 \leq 18 \text{ and } x_1, x_2, \geq 0}$</td><td>BTL -5</td><td>Evaluating</td></tr>
<tr><td>12.</td><td>Find the assignment of machines to the job that will result in maximum profit.
$\begin{matrix} 62 & 78 & 50 & 111 & 82 \\ 71 & 84 & 61 & 73 & 59 \\ 87 & 92 & 111 & 71 & 81 \\ 48 & 64 & 87 & 77 & 80 \end{matrix}$</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>13.(a)</td><td>Find the optimal solution of the transportation problem
<table>
<tr><td></td><td>P</td><td>Q</td><td>R</td><td>S</td><td>Supply</td></tr>
<tr><td>A</td><td>6</td><td>3</td><td>5</td><td>4</td><td>22</td></tr>
<tr><td>B</td><td>5</td><td>9</td><td>2</td><td>7</td><td>15</td></tr>
<tr><td>C</td><td>5</td><td>7</td><td>8</td><td>6</td><td>8</td></tr>
<tr><td>Requirement</td><td>7</td><td>12</td><td>17</td><td>9</td><td></td></tr>
</table></td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>13.(b)</td><td>Solve by graphical method Minimize $\mathbf{Z = 2x_1 + 3x_2}$, Subject to
$\mathbf{x_1 + x_2 \geq 5; \; x_1 + 2x_2 \geq 6; \text{ and } x_1, x_2, \geq 0}$</td><td>BTL -5</td><td>Evaluating</td></tr>
<tr><td>14.</td><td>Solve the assignment problem ,
Job
Machine $\begin{matrix} 7 & 7 & 0 & 4 & 8 \\ 9 & 6 & 4 & 5 & 6 \\ 11 & 5 & 7 & 0 & 5 \\ 9 & 4 & 8 & 9 & 4 \\ 8 & 7 & 9 & 11 & 3 \end{matrix}$</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td></td><td>Part – C</td><td></td><td></td></tr>
<tr><td>15.</td><td>Solve the transportation problem
Supply
$\begin{bmatrix} & 5 & 2 & 4 & 3 & 22 \\ & 4 & 8 & 1 & 6 & 15 \\ & 4 & 6 & 7 & 5 & 8 \\ Demand & 7 & 12 & 17 & 9 & 45 \end{bmatrix}$</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>16.</td><td>Solve the assignment problem ,
Job</td><td>BTL -3</td><td>Applying</td></tr>
</table>

<table>
<tr><td></td><td>Machine
<table><tr><td>12</td><td>10</td><td>15</td><td>22</td><td>18</td><td>8</td></tr><tr><td>10</td><td>18</td><td>25</td><td>16</td><td>12</td><td>11</td></tr><tr><td>10</td><td>3</td><td>8</td><td>5</td><td>9</td><td>6</td></tr><tr><td>6</td><td>14</td><td>10</td><td>13</td><td>13</td><td>12</td></tr><tr><td>8</td><td>12</td><td>11</td><td>7</td><td>13</td><td>10</td></tr></table></td><td></td><td></td></tr>
<tr><td>17.</td><td>Solve by Simplex method. Max Z = 2x₁ + x₂, Subject to
$x_1 + 2x_2 \le 10$; $x_1 + x_2 \le 6$; ; $x_1 - x_2 \le 2$; $x_1 - 2x_2 \le 1$, $x_1, x_2, \ge 0$</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>18.</td><td>A travelling sales man has to visit 5 cities .He wishes to start from a particular city, visit each city once and then returns to his starting point. Cost of going from one city to another is shown below. Find the least cost route
<table><tr><td></td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td></tr><tr><td>A</td><td>∞</td><td>4</td><td>10</td><td>14</td><td>2</td></tr><tr><td>B</td><td>12</td><td>∞</td><td>6</td><td>10</td><td>4</td></tr><tr><td>C</td><td>16</td><td>14</td><td>∞</td><td>8</td><td>14</td></tr><tr><td>D</td><td>24</td><td>8</td><td>12</td><td>∞</td><td>10</td></tr><tr><td>E</td><td>2</td><td>6</td><td>4</td><td>16</td><td>∞</td></tr></table></td><td>BTL -3</td><td>Applying</td></tr>
</table>

UNIT – V FOURIER SERIES: Fourier trigonometric series : Periodic function as power signals–Convergence of series–Even and odd function : Cosine and sine series–Non periodic function : Extension to other intervals-Power signals : Exponential Fourier series–Parseval's theorem and power spectrum–Eigenvalue problems andorthogonal functions–Regular Sturm-Liouville systems–Generalized Fourier series.

Q.No.	**Question**	**Bloom's Taxonomy Level**	**Domain**
	PART – A		
1.	If the periodic function f(t) $=\begin{cases} 0 & -\pi < t < 0 \\ t, & 0 < t < \pi \end{cases}$ where f(t + 2π) = f(t) is expanded as a Fourier series , find the value of a_n.	**BTL -2**	Understanding
2.	Define energy signals and power signals?	**BTL -1**	Remembering
3.	Find a Fourier sine series for the function f(x) = 1 , $0 < x < \pi$.	**BTL -2**	Understanding
4.	Define a periodic function as power signals.	**BTL -1**	Remembering
5.	Calculate average power of period T =2, f(t) = 2cos 5πt + sin6πt using time domain analysis.	**BTL -2**	Understanding
6.	State Parseval's theorem.	**BTL -1**	Remembering
7.	Find the Fourier constants b_n for x sinx in $(-\pi, \pi)$.	**BTL -3**	Applying

8.	State convergence of the series.	**BTL -1**	Remembering
9.	Write note on Singular Sturm- Liouville System.	**BTL -1**	Remembering
10.	Find the value of $\boldsymbol{a_0}$ in the Fourier series expansion of $\boldsymbol{f(x) = e^x in\ (0, 2\pi)}$.	**BTL -4**	Analyzing
11.	Define self ad joint operator.	**BTL -1**	Remembering
12.	Write the power signals Exponential Fourier Series.	**BTL -2**	Understanding
13.	Define generalized Fourier series?	**BTL -1**	Remembering
14.	If $\boldsymbol{(\pi - x)^2 = \frac{\pi^2}{3} + 4\sum_{n=1}^{\infty} \frac{cosnx}{n^2}}$ in $\boldsymbol{0} < x < 2\pi$ then deduce the value of $\boldsymbol{\sum_{n=1}^{\infty} \frac{1}{n^2}}$.	**BTL -4**	Analyzing
15.	Put the following DE in self – ad joint form $x^2 y'' + 3xy' + \lambda y = 0$.	**BTL -4**	Analyzing
16.	Distinguish Periodic and Non Periodic functions, with example.	**BTL -2**	Understanding
17.	Write short note on Eigen value problem and orthogonal functions.	**BTL -2**	Understanding
18.	State the properties of the eigen values of a Regular Sturm-Liouville System.	**BTL -1**	Remembering
19.	Write note on cosine and sine series.	**BTL -1**	Remembering
20.	Find the root mean square value of the function f(x) = x in (0, *l*).	**BTL -5**	Evaluating
	PART –B		
1.(a)	Find the Fourier series of the periodic Ramp function $\boldsymbol{f(t) = \begin{cases} 0, & -\pi < t < 0 \\ t, & 0 < t < \pi \end{cases}}$, f(t+2π) = f(t) Using (i) time domain analysis and (ii) Frequency domain analysis.	**BTL -2**	Understanding
1. (b)	Find the Fourier series of the function $\boldsymbol{f(x) = (\pi - x)^2}$, in $\boldsymbol{(0, 2\pi)}$ with periodicity $\boldsymbol{2\pi}$.	**BTL -3**	Applying
2. (a)	Find the fourier series of the sawtoothfunction **f(t) = t, -1 < t <1** where **f(t+2) = f(t).**	**BTL -2**	Understanding
2.(b)	A periodic function f(t) of period 2 is defined by $f(t) = \begin{cases} 3t & 0 \le t \le 1 \\ 3 & 1 \le t \le 2 \end{cases}, f(t+2) = f(t).$	**BTL -3**	Applying

	Determine a Fourier series expansion for the function and sketch a graph of f(t) for $-4 \le t \le 4$.		
3. (a)	Find a fourier series representation of $f(t) = t^2$, $0 < t < 1$. i) as a sine series with period T =2 ii) as a cosine series with period T =2 iii) as a full trigonometric series with period T =1	**BTL -4**	Analyzing
3.(b)	Obtain the half range cosine series for $f(x)= (x - 1)^2$ $in\ 0 < x < 1$. Deduce that $\sum_{1}^{\infty} \frac{1}{(2n-1)^2} = \frac{\pi^2}{8}$	**BTL -3**	Applying
4. (a)	Calculate the averge power of the periodic signal, period T =2 $f(t) = 2 \cos 6\pi t + \sin 5\pi t$	**BTL -5**	Evaluating
4.(b)	Obtain the Fourier series for $f(x) = 1 + x + x^2$ in $(-\pi, \pi)$.	**BTL -3**	Applying
5. (a)	Find the eigen values and eigen functions of $y'' + \lambda y = 0$, $0 < x < p$, $y(0) = 0, y(p) = 0$.	**BTL -4**	Analyzing
5.(b)	Find the half range sine series of $f(x) = 4x - x^2$ in the interval (0, 4).Hence deduce $\frac{1}{1^3} - \frac{1}{3^3} + \frac{1}{5^3} - \frac{1}{7^3} + \cdots$	**BTL -3**	Applying
6.	Find an expression for the Fourier coefficients associated with the generalisedfourier series arising from the eigen functions of $y'' + y' + \lambda y = 0$, $0 < x < 3$, $y(0) = 0$, $y(3) = 0$.	**BTL -4**	Analyzing
7. (a)	Find the eigen values and eigen functions of $y'' + \lambda y = 0$, $-\pi < x < \pi$, $y(-\pi) = y(\pi)$, $y'(-\pi) = y'(\pi)$.	**BTL -4**	Analyzing
7. (b)	Obtain the cosine series for $f(x) = x$ in $0 < x < \pi$ and deduce that $\sum_{n=1}^{\infty} \frac{1}{(2n-1)^4} = \frac{\pi^4}{96}$	**BTL -3**	Applying
8.	Find the generalized Fourier Series expansion of the function $f(x) = 1$, $0 < x < 1$, in terms of the eign functions of $y'' + y' + \lambda y = 0$, $0 < x < 1$, $y(0) = 0$, $y(1) + y'(1) = 0$.	**BTL -4**	Analyzing
9.	Find half range cosine series given $f(x) = x \quad 0 \le x \le 1$ $= 2 - x \quad 1 \le x \le 2$	**BTL -3**	Applying
10.	Find a Fourier series with period 3 to represent $f(x) = 2x - x^2$ $in\ (0,3)$.	**BTL -4**	Analyzing
11.(a)	Find the Fourier series expansion of the periodic function f(x) of period $2l$ define by $f(x) = l + x \quad -l \le x \le 0$ $= l - x \quad 0 \le x \le l$ Deduce that $\sum_{1}^{\infty} \frac{1}{(2n-1)^2} = \frac{\pi^2}{8}$	**BTL -3**	Applying

12.	Find the Fourier series expansion of $f(x) = \begin{cases} -x+1 \text{ for } -\pi < x < 0 \\ x+1 \text{ for } 0 < x < \pi \end{cases}$	**BTL -3**	Applying
13.	Expand f(x)= $\begin{cases} 1+\frac{2x}{\pi}, -\pi < x < 0 \\ 1-\frac{2x}{\pi}, 0 < x < \pi \end{cases}$ as a full range Fourier series in the interval $(-\pi, \pi)$.Hence deduce that $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+....... = \frac{\pi^2}{8}$.	**BTL -3**	Applying
14.	Obtain Fourier series for f(x) of period $2l$ and defined as follows f(x)= $\begin{cases} l-x & in \quad 0 \le x \le l \\ 0 & in \quad l \le x \le 2l \end{cases}$ Hence deduce that (i) $1-\frac{1}{3}+\frac{1}{5}-\frac{1}{7}+....... = \frac{\pi}{4}$ (ii) $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+....... = \frac{\pi^2}{8}$	**BTL -3**	Applying
	Part – C		
15.	Find the Fourier series for f(x) = x^2 in $(-\pi, \pi)$. Hence find i) $\frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+..........$ ii) $\frac{1}{1^2}-\frac{1}{2^2}+\frac{1}{3^2}-\cdots$. iii) $\frac{1}{1^4}+\frac{1}{2^4}+\frac{1}{3^4}+\frac{1}{4^4}........\infty$	**BTL -3**	Applying
16.	Find the eigen values, eigen functions of $y'' + \lambda y = 0$, $0 < x < 1$, $y(0) = 0$, $y(1) + y'(1) = 0$.	**BTL -4**	Analyzing
17.	Obtain the Fourier series to represent the function $f(x) = \lvert x \rvert, -\pi < x < \pi$ and Deduce $\sum_{n=1}^{\infty} \frac{1}{(2n-1)^2} = \frac{\pi^2}{8}$.	**BTL -4**	Analyzing
18.	Find the Fourier expansion of the following periodic function of period 4 $f(x) = \begin{cases} 2+x, & -2 \le x \le 0 \\ 2-x, & 0 \le x \le 2 \end{cases}$ Hence deduce that $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+\cdots\infty = \frac{\pi^2}{8}$.	**BTL -1**	Remembering