Dr. Vasantraodada Patil Shetkari hikshan Mandal's

# PADMABHOOSHAN VASANTRAODADA PATIL INSTITUTE OF TECHNOLOGY, Sangli, Maharashtra 416304

# **DEPARTMENT OF FIRST YEAR ENGINEERING**

Academic Year 2024-25



# **QUESTION BANK**

I SEMESTER





# Dr. Vasantraodada Patil Shetkari shikshan Mandal's PADMABHOOSHAN VASANTRAODADA PATIL INSTITUTE OF TECHNOLOGY,

Sangli, Maharashtra 416304

**DEPARTMENT OF FIRST YEAR ENGINEERING** 

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## **UNIT-I: Linear Algebra- Matrices**

Sr. No	Questions
1.	Use Gauss Jordan Method to find A <sup>-1</sup> , where A = $\begin{bmatrix} 2 & 1 & -1 \\ 0 & 2 & -1 \\ 5 & 2 & -3 \end{bmatrix}$ .
2.	Use Gauss Jordan Method to find A <sup>-1</sup> , where $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & -1 \\ 1 & 1 & 0 \end{bmatrix}$ .
3.	Use Gauss Jordan Method to find A <sup>-1</sup> , where A = $\begin{bmatrix} 2 & 1 & 3 \\ 1 & 0 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ .
4.	Use Gauss Jordan Method to find A <sup>-1</sup> , where A = $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ 1 & -3 \end{bmatrix}$ .
5.	Reduce the matrix to normal form and find its rank $A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 2 & 4 & 6 & 8 \\ 3 & 6 & 9 & 12 \end{bmatrix}$ .
6.	Reduce the following matrices into normal form and find its ranks $A = \begin{bmatrix} 1 & -1 & 2 & 3 \\ 4 & 1 & 0 & 2 \\ 0 & 3 & 1 & 4 \end{bmatrix}.$
7.	$\begin{bmatrix} 0 & 1 & 0 & 2 \end{bmatrix}$ Reduce the following matrix into normal form and find its ranks $A = \begin{bmatrix} 1 & -1 & -1 \\ 1 & 1 & 1 \\ 2 & 1 & 1 \end{bmatrix}.$
8.	Find the rank of matrix A by reducing to normal form $\begin{bmatrix} 1 & 2 & -1 & 3 \\ 3 & 4 & 0 & -1 \\ 1 & 0 & 2 & 7 \end{bmatrix}$
9.	Find the rank of a matrix A by reducing to normal form $A = \begin{bmatrix} 1 & 2 & 3 & 0 \\ 2 & 4 & 3 & 2 \\ 3 & 2 & 1 & 3 \end{bmatrix}$ .
10.	Find the rank of matrix A by reducing to normal form $\begin{bmatrix} 1 & 2 & 3 & -1 \\ -1 & -1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & -1 \end{bmatrix}$ .
11.	Test for consistency and hence solve the equation.

- x + y + z = 6, x y + 2z = 5, 3x + y + z = 8, 2x 2y + 3z = 7.12. Test for consistency and if possible, solve the equations. x + y + z + 3 = 0, 3x + y - 2z + 2 = 0, 2x + 4y + 7z = 7.Determine the consistency of the set of equations 13. x-y-z=2; x+2y+z=2; 4x-7y-5z=2 And solve them if found consistence. 14. Examine for the consistency and if consistent. Solve the system 2x - y - z = 2; x + 2y + z = 2; 4x - 7y - 5z = 2. 15. Investigate for what values of  $\lambda$  and  $\mu$  the simultaneous equation x + y + z = 6; x + 2y + 3z = 10;  $x + 2y + \lambda z = \mu$  have i) no solution ii) a unique solution and iii) an infinite number of solution. Solve the equation 2x - y + 3z = 0, 3x + 2y + z = 0, x - 4y + 5z = 0. 16. Determine the value of k for which the following system has nonzero solution and find 17. the solution for each value of  $k_1 3x + y - kz = 0, 4x - 2y - 3z = 0, 2kx + y - 2y - 3z = 0, 2kx + y - 2y - 3z = 0, 2kx + y - 2x + y - 2$ 4v + kz = 0.Test for consistency and solve 18. 4x-2y+6z=8; x+y-3z=-1; 15x-3y+9z=21. Test the consistency and solve; 19. 2x + y - z + 3w = 11, x - 2y + z + w = 8, 4x + 7y + 2z - w = 0, 3x + 5y + 4z + 4w = 17. 20. For what value of  $\lambda$  the following system of linear equations is consistent and solve it completely in each case:  $x + y + z = 1, x + 2y + 4z = \lambda, x + 4y + 10z = \lambda^{2}$ . Find the Eigen values and Eigen vectors of the matrices 21.  $\begin{bmatrix} -2 & -8 & -12 \end{bmatrix}$ 4 4 0 1 1 0 22. 2 0 1 Find Eigen values and Eigen vector for smallest Eigen value of the matrices  $\begin{vmatrix} 0 & 2 & 0 \end{vmatrix}$ 1 0 2 23. Find the Eigen values and corresponding Eigen vectors of the matrix -22 A= 1 1 1. -1Find Eigen values and Eigen vector for largest Eigen value of the matrices 24.
  - $\begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$

25. Find the Eigen values and corresponding Eigen vectors of the matrix  $\mathbf{A} = \begin{bmatrix} 3 & 1 & 1 \\ 1 & 3 & -1 \\ 1 & -1 & 3 \end{bmatrix}.$ 26. Verify Cayley–Hamilton theorem and find  $A^{-1}$  of the matrices  $\begin{vmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{vmatrix}$ Verify Cayley Hamilton theorem and find  $A^{-1}$  &  $A^4$  where  $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & 1 & 2 \end{bmatrix}$ . 27. Verify Cayley Hamilton theorem and find A<sup>-1</sup>&A<sup>4</sup> where 28.  $\mathbf{A} = \begin{bmatrix} \mathbf{1} & \mathbf{0} & -\mathbf{2} \\ \mathbf{2} & \mathbf{2} & \mathbf{4} \\ \mathbf{0} & \mathbf{0} & \mathbf{2} \end{bmatrix}.$ Verify Cayley-Hamilton theorem and Also find the matrix represented by 29.  $A = \begin{vmatrix} 1 & 4 \\ 2 & 3 \end{vmatrix}$  $A^{5} - 4A^{4} - 7A^{3} + 11A^{2} - A - 10I$  where 30. Find the characteristic equation of the matrix A given below and also find the matrix  $A = \begin{vmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{vmatrix}$ represented by  $A^7 - 4A^6 - 20A^5 - 34A^4 - 4A^3 - 20A^2 - 33A + I$  where 31. Verify Cayley–Hamilton theorem and find  $A^{-1}$ , of the matrix A=  $\begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \end{bmatrix}$ **UNIT-II: Partial Differentiation** Sr. No Questions Evaluate  $\frac{\partial u}{\partial x}$ ,  $\frac{\partial u}{\partial z}$  if  $z = \tan^{-1}\left(\frac{x^2 + y^2}{x + y}\right)$ . 1. 2. If  $z(x + y) = x^2 + y^2$ , show that  $\left(\frac{\partial z}{\partial x} - \frac{\partial z}{\partial y}\right)^2 = 4\left(1 - \frac{\partial z}{\partial x} - \frac{\partial z}{\partial y}\right)$ 3. If  $u = x^y$  show that  $\frac{\partial^3 u}{\partial x^2 \partial y} = \frac{\partial^3 u}{\partial x \partial y \partial x}$ 4. If u = f(y - z, z - x, x - y) show that  $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$ 5. If  $z = \tan(y + ax) + (y - ax)^{\frac{3}{2}}$  then prove that  $\frac{\partial^2 z}{\partial x^2} - a^2 \frac{\partial^2 z}{\partial y^2} = 0$ 

6. If  $u = x^2 tan^{-1}\left(\frac{y}{x}\right) - y^2 tan^{-1}\left(\frac{x}{y}\right)$ , find  $\frac{\partial^2 u}{\partial x \partial y}$ 7. If  $u = \log \sqrt{x^2 + y^2 + z^2}$  then show that  $(x^{2} + y^{2} + z^{2})\left(\frac{\partial^{2}u}{\partial x^{2}} + \frac{\partial^{2}u}{\partial y^{2}} + \frac{\partial^{2}u}{\partial z^{2}}\right) = 1$ 8. If z = f(x, y) where  $x = e^u + e^{-v}$  and  $y = e^{-u} - e^v$  then show that,  $\frac{\partial z}{\partial y} - \frac{\partial z}{\partial y} = x \frac{\partial z}{\partial x} - y \frac{\partial z}{\partial y}$ If u = f(r) where,  $r^2 = x^2 + y^2 + z^2$  then show that 9.  $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial z^2} = f''(r) + \frac{2}{r}f'(r)$ 10. If u = f(r, s, t) and  $r = \frac{x}{y}$ ,  $s = \frac{y}{z}$ ,  $t = \frac{z}{x}$  show that  $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z} = 0$ If  $u = \frac{y}{z} + \frac{z}{x} + \frac{x}{y}$ , show that  $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z} = 0$ 11. 12. Evaluate  $\frac{\partial u}{\partial x}$ ,  $\frac{\partial u}{\partial z}$  if  $z = \tan^{-1}\left(\frac{x^2 + y^2}{x + y}\right)$ . 13. If x = logu, y = logv and z = f(x, y) then prove that  $\frac{\partial^2 u}{\partial x \partial y} = uv \left( \frac{\partial^2 z}{\partial u \partial y} \right)$ 14. If  $v = log(x^2 + y^2 + z^2)$ , prove that  $(x^2 + y^2 + z^2) \left( \frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2} + \frac{\partial^2 v}{\partial z^2} \right) = 2$ If  $u = \sin^{-1}\left(\frac{x}{y}\right) + \tan^{-1}\left(\frac{y}{x}\right)$ , prove that  $x\frac{\partial u}{\partial x} + y\frac{\partial x}{\partial y} \equiv 0$ 15. 16. If  $logu = \frac{x^3 + y^3}{3x + 4y}$  then prove that  $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 2ulogu$ 17.  $u = \sin^{-1}\left(\frac{x+y}{\sqrt{x-y}}\right)$  then prove that  $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \frac{1}{2}\tan u$ 18. If  $z = x^4 y^2 sin^{-1}\left(\frac{x}{y}\right) + \log x - \log y$ , find  $x\frac{\partial z}{\partial x} + y\frac{\partial z}{\partial y}andx^2\frac{\partial^2 z}{\partial x^2} + 2xy\frac{\partial^2 z}{\partial x\partial y} + y^2\frac{\partial^2 z}{\partial y^2}$ 19. If  $u = x^2 \tan^{-1}\left(\frac{y}{x}\right) + y^2 \sin^{-1}\left(\frac{y}{x}\right)$ , prove that  $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = 2u$ Verify Euler's Theorem for  $u = \sin^{-1} \sqrt{x^2 + y^2}$ 20. 21. If  $u = \log(x^2 + xy + y^2)$ , show that  $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 2$ 22. If  $u = \sin^{-1}\left(\frac{x^{\frac{1}{4}} + y^{\frac{1}{4}}}{x^{\frac{1}{5}} + x^{\frac{1}{5}}}\right)$ , prove that  $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \frac{1}{20} \tan u$ 

23. If  $u = sin^{-1} \left( \frac{x+y}{\sqrt{x}+\sqrt{y}} \right)$ , then prove that,  $x^{2}\frac{\partial^{2}u}{\partial x^{2}} + 2xy\frac{\partial^{2}u}{\partial x\partial y} + y^{2}\frac{\partial^{2}u}{\partial y^{2}} = \frac{-\sin u \cdot \cos 2u}{4\cos^{3}u}$ 24. If  $u = \tan^{-1}\left[\frac{\sqrt{x^2 + y^2}}{x + y}\right]$ , find  $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2}$ 25. If  $u = e^{xyz}$  find  $\frac{\partial^3 u}{\partial x \partial y \partial z}$ If  $u = \log(x^3 + y^3 + z^3 - 3xyz)$  prove that  $(\frac{\partial}{\partial x} + \frac{\partial}{\partial y} + \frac{\partial}{\partial z})^2 u = \frac{-9}{(x+y+z)^2}$ 26. 27. If  $u = \tan^{-1}(\frac{x^3 + y^3}{x - y})$  prove that  $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \sin 2u$ If  $u = \sin\left(\frac{x}{y}\right)$  and  $x = e^t$ ,  $y = t^2$  verify  $\frac{du}{dt} = \frac{\partial u}{\partial x}\frac{dx}{dt} + \frac{\partial u}{\partial y}\frac{dy}{dt}$ 28. 29. If f(u) is a homogeneous function of degree n in x & y then show that  $x^2 \frac{\partial^2 u}{\partial x^2} +$  $2xy\frac{\partial^2 u}{\partial x \partial y} + y^2\frac{\partial^2 u}{\partial y^2} = G(u).[G'(u) - 1] \text{ where } G(u) = n\frac{f(u)}{f'(u)}$ 30. Verify Euler theorem for  $u = \frac{x^2 + y^2}{x + y}$ 31. Evaluate  $\frac{\partial u}{\partial x}$ ,  $\frac{\partial u}{\partial z}$  if  $z = \tan^{-1}\left(\frac{x^2 + y^2}{x + y}\right)$ . **UNIT-III: Applications of Partial differentiation** Sr. No Questions If  $u = x + 2y^2 - z^3$ ,  $v = 2x^2yz$ ,  $w = 2z^2 - xy$  then evaluate  $\frac{\partial(u, v, w)}{\partial(x, v, z)}$ 1. Discuss the maxima and minima for the function  $x^2 + y^2 + (30 - x - y)^2$  and hence find 2. the extreme value of the function. 3. Using Lagrange's undetermined multipliers find the maximum value of function  $x^{2} + y^{2} + z^{2}$  when x + y + z = 3aExpand  $f(x, y) = e^{x+y}$  in Maclaurin's theorem up to fourth term. 4. If x = u(1 - v), y = uv prove that JJ' = 15. A rectangular box open at the top is to have volume of 256 cubic feet, determine the 6. dimensions of the box required least material for the construction of the box. Examine the function  $x^3 + y^3 - 3axy$  for maxima & minima where a > 07.

- 8. Find the points on the surface  $z^2 = xy + 1$  nearest to the origin.
- 9. If  $u = \frac{yz}{x}$ ,  $v = \frac{zx}{y}$ ,  $w = \frac{xy}{z}$  show that  $\frac{\partial(u, v, w)}{\partial(x, y, z)} = 4$
- 10. Expand  $f(x, y) = \cos x \sin y$  as far as the terms of third degree.

- 11. If  $u = x^2 y^2$ , v = 2xy and  $x = r\cos\theta$ ,  $y = r\sin\theta$ , find  $\frac{\partial(u,v)}{\partial(r,\theta)}$ .
- 12. Find the first six terms of the expansion of the function  $f(x, y) = e^x \log(1 + y)$  in the powers of x and y.
- 13. Test the function  $f(x, y) = x^4 + y^4 x^2 y^2 + 1$  for the maxima, minima and saddle point.
- 14. Find Maxima and Minima values of the function f(x, y) = sinx + siny + sin(x + y)
- 15. Find the maximum value of  $x^m y^n z^p$  when x + y + z = a
- 16. Find the maximum and minimum distances from the origin to the curve  $3x^2 + 4xy + 6y^2 = 140$
- 17. Find the volume of the largest parallelepiped that can be inscribed in the ellipsoid  $\frac{x^2}{z^2} + \frac{y^2}{L^2} + \frac{z^2}{z^2} = 1$
- 18. Find the stationary values of  $x^2 + y^2 + z^2$  subject to  $ax^2 + by^2 + cz^2 = 1$  and lx + my + nz = 0
- 19. Determine the point in the plane 3x 4y + 5z = 50 nearest to the origin.
- **20.** The sum of three numbers is a constant. Prove that their product is maximum when they are equal.

21. If 
$$u^3 + v^3 + w^3 = x + y + z$$
,  $u^2 + v^2 + w^2 = x^3 + y^3 + z^3$ ,  $u + v + w = x^2 + y^2 + z^2$  the show that  $\frac{\partial(u, v, w)}{\partial(x, y, z)} = \frac{(x - y)(y - z)(z = x)}{(u - v)(v - w)(w - u)}$   
22. If  $u^3 + v^3 - w + w - v^2 + v^2 - v^3 + w^3$  then  $v^3 + w^3$  then  $v^4 = v^4 + z^2 - v^2$ 

If 
$$u^3 + v^3 = x + y$$
,  $u^2 + v^2 = x^3 + y^3$  then show that  $\frac{\partial(u,v)}{\partial(x,y)} = \frac{1(x^2 - y^2)}{2uv(u-v)}$ 

- **23.** If  $x = e^u cosv$ ;  $y = e^u sinv$  then prove that JJ' = 1
- 24. As the dimension of a triangle ABC are varied of  $\cos A.\cos B.\cos C$  is obtained when the triangle is equilateral.
- **25.** Using Lagrange's method 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.

#### **UNIT-IV: Reduction Formulae and Tracing of Curves**

#### Sr. No Questions

- 1. Evaluate  $\int_0^{\frac{\pi}{2}} \cos^6 x \, dx$
- 2. Evaluate  $\int_0^{\frac{\pi}{2}} \sin^8 x \cos^7 x \, dx$
- 3. Evaluate  $\int_0^{\frac{\pi}{6}} \cos^4 3\theta \sin^3 6\theta d\theta$

4. Evaluate 
$$\int_0^{2a} x \sqrt{(2ax - x^2)} dx$$

- 5. Evaluate  $\int_0^a x^2 (a^2 x^2)^{\frac{3}{2}} dx$
- 6. Evaluate  $\int_0^4 x^3 \sqrt{4x x^2} dx$

7.	Evaluate $\int_0^\infty \frac{t^2}{(1+t^2)^{\frac{7}{2}}} dt$
8.	Evaluate $\int_{0}^{\frac{\pi}{2}} \sin^3 x \sin^4 x  dx$
9.	Evaluate $\int_{0}^{\pi} x \sin^{7} x \cos^{4} x dx$
10.	Evaluate $\int_{0}^{1} x^{4} (1 - x^{2})^{\frac{3}{2}} dx$
11.	Evaluate $\int_{0}^{1} \frac{x^{7}}{\sqrt{1-x^{2}}} dx$
12.	Evaluate $\int_{0}^{1} \frac{x^{2}(4-x^{2})}{\sqrt{4-x^{2}}} dx$
13.	Evaluate $\int_{-\pi}^{\pi} \sin^4 x \cos^2 x  dx$
14.	Evaluate $\int_{0}^{\frac{\pi}{2}} \sin^{8}x  dx$
15.	Evaluate $\int_{0}^{2a} \frac{x^3}{\sqrt{2ax-x^2}} dx$
16.	Integrate $\int \sin^4 x  dx$
17.	Integrate $\int \cos^4 x  dx$
18.	Trace the curve : $y^2(a - x) = x^2(a + x)$
19.	Trace the curve $r = 1 - 2\sin\theta$
20.	Trace the curve: $xy^2 = 4a^2(2a - x)$
21.	Trace the curve: $y^2(2a - x) = x^3$
22.	Trace the curve: $r = a(1 + \cos \theta)$
23.	Trace the curve: $r = 2 \sin 3\theta$
24.	Trace the curve: $y^2 = x^3$
26.	Trace the curve: $x = a\cos^3 t$ , $y = a\sin^3 t$
27.	Trace the curve: $r = a\cos 3\theta$
28.	Trace the curve: $r = 1 + 2\cos\theta$
29.	Trace the curve: $r^2 = a^2 cos 2\theta$
30.	Trace the curve: $xy^2 = a(x^2 - a^2)$
31.	Trace the curve: $y^2(4 - x) = x(x - 2)^2$
32.	Trace the curve: $y^2(x - a) = x^2(2a - x)$
33.	Trace the curve: $r = 3 + 2cos\theta$
34.	Trace the curve: $y^2 = x^2(1 - x)$
35.	Trace the curve: $\sqrt{x} + \sqrt{y} = \sqrt{a}$
36.	Trace the curve: $ay^2 = x^2(a - x)$
37.	Trace the curve: $r = \frac{2a}{1+sin\theta}$

Sr. No	Questions
1.	Evaluate: $\int_{0}^{5} \int_{0}^{x^{2}} x(x^{2} + y^{2}) dx dy$
2.	Evaluate: $\int_{-1}^{1} \int_{0}^{x} \int_{x-z}^{x+z} (x+y+z) dx dy dz$
3.	Evaluate: $\int_{0}^{a} \int_{0}^{x+y} \int_{0}^{x+y+z} dz dy dx$
4.	Evaluate: $\int_{1}^{e} \int_{1}^{\log y} \int_{1}^{e^{x}} \log z dz dx dy$
5.	Evaluate: $\int_{-c-b-a}^{c} \int_{-a}^{b} \int_{-a}^{a} (x^{2} + y^{2} + z^{2}) dx dy dz$
6.	Evaluate the integrals by Changing the order of integration: $\int_{0}^{4a} \int_{x^2/4a}^{2\sqrt{ax}} dy dx$
7.	Evaluate the integrals by Changing the order of integration: $\int_{0}^{a} \int_{\sqrt{ax}}^{a} \frac{y^2}{\sqrt{y^4 - a^2 x^2}} dx dy$
8.	Evaluate the integrals by Changing the order of integration: $\int_{0}^{1} \int_{x^{2}}^{2-x} xy dx dy$
9.	Evaluate the integrals by Changing the order of integration: $\int_{0}^{1} \int_{x}^{\sqrt{2-x^{2}}} \frac{x}{\sqrt{x^{2}+y^{2}}} dx dy$
10.	Evaluate the integrals by Changing the order of integration: $\int_{0}^{3} \int_{1}^{\sqrt{4-y}} (x+y) dx dy$
11.	Evaluate the integrals by Changing the order of integration: $\int_{0}^{a/\sqrt{2}} \int_{y}^{\sqrt{a^{2}-y^{2}}} \log(x^{2}+y^{2}) dx dy$
12.	Evaluate the integrals by Changing the order of integration: $\int_{0}^{1} \int_{x}^{\sqrt{x}} xy dy dx$
13.	Evaluate the integrals by Changing the order of integration: $\int_{0}^{\infty} \int_{x}^{\infty} \frac{e^{-y}}{y} dy dx$
14.	Evaluate the integrals by Changing the order of integration: $\int_{0}^{\infty} \int_{0}^{x} x e^{-x^{2}/y} dy dx$

Change to polar and evaluate the  $\int_{a}^{a} \int_{a}^{\sqrt{a^2 - y^2}} e^{-x^2 - y^2} dx dy$ 15. Change to polar and evaluate the  $\int_{0}^{1} \int_{x^2}^{x} \frac{dxdy}{\sqrt{x^2 + y^2}}$ 16. Change to polar and evaluate the  $\int_{-1}^{1} \int_{-1}^{0} \frac{4\sqrt{x^2 + y^2}}{1 + x^2 + y^2} dx dy$ 17. 18. Change to polar and evaluate the  $\int_{0}^{3} \int_{\sqrt{2x}}^{x} \frac{dxdy}{\sqrt{x^2 + y^2}}$ 19. Change to polar and evaluate the  $\int_{-\infty}^{1} \int_{-\infty}^{\sqrt{1-x^2}} x^2 y^2 dx dy$ 20. Find the area of a plate in the form of a quadrant of the ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ 21. Show that the area between the parabolas  $y^2 = 4ax$  and  $x^2 = 4ay$  is  $\frac{16a^2}{2}$ 22. Find, by double integration, the area lying inside the circle  $r = a \sin \theta$  and outside the cardioid  $r = a(1 - \cos \theta)$ Find the area lying between the parabolas  $y = x^2$  and the line x + y - z = 023. Find the volume bounded by the cylinder  $x^2 + y^2 = 4$  and the planes y + z = 4 and 24. z = 025. Find the volume of the ellipsoid  $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ 

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DEPARTMENT OF FIRST YEAR ENGINEERING

Course Name & Code: Engineering Chemistry (24AF1CHEBS102)

# **Unit 1 Water Treatment**

- Q.1 Differentiate between Temporary hardness and Permanent Hardness
- Q.2 Discuss disadvantages of hard water in domestic and industrial uses.
- Q.3 Define hard water and soft water. How does Hardness of water determined by using EDTA method.
- Q.4 Explain ion exchange process of soft meaning of water with its advantages and disadvantages.
- Q.5 Explain in detail hot lime soda process of softening of water with its advantages and disadvantages.
- Q.6 Explain in detail Dissolved oxygen in water by Winklers method.
- Q.7 Explain desalination of water by reverse osmosis method.What is reverse osmosis? How sea water is purified using this techniques?

OR

- Q.8 Explain methods for disinfection of water.
- Q.9 Note on-1) Aeration
  - 2) Sedimentation.

#### Unit II Fuels and Lubricants

- Q.1 What are fuels? How they classified? state characteristics of good fuels
- Q.2 How calorific value of non-volatile liquid determined by Bomb calorimeter? **OR** Draw a neat labelled diagram and explain the working of Bomb Calorimeter.
- Q.3 How calorific value of non-volatile liquid determined by Boy's calorimeter? **OR** Draw a neat labelled diagram and explain the working of Boy's Calorimeter.
- Q.4 What is fractional distillation and describe refining of petroleum.
- Q.5 Describe the process of determination of percentage of carbon, hydrogen and sulphur in a coal.
- Q.6 Describe the proximate analysis of coal with its significance.
- Q.7 Explain how percentage of nitrogen and sulphur can be estimated from coal can be estimated.
- Q.8 Give the physical properties of lubricants.
- Q.9 Explain liquid lubricants in details.
- Q.10 Give the chemical properties of lubricants.

#### **Unit III Electrochemistry**

Q.1 Explain the method of conductance measurement by Wheatstone bridge method

and discuss the term cell constant.

- O.2 Explain Conduct metric titration with suitable examples.
- Q.3 Write a note on glass electrode.
- Q.4 Explain Ostwald's theory of acid – base indicator. 6M
- What is Fuel cell? Explain in detail (H2 O2) fuel cell. 6M Q.5
- Write a note on fuel cell. Q.6
- Q.7 Explain the lithium ion batteries in detail.
- Q.8 Describe in detail lithium batteries.

#### **Unit IV Instrumental Methods of analysis**

- Q.1 Draw neat labelled diagram of double beam spectrophotometer and explain its working. **OR** Explain double beam spectrophotometer with neat labelled diagram.
- Q.2 Explain the law of absorption
  - OR State and explain Beer -Lambert's law.
- Explain flame photometry with neat labelled diagram. Q.3 OR
- Draw neat labelled diagram of Flame photometry and explain its working. Q.4
  - Write a short note on-1) Classification of Chromatography

## 2) Thin Layer Chromatography

- Draw neat labelled diagram of double beam IR spectrometer and explain its working. Q.5 **OR** Explain double beam IR spectrometer with neat labelled diagram.
- Q.6 Define IR spectroscopy. Explain in detail the range of IR radiations.

# **Unit V Engineering Materials**

- Define Portland cement .Explain manufacturing of Portland cement. Q.1
- Q.2 Define Portland cement. Describe in detail the chemical composition of Portland cement.
- Q.3 Write a note on Chemical composition of Cement.
- Q.4 What is Plaster of Paris? Give its properties and Uses. What is Gypsum Plaster? Give its properties and Uses.
- Q.5 Define Polymerization and explain its types.
- Differentiate Thermoplastic and thermosetting Plastic. Q.6
- Explain in detail the constituent of Plastic. Q.7
- Describe the synthesis of Urea formaldehyde with its properties and uses. Q.8
- Q.9 Explain natural rubber in detail. OR

Describe the synthesis of Styrene Butadiene rubber with its properties and uses

====END=====

OR



# Unit No.1: Basic concepts

- 1) State the following terms.
  - **a.** Law of transmissibility of forces
  - **b.** Free body diagram.
  - c. Define: Rigid body, Statics, and Line of action of force.
  - d. State Parallelogram, Polygon and Triangle law of forces.
  - e. Define: Resultant force, coplanar forces, and Moment of a force.
  - **f.** Force system
  - g. Varignon's theorem.
- 2) What do you mean by resolution and composition of the force? What do you mean by the resultant force? Also define moment of couple.
- 3) Define force system. Name the different force system.
- 4) A force system acting on a rigid body is as shown in figure. Find the magnitude and direction of resultant and its position with respect to point A. Find X-intercept and Y-intercept.



5) Four forces each of magnitude 400N is acting on a wheel as shown in fig. Find the resultant in magnitude and direction and locate it in the fig. Take radius of wheel as 1m.



6) A square plate 8cm X 8cm with its Centre at the origin is subjected to four forces as under. Plate also carries a clockwise moment of 200Ncm at its Centre. Determine the magnitude, direction of resultant force and its location on X-axis. (Note-All forces are in Newton)

No.	Magnitude (kN)	From	То
1	1.5	(1,2)	(3,3)
2	2.0	(0,1)	(-3,3)
3	1.0	(-2,0)	(-1,-3)
4	2.5	(1,-2)	(3,0)

7) Calculate the resultant of non-concurrent force system as shown in fig. Locate its position from point A.



8) The resultant R of four forces of which four are shown in fig. is 1950 down to right with slope of 5 to 12 through point A. Determine the unknown force F & its X intercept.

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- 9) Two persons are pushing a box so that the net force on the box is 12 N to the east. If one of the person is applying a force 5 N to the north, what is the force applied by the other person.
- **10)** Find the magnitude and direction of the resultant force for a number of forces acting at a common point:
  - i) 600 N inclined at 45° towards South of West.
  - ii) 800 N towards South-East,
  - iii) 400 N inclined at 30° towards North of East
  - iv) 300 N towards North-West
  - iv) 500 N towards North
- 11)

Find the magnitude and direction of the resultant force for the number of forces acting at a common point as shown in figure. The forces 20 N, 30 N, 40 N, 50 N and 60 N are acting at one of the angular points of a regular hexagon, towards the other five angular points, taken in order.





#### Unit No. 2: Equilibrium of forces

- 1) State and explain Lami's Theorem. What are the limitations of Lami's theorem?
- 2) State and explain parallel axis theorem and perpendicular axis theorem
- 3) What do you mean by radius of gyration? Explain the term moment of inertia.
- 4) Derive expression for moment of inertia of triangular section about base.
- 5) Derive expression for moment of inertia of hollow circular section about centroidal axis.
- 6) Calculate moment of inertia of the shaded area about X-X axis. Also compute radius of gyration about X-X axis. All dimensions are in mm.



 Determine moment of inertia of given lamina about Cartesian axis OX and OY as shown in fig.



8) Locate the centroid of the I-section shown in figure with respect to the axes shown. (All dimensions are in mm)



9) Calculate moment of inertia of the given shaded portion of given fig. about its centroidal axis.



**10)** Find the force P as shown in fig. Such that the motion of the block A is impending in the direction of P. The coefficient of friction between the block B and the plane is 0.2 and between the block A and the plane is 0.3.



11) Two cylinders A of wt 4KN & B of wt 2KN rest on two smooth inclined planes as shown in fig. They are connected by a rod of negligible wt at its geometric centers. Find the force p to be applied as shown in fig. such that it will hold the system in the equilibrium.



**12)** When two rollers of wt 100N and 200N are having 150mm and 225mm diameter respectively are supported as shown in fig. Find reaction induced at supports and contact points



13) block of weight 500 N is lying on a rough plane inclined at an angle of 25° with the horizontal. It is supported by a pull (P) parallel to the plane as shown in figure. The angle of friction is 20°. Determine the minimum and maximum values of P, for which the equilibrium can exist.



- 14) Define friction and state laws of static friction and dynamic friction.
- 15) Bucket A and block C are connected by a cable that passes over drum B. Knowingthat drum B rotates slowly counterclockwise and that the coefficients of static & kinetic friction at all surfaces are  $\mu s = 0.35$  and  $\mu k = 0.25$ , determine the smallest combined mass m of the bucket and its contents for which block C will
  - (a) remain at rest,
  - (b) start moving up the incline,



16) What should be the value of  $\theta$  that will make the motion of 900 N block down the plane to impend? The coefficient of friction for all contact surfaces is 1/3. (Note: Upper block weighs 300 N)



17) A Uniform wheel of 1200 mm diameter weighing 10 kN rests against a rigid rectangular block of 300 mm height as shown in figure below. Find the least force (P) through the centre of the wheel required just to turn the wheel over the corner A of the block. Also find the reaction at corner A of the block?



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18) A ladder weighing 100 N is to be kept in the position shown in figure, resting on a smooth floor and leaning on a smooth wall, also a man weighing 700 N is at 2m above floor level. Determine (i) The horizontal force F required at floor level to prevent it from slipping. (ii) If the horizontal force F is to be applied at a height of 1 m above the ground level, how much should F be?



- 19) A ladder 5 meters long rests on a horizontal ground and leans against a smooth vertical wall at an angle 70° with the horizontal. The weight of the ladder is 900 N and acts at its middle. The ladder is at the point of sliding, when a man weighing 750 N stands on a rung 1.5 meter from the bottom of the ladder. Calculate the coefficient of friction between the ladder and the floor.
- 20)

The cylindrical rollers of weight 50 N each having radius 0.3 m are placed inside a cup having base width 1 m. Find reactions at points of contact A, B, C and D.



21) A string ABCD, attached to fixed points A and D has two equal weights of 1000 N attached to it at B and C. The weights rest with the portions AB and CD inclined at angles. Find the tensions in the portions AB, BC and CD of the string, if the inclination of the portion BC with the vertical is 120°.



# Unit No. 03: Beam and Truss

- 1) State & explain different types of beams & beam supports.
- 2) State different types of loads acting on the beam.
- 3) Determine support reaction of simply supported beam.



4) A continuous beam ABCD is as shown in fig. There is provided an internal hinge at C. Beam CD carries an UDL and offers an reaction at B as 60kN. Determine load W and find reaction at A and D



5) Determine the support reactions of the Compound beam.



- 6) Determine the support reactions
- 7)



7) Find the support reactions for a simply supported beam as shown in fig.



8) Find the support reactions for a simply supported beam as shown in fig.



9) Find magnitude and nature of forces in members of a truss shown in Fig.



- 10) Distinguish between method of joints and method of section for analysis of truss
- Determine the forces in the various members of a pin-joined frame as shown in figure. Tabulate the result stating its nature.



- 12) Differentiate between method of joint and method of section.
- 13) Explain the terms: 1) Stable truss, 2) Unstable truss, 3) Perfect truss.
- 14) Find the forces induced in members due to load of 15 KN at point C in truss shown in fig.



15) Determine the forces in members of the truss as shown in fig.



16) Determine the forces in members of the frame as shown in fig.



17) Determine the forces in members of the frame as shown in fig.



18)

Find out forces in all the members of truss. (All angles are 60°)



**Unit No.04 Kinematics** 

- 1) A body starts with a velocity of 3 m/s and moves in a straight line with a constant acceleration. If its velocity at the end of 5 seconds is 5.5 m/s, find (i) the uniform acceleration, and (ii) distance travelled in 10 seconds.
- **2)** A car starts from rest and accelerates uniformly to a speed of 72 kmph. over a distance of 500 m. Find acceleration of the car and time taken to attain this speed. If a further acceleration rises the speed to 90 kmph. in 10 seconds, find the new acceleration and the further distance moved.
- **3)** A bullet moving at the rate of 300 m/s is fired into a thick target and penetrates up to 500 mm. If it is fired into a 250 mm thick target, find the velocity of emergence. Take the resistance to be uniform in both the cases.
- **4)** A stone is dropped from the top of a cliff 120 meters high. After one second, another stone is thrown down and strikes the first stone when it has just reached the foot of the cliff. Find the velocity with which the second stone was thrown.
- **5)** A body is projected upwards with a velocity of 30 m/s. Find the time when its velocity will be 5 m/s; when it will be 20 meters above the point of projection and when it will return to the point of projection.
- **6)** A car starts from rest with an acceleration of 4 m/s2. What is the distance travelled in 8th second?
- 7) What is the difference between uniform acceleration and variable acceleration?
- 8) Distinguish clearly between speed and velocity. Give examples.

- 9) The equation of motion of an engine is given by s = 2t3 6t2 5, where (s) is in meters and (t) in seconds. Calculate (i) displacement and acceleration when velocity is zero; and (ii) displacement and velocity when acceleration is zero.
- 10) A body starting from rest, moves in such a way that its acceleration is given by: a = 3 0.15 t2. Find the time when the body comes to stop and distance travelled during this time.
- 11) A train moving at 30 kmph is struck by a stone moving at right angles to the train with a velocity of 22.5 kmph Find the velocity and direction which the stone appears to strike the train, to a person sitting in it.
- 12) What do you understand by the term 'relative velocity'?
- 13) A bomber, flying horizontally at a height of 500 m with a velocity of 450 kmph, has aimed to hit a target. Find at what distance from the target, he should release the bomb in order to hit the target.
- 14) A cricket ball, shot by a batsman from a height of 1.8 m at an angle of 30° with horizontal with a velocity of 18 m/s is caught by a fields man at a height of 0.6 m from the ground. How far apart were the two players?
- **15)** A bird is sitting on the top of a tree 10 m high. With what velocity should a person, standing at a distance of 25 m from the tree, throws a stone at an angle of 30° with the horizontal so as to hit the bird?
- 16) A player can throw a cricket ball 100 m on a level ground. Find the distance through which he can throw the same ball from the top of hill at angle of 52° 30', if slope of the hill is 15°.
- 17) A shot is fired with a velocity of 100 m/s at an angle of 45° with the horizontal on a plane inclined at an angle of 30° with the horizontal. Find the maximum range of the shot.
- 18) Explain centripetal and centrifugal force.
- **19)** Relation between angular motion and linear motion
- **20)** A box of mass 1kg is placed on a smooth horizontal plane. A horizontal force F (N) acting which varies as F=8-10t. Find the maximum velocity attained by the body. Also find corresponding displacement.
- 21) A motorist travelling at a speed of 90km/hr suddenly applies brakes and comes to a stop after skidding 68m. Determine 1) time needed to stop the car, 2) Coefficient of friction between the tyres and road.

- 22) Enlist and explain types of motion curves.
- **23)** A bus starts from rest at a point A and accelerates at the rate of 0.8m/s till it reaches a speed of 12m/s. It then proceeds at 12m/s till the brakes are applied. It comes to rest at point B, 42m beyond the point where brakes are applied. Assuming the uniform deceleration and that the total time of travel from A to B is 36second, determine the distance between A and B using v-t diagram, Also draw v-t diagram.
- 24) A ball is projected upwards with a velocity of 60 m/s and reaches a maximum height of 5 metres above ground level. Determine the angle of projection and point where it hits the ground.
- 25)

At a certain instant, a body of mass 10 kg, falling freely under the force of gravity, was found to be falling at the rate of 20 m/s. What force will stop the body in (i) 2 seconds and (ii) 2 metres?

**26)** Motion of a particle along a straight line is given by the equation:

x = t3 - 3t2 - 9t + 12. Determine the time, position and acceleration of the particle when its velocity becomes zero.

- **27)** The distance between two stations A and B is 3.9 km. A train starts from station A and reach its speed 30 kmph in 20 seconds and travels until the speed reaches 36 kmph. This speed is maintained until brakes are applied and the train is brought to rest at the second station B under the retardation of 0.9 m/s<sup>2</sup>. Find the time taken to perform this journey.
- **28)** A motorist is traveling on a curved road of radius 200 m at a speed of 72 kmph. Find the normal and tangential components of acceleration.
- 29) Boat A is moving north-west at a speed of 36 km/h and the boat B is moving east at speed 18 km/h. Find the magnitude and direction of the relative velocity of the boat B with respect to the boat A.
- **30)** A wheel increases its speed from 45 r.p.m. to 90 r.p.m. in 30 seconds. Find (i) angular acceleration of the wheel, and (ii) no. of revolutions made by the wheel in these 30 seconds.
- **31)** A particle is projected inside a horizontal tunnel with a velocity of 60 m/s. The height of tunnel is 5 metres. Find the angle of projection and the greatest possible range.
- **32)** At a certain instant, a body of mass 10 kg, falling freely under the force of gravity, was found to be falling at the rate of 20 m/s. What force will stop the body in (i) 2 seconds, and (ii) 2 metres?
- **33)** The equation of motion of an engine is given by s = 2t3 6t2 5, where (s) is in meters and (t) in seconds. Calculate (i) displacement and acceleration when velocity is zero; and (ii)

displacement and velocity when acceleration is zero.

- **34)** A projectile is aimed at a target on the horizontal plane and falls 12m short when the angle of projection is 150, while it overshoots by 24 m when the angle is 450. Find the angle of projection to heat the target.
- **35)** A passenger train 300m long, moving with a velocity of 108kmph overtakes a goods train moving on a parallel path in the same direction, completely in 45 seconds. If the length of the goods train is 250 m, determine the speed of the goods train?
- **36)** If a particle is projected inside a horizontal tunnel which is 5 meters high with velocity of 60 m/s, find the angle of projection and the greatest possible range.
- 37) A body moves along a straight line and its acceleration 'a' which varies with time is given by a = 2 3t. Five seconds after start of the observations, its velocity is found to be 20 m/sec. Ten seconds after start of the observation, the body is at 85 m from the origin. Determine its acceleration, velocity and distance from the origin.

# Unit No. 5 Kinetics and Work, Power, Energy

- 1. Find the force required to give an acceleration of 1.5 m/s2 to a body of mass 40 kg.
- **2.** A body of mass 40 kg is moving with a constant velocity of 2.5 m/s. Now a force of 100 N is applied on the body in its direction of motion. What will be its velocity after 2 second?
- **3.** A railway coach of mass 50 tons can exert a tractive force of 20 kN Find the acceleration of the coach on a level track if the resistance is 150 N per ton?
- 4. In an office, a lift is moving upwards with an acceleration of 1.5 m/s2. Find the pressure exerted by a body of mass 30 kg on the floor of the lift.
- 5. An elevator of mass 2 t is to be lifted and lowered by means of a rope. Find the tension in the rope, when the elevator is moving (i) upward with an acceleration of 2 m/s2 and (ii) downward with an acceleration of 1.5 m/s2.
- 6. A bullet of 10 gm mass is fired horizontally with a velocity of 1000 m/s from a gun of mass 50 kg. Find (a) velocity with which the gun will recoil, and (b) force necessary to be ring the gun to rest in 250 mm.
- 7. Derive an expression for the tension in the cable supporting a lift when (i) it is going up, and (ii) it is coming down.
- 8. Explain clearly the term 'recoil of gun'. How will you find the velocity of the bullet?
- **9.** A mass of 9 kg, while descending vertically down, drags up a mass of 6 kg by means of a string passing over a smooth pulley. Find the acceleration of the system and tension in the string.
- **10.** Two bodies of mass 3 kg and 2.5 kg are hung to the ends of a string passing over a smooth pulley. At the end of 5 seconds, the string breaks. How much higher the 2 kg mass will go?
- 11. Explain the reason for the tension in both the strings to be equal, when two masses are attached to its ends, and the inextensible string is made to pass over a smooth pulley.

- **12.** Derive an equation for the tension in the string, when one body is free and the other is lying on a rough horizontal plane.
- **13.** Two bodies of masses 45 and 30 kg are hung to the ends of a rope, passing over a frictionless pulley. With what acceleration the heavier mass comes down? What is the tension in the string?
  - **14)** A body weighing 300N is pushed up a 30 plane by a 400N force acting parallel to the plane. If the initial velocity of the body is 1.5 m/s and coefficient of kinetic friction is 0.2 what velocity will the body have after moving 6 m?
  - **15)** State and explain D'Alembert's principle and co-relate this with Newton's second law of motion.
  - 16) A block weighing 2500N rests on a level horizontal plane for which coefficient of friction is 0.2. This block is pulled by a force of 1000N acting at an angle of 30 degree to the horizontal. Find the velocity of the block after it moves 30m starting from rest. If the force of 1000N is then removed how much further will it move? Use work energy principle.
  - 17) An elevator cage of a mine shaft weighing 8kN, when empty, is lifted or lowered by means of wire rope. Once a man weighing 600N, entered it and lowered with uniform acceleration such that when a distance of 187.5m was covered, the velocity of the cage was 25m/s. determine the tension in the rope and the force exerted by the man on the floor of the cage.
  - 18) A locomotive starts from rest and pulls a train, weighing 18MN down at 1% grade. The train resistance is 3 N/ kN. If the draw bar pull is constant and equal to 44.5 kN. Find the speed of train after it has travelled a distance of 1500m. Find the final power developed by the engine. What is the acceleration of locomotive and for what duration has it been in motion to cover this distance?
  - **19)** Two blocks A and B are 5m apart, held on a plane inclined at an angle of  $25^{0}$  with horizontal. If Block B slides down towards bock A. Calculate the time and distance travelled by each block before collision. Take  $\mu_{a}=0.2$ ,  $\mu_{b}=0.1$
  - 20) Determine Acceleration of the system and Tension in the string.



- 21) State and explain 1) Work-energy principle, 2) Impulse-momentum principle.
- 22) State and explain principle of virtual work.

- **23)** State and explain conservation of energy.
- 24) The coefficient of restitution between two spheres of masses 1 Kg and 5Kg is 0.75. The 1 KG sphere moving with a velocity of 3m/s, strikes the 5 Kg sphere moving in the same direction with velocity 60m/s. Find the velocities of two spheres after impact and loss of K.E. during impact.
- **25)** A Ball of 4Kg mass moving with a velocity of 2m/s impinges directly on another to all of 5Kg mass moving with velocity of 1m/s in opposite direction. If the coefficient of restitution is 0.5. Find the velocities of balls after impact also find the loss of energy due to impact.
- 26) A ball of 100 gm strikes directly another ball of same mass which is at rest. The first ball comes to rest due to the impact. Find the loss of KE if the coefficient of restitution is  $1/\sqrt{2}$ ?
- 27) A vehicle of mass 600 kg and moving with a velocity of 12m/s strikes another vehicle of mass 400 kg moving at 9m/s in same direction. Both the vehicles get coupled together due to Impact. Find the common velocity with which the two vehicles will move. Also find the loss of K.E. due to impact?
- **28)** A vehicle of mass 1600 kg and moving with a velocity of 22 m/s strikes another vehicle of mass 1400 kg and moving at 18m/s in the same direction. Both the vehicles coupled together due to impact. Find the common velocity with which the two vehicles move. Also find the loss of K.E.?
- **29)** A body weighing 300N is pushed up a  $30^{0}$  plane by a 400N force acting parallel to the plane. If the initial velocity of the body is 1.5 m/s. and coefficient of kinetic friction is  $\mu$ = 0.2, what velocity will the body have after moving 6m?
- **30)** A block of mass 30kg slides down a rough inclined plane at 25<sup>0</sup> with horizontal if coefficient of friction is 0.25 and spring constant 12.5N/mm. Determine maximum compression in spring.



**31)** A 2kg smooth collar is attached to a spring has upstretched length 3m. It is drawn to point B and released from rest determine its speed when it reaches at point A.



- **32)** A ball of mass 10kg moving with a velocity of 20m/s impinges directly on a ball of mass 20kg at rest. The first ball, after impinging, comes to rest. Find the velocity of the second ball after the impact and the coefficient of restitution.
- **33)** An automobile is moving at a speed of 70 kmph, when the breaks are fully applied causing all four wheels to skid. Determine the time required to stop the automobile, a) On concrete road, coeff. of friction = 0.75 b) On ice for which coeff. of friction = 0.08
- 34) A motorist travelling at a speed of 70 kmph suddenly applies a breaks and halts after skidding 50 m. Determine A) The time required to stop the car, B) The coefficient of friction between the tyres and road.
- **35)** A railway engine of mass 20 tonnes is moving on a level track with a constant speed of 45 km.p.h. Find the power of the engine, if the frictional resistance is 80 N/t. Take, efficiency of the engine as 80 %.
- **36)** State with mathematical equation: i) Law of conservation of momentum, ii) Newton's law of collision of elastic bodies. iii) Coefficient of restitution.
- 37) A vehicle, of mass 500 kg, is moving with a velocity of 25 m/s. A force of 200 N acts on it for 2 minutes. Find the velocity of the vehicle; when the force acts in the direction of motion and when the force acts in the opposite direction of the motion.
- **38)** A 750 N crate rests on a 500 N cart. The coefficient of friction between the crate and the cart is 0.3 and between cart and the road is 0.2. If the cart is to be pulled by a force P such that the crate does not slip. Determine: the maximum allowable magnitude of P, the corresponding acceleration of the cart, By Using D'Alembert's principle,



- 39) A 1500 N block is in contact with a level plane, the coefficient of friction between two contact surfaces being 0.1. If the block is acted upon by a horizontal force of 300 N, what time will elapse before the block reaches a velocity of 16 m/sec starting from rest? If 300 N force is then removed, how much longer will the block continue to move? Solve the problem using impulse momentum equation.
- **40)** An army truck of mass 5 tone's (t) has tractive resistance of 150 N/t. Find the power required to propel the truck at a uniform speed of 36 kmph. (a) up an incline of 1 in 100; (b) on a level track; and (c) down an incline of 1 in 100.

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#### **PVPIT Sangli**



# Dr. Vasantraodada Patil Shetkari shikshan Mandal's PADMABHOOSHAN VASANTRAODADA PATIL INSTITUTE OF TECHNOLOGY, SANGLI, MAHARASHTRA 416304

## DEPARTMENT OF FIRST YEAR ENGINEERING

Course Name & