Srinivas University - Institute of Engineering and Technology

I Semester B.Tech 2025-26

COMPUTATIONAL TECHNIQUES 1 (BTF002)

Question Bank

Sl.no	Module 1	Marks
	1)If 2, -3, -1 are the eigen values of a 3×3 matrix, then its determinant is A) -2 B) 6 C) -6 D) 2 3)In Gauss-Jordan method, the coefficient matrix of given system will be reduced to A) Upper triangular matrix B) Scalar matrix C) Lower triangular matrix D) Diagonal matrix 4)In Gauss-Elimination method, the coefficient matrix of given system will be reduced to A) Upper triangular matrix B) Scalar matrix C) Diagonal matrix D) Identity matrix 5)Rank of a matrix is equal to 1. Number of zero rows in the matrix 2. Number of non-zero rows in the matrix C) Number of zero rows in the row echelon form of the matrix D) Number of non-zero rows in the row echelon form of the matrix 6)Rank of 4×4 identity matrix is A) 4 B) 2 C) 1 D) 0 7) Let A be a 3×3 matrix, 8, 7, λ be the eigen values of A and $\|A\|=672$ then $\lambda =$ A. 12 B. 14 C. 11 D. 21 8) If 9, 11, λ are eigen values of a 3×3 matrix A and 2 is the sum of diagonal entries of A, then $\lambda =$ A. -18 B. 18 C. 16 D. -2 9) If $\begin{bmatrix} 1 & -1 & 2 \\ 0 & 0 & -3 \\ 0 & 0 & 0 \end{bmatrix}$ is a row echelon form of a matrix then its rank is A. 2 B. 1 C. 0 D. 3	1 mark

	10. Which of the following systems of linear equations has a strictly diagonally dominant coefficient matrix? A) x – y = -4, 2x + 5y = 2 B) 2x + y = 1, x - 7y = 4 C) 3x + 5y = 2, x + y = -3 D) 4x = 2y – 1, 3x +2 y = -41 11. Rayleigh Power Method is used to find A) positiveeigen value of a square matrix B) negativeeigen value of a square matrix C) largesteigen value of a square matrix D) any eigen value of a square matrix	
	Discriptive Questions	
1	a)Find the rank of following matrices by reducing to echelon form of matrix $A = \begin{bmatrix} 0 & 2 & 3 & 4 \\ 2 & 3 & 5 & 4 \\ 4 & 8 & 13 & 12 \end{bmatrix}$ b)Solve the following system of equations by Gauss Elimination method $2x + 5y + 7z = 52, \quad 2x + y - z = 0, \quad x + y + z = 9.$	8
2	a) Find the rank of following matrices by reducing to echelon form of matrix $B = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 7 \\ 3 & 6 & 10 \end{bmatrix}$. b)Solve the following system of equations by Gauss Elimination method $2x + y + 4z = 12\,, \quad 4x + 11y - z = 33, \quad 8x - 3y + 2z = 20.$	8
3	Solve by the Gauss Jordan method $x + y + z = 9\,, \quad 2x - 3y + 4z = 13, \quad 3x + 4y + 5z = 40.$	8
4	Solve following system of equation by Gauss-Jordan method $x + y + z = 9, \quad x - 2y + 3z = 8\,, \; 2x + y - z = 3$	8
5	Solve following system of equation by Gauss-Jordan method $2x + 2y + z = 12, 3x + 2y + 2z = 8\,, \; 5x + 10y - 8z = 10$	8
6	Solve the following system of equations by Gauss Seidel Method $10x + y + z = 12$ $x + 10y + z = 12$ $x + y + 10z = 12$ Carry out 4 iterations.	8
7	Employ Gauss-Seidel method to solve $5x + 2y + z = 12$ $x + 4y + 2z = 15$ $x + 2y + 5z = 20$ Carry out 4 iterations taking the initial approximation to the solution as (1, 0, 3).	8
8	Solve the following system of equations by Gauss Seidel Method. Carry out 4 iterations. $x + y + 54z = 110$ $27x + 6y - z = 85$ $6x + 15y + 2z = 72.$	8
9	Find the largest eigen value and the corresponding eigenvector of the matrix A by Rayleigh power method given that A=$\begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}$Take initial vector as$\begin{bmatrix} 1 & 0 & 0 \end{bmatrix}$ and perform 7 iterations.	8

10	Find the dominant eigen value and corresponding eigen vector of the matrix $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$ by Rayleigh power method taking the initial eigen vector as $[1 \quad 1 \quad 1]$. Perform 6 iterations.	8
	MODULE 2	
	1)If P(x, y) is a point on Cartesian plane then its polar coordinates are A) (rcosθ, rsinθ) B)(rsinθ, rcosθ) C)(cosθ, sinθ) D)(sinθ, cosθ) 2)If ϕ is the angle between radius vector and tangent to the polar curve r=f(θ) then A)cot ϕ=r (dθ/dr) B)tan ϕ=r (dr/dθ) C)cot ϕ= dr/dθ D)tan ϕ=r (dθ/dr) 3)Two polar curves intersect orthogonally if A) tan ϕ_1 tan ϕ_2 = 1 B)tan ϕ_1 tan ϕ_2 = -1 C)cot ϕ_1 cot ϕ_2 = 1 D)tan ϕ_1 = tan ϕ_2 4)With usual notations, which of the following is correct? A)p= r cos ϕ B)p= r sin ϕ C)p= r tan ϕ D)p= r sin θ 5)Radius of curvature of a circle is A)0 B)Constant C)always 1 D)always negative 6) The radius of curvature of $y = e^x$ at $x = 0$ A) $\sqrt{2}$ B) 2 C) $2\sqrt{2}$ D) none 7) The radius of curvature of straight line is A) 1 B) 2 C) 0 D) none 8) In a polar curve r=f(θ), the relation between θ and coordinate (x, y) is A) $(1+\sec^2\theta) = \frac{y^2}{x^2}$ B) $\theta = \frac{x}{y}$ **C)** $tan\theta = \frac{x}{y}$ D) none	1 mark

	9) The pedal equation of a polar curve r=2 (1+ cosθ) is A) $r^3 = 4p^2$ B) $r = 4p$ **C)** 0 D) none 10) If radius of curvature of $f(x) = 0$ then which of the following is true A) $f(x) = x^2 + 1$ B) $f(x) = 2x + 5$ C) $f(x) = cosx$ D) $f(x) = sinx$	
	Discriptive Questions	
1	a)Find the angle between the radius vector and the tangent for the following curves $r = a(1 + cos\theta)$ b)Find the acute angle between the following pairs of curves $r = sin\theta + cos\theta$ and $r = \alpha sin\theta$	8
2	a)Find the angle between the radius vector and the tangent for the following curves $r^m = a^m(cosm\theta + sinm\theta)$ b)Show that the following pairs of curves intersect each other orthogonally $r = a(1 + cos\theta)$ and $r = b(1 - cos\theta)$.	8
3	Find the pedal equation of $r^2 = a^2cos2\theta$	8
4	Find the pedal equation of $r^n = a^n(cosn\theta + sinn\theta)$	8
5	Show that the radius of curvature for the curve $y = alog\left(\sec\left(\frac{x}{a}\right)\right)$ is $a\sec\left(\frac{x}{a}\right)$	8
6	Find the radius of curvature of the curve $x^3 + y^3 = 3axy$ at the point $(\frac{3a}{2}, \frac{3a}{2})$	8
7	Find the radius of curvature of the curve $x = alog(sect + tant)$ and $y = asect$	8
8	Find the radius of curvature of the curve $r = a(1 + cos\theta)$	8
	MODULE 3	
	1)gcd (124, 48) is A) 4 B) 14 C) 31 D) 2 2)If gcd and lcm of two positive integers are 54 and 1188 respectively then the product of those integers is A) 54152 B) 64152 C) 72110 D) 76213 3)If a ≡b (mod m) and c ≡d (mod m) then which of the following is not true. A) a ≡d (mod m) B) a^n ≡b^n (mod m) C) (a +c) ≡(b +d) (mod m) D) a c ≡b d(mod m) 4)The inverse of 23 modulo 13 is	1 mark

	A) 11 B) 9 C) 6 D) 4 5)The solution of system x ≡2 (mod 5) and x ≡3 (mod 7) is A) x ≡13 (mod 35) B) x ≡17 (mod 35) C) x ≡31 (mod 35) D) x ≡33 (mod 35) 6)Which of the following is not a solution of Diophantine equation 8x+12y=28 A) (2,1) B) (-1,3) C) (8,-3) D) (7,-2) 7)Remainder of 7^{16} when divided by 17 is A) 1 B) 2 C) 3 D) 4 8)If p is a prime and a is any integer, then which of the following is not true A) $(p-1)! \equiv -1 (\text{mod } p)$ B) $(p-1)! \equiv (p-1) (\text{mod } p)$ C) $(p-1)! \equiv p (\text{mod } p)$ D) $a^p \equiv a (\text{mod } p)$ 9)The value of $\phi(143)$ is A) 120 B) 142 C) 134 D) 111 10) The value of $\phi(2024)$ is A) 880 B) 144 C) 1340 D) 121	
	Discriptive Questions	
1	*a)*Find gcd(414, 662) by Euclidean algorithm. b)Find the remainder when 15! is divided by 17	8
2	**a)** Find gcd(12378, 3054) by Euclidean algorithm. Hence find *lcm*(12378*,* 3054). **b)** Verify that $5^{38} \equiv 4 (mod\ 11)$	8
3	Show that $2^{20} + 3^{30} + 4^{40} + 5^{50} + 6^{60} \equiv 0 (mod\ 7)$	8
4	Find last digit of 17^{17} & last two digits of 33^{42} by using Euler's Theorem.	8
5	*Solve the following system of linear congruences.* $x \equiv 2\ (mod\ 3),\ x \equiv 3\ (mod\ 5),\ and\ \ x \equiv 2\ (mod\ 7)$	8
6	*Solve the following system of linear congruences* $x \equiv 5\ (mod\ 11),\ x \equiv 14\ (mod\ 29), and\ x \equiv 15\ (mod\ 31).$	8
7	*Solve the following system of linear congruences* $x \equiv 1 (mod\ 5),\ x \equiv 2\ (mod\ 6),\ and\ \ x \equiv 3\ (mod\ 7)$	8

8	Find all the solutions of the linear Diophantine equation $172x + 20y = 1000$	8
9	Find all the solutions of the following linear Diophantine equations. $29x + 138y = 18$	8
10	Find all the solutions of the following linear Diophantine equations. $221x + 91y = 117$	8
	MODULE 4	
	1. If $x = r\,cos\theta, y = r\,sin\theta$ then $\frac{\partial(x,y)}{\partial(r,\theta)}$ is equal to A) 1 B) r C) $\frac{1}{r}$ D) 0 2. If $u = (x-y)^2 + (y-z)^2 + (z-x)^2$ then $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z}$ is A) 1 B) 24 C) $2(x+y+z)$ **D)** 0 3. If $x = \rho\,cos\theta, y = \rho\,sin\theta, z = z$ then $\frac{\partial(x,y,z)}{\partial(\rho,\theta,z)}$ A) ρ B) 1 C) 0 D) θ 4. If $u = x + y + z, v = y + z, z = z$ then $\frac{\partial(u,v,z)}{\partial(x,y,z)} =$ A) 1 B) -1 C) 0 D) none 5. If $u = x^y$ then $\frac{\partial u}{\partial y}$ is A)$y^x logx$ B) $x^y logx$ C)yx^{y-1} D) $x^{y-1}\,logx$ 6. If $u = \sin(xy)$ then $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y}$ at x=0 is A) x B) y C) 1 **D)** 0 7. The value of $\lim_{x\to 0}\frac{sinx}{2x+1}$ is A) 1 B) 0 C) 2 **D)** $\frac{1}{2}$ 8. If $x = 2t^2$ and y= 4t then $\frac{dy}{dx}$ is A) $\frac{1}{t}$ B) 4 C) $\frac{1}{4}$ **D) 1**	1 mark
	Discriptive Questions	
1	Prove that $\sqrt{1 + sin2x} = 1 + x - \frac{x^2}{2} - \frac{x^3}{6} + \frac{x^4}{24} + \cdots$	8
2	Expand the function $\log(secx)$ in ascending power using Maclaurin's series.	8
3	Evaluate the $\lim_{x\to 0}\left(\frac{a^x+b^x+c^x}{3}\right)^{\frac{1}{x}}$	8
4	Evaluate the $\lim_{x\to a}\left[2 - \frac{x}{a}\right]^{\tan\left(\frac{\pi x}{2a}\right)}$.	8
5	a)Find $\frac{\partial(u,\ v,w)}{\partial(x,\ y,z)}$ where $u = x^2 + y^2 + z^2,\ \ v = xy + yz + zx,\ \ w = x + y + z$. (Ans:$J = 0$) b)Obtain the Maclaurin's Series expansion e^x.	8
6	If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$, prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0$	8
7	If $u = e^{ax+by}f(ax - by)$, then prove that $b\frac{\partial u}{\partial x} + a\frac{\partial u}{\partial y} = 2abu$ by using the concept of composite function.	8

8	If $u = f(x-y, y-z, z-x)$ show that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$	8
9	If $u = \frac{yz}{x}$, $v = \frac{zx}{y}$, $w = \frac{xy}{z}$ show that $\frac{\partial(u,\ v,\ w)}{\partial(x,\ y,\ z)} = 4$	8
10	If $x = rsin\theta cos\phi,\ y = rsin\theta sin\phi, z = rcos\theta$ show that $\frac{\partial(x,\ y,\ z)}{\partial(r,\ \theta,\ \phi)} = r^2 sin\theta$.	8
	MODULE 5	
	1. A vector field $\vec{F}$ is said to Irrotational, if A) div $\vec{F}$=0 **B)** curl $\vec{F} = 0$ C) grad $\oint$= $\vec{F}$ D) none 2.A vector field $\vec{F}$ is said to be Solenoidal, is A) $\nabla\phi = F$ B) div $\vec{F}$ =0 C) curl $\vec{F} = 0$ D) none 3. ∇ x $\nabla\oint$ is equal to A) $\nabla^2\oint$ B) $\nabla\phi$ C) $\vec{0}$ D) 0 4.. The representation $i\frac{\partial f}{\partial x} + j\ \frac{\partial f}{\partial y} + k\frac{\partial f}{\partial z}$ is A) ∇.f B) ∇ x f C) ∇^2f D) ∇f 5. .If $\vec{r} = xi + yj + zk$ then ∇ x $\vec{r}$ A) xyz B) 0 C) 4 D) 3 6. If $\vec{r}$ is the position vector of any point $P(x,y,z)$ then ∇. $\vec{r}$ is **A)** 3 B) -3 C) 2 D) 0 7. Directional derivative is maximum along A) tangent to the surface **B)** normal to the surface C) any unit vector D) coordinate axis 8. If $\oint\ = 3x^2 - 3y^2 + 4z^2$, then curl (grad $\oint$)= A) $4x - 6y + 8z$ B) $4x_i - 6y_j + 8z_k$ **C)** 0 D) 3 9. The gradient, divergence, curl are respectively A) Scalar, scalar, vector B) vector, scalar, vector **C)** scalar, vector, vector D) vector, vector, scalar 10. If $f\ = 3x^2 i - xyj + (a-3)xz$ is Solenoidal then a is equal to A) 0 B) -2 C) 2 D) 3	1 mark
	Discriptive Questions	
1	Find $div\vec{A}$ and $curl\vec{A}$ where $\vec{A} = \nabla(x^3 + y^3 + z^3 - 3xyz)$.	8
2	If $\vec{A} = \nabla(xy^3z^2)$ find $div\vec{A}$ and $curl\vec{A}$ at the point$(1,-1,1)$.	8
3	If $\vec{A} = (3x^2y - z)i + (xz^3 + y^4)j - 2x^3z^2k$ find $grad(div\vec{A})$ at the point$(2,-1,0)$.	8
4	Prove that $div(\phi\vec{A}) = \phi(div\vec{A}) + grad\phi \cdot \vec{A}$	8
5	Prove that $curl(\phi\vec{A}) = \phi(curl\vec{A}) + grad\phi \times \vec{A}$	8
6	Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at the point $(2,-1,2)$.	8
7	Find the angle between normal to the surfaces $xy = z^2$ at the point $(4,1,2)$ and $(3,3,-3)$.	8
8	Show that $\vec{A} = \frac{xi+yj}{x^2+y^2}$ is both solenoidal and irrotational.	8

9	Show that $\vec{A} = (y+z)i + (z+x)j + (x+y)k$ is irrotational. Also find a scalar function ϕ such that $\vec{A} = \nabla\phi$.	8
10	If $\vec{A} = (x+y+az)i + (bx+2y-z)j + (x+cy+2z)k$ find a, b, c such that $\vec{A}$ is irrotational. Also find ϕ such that $\vec{A} = \nabla\phi$.	8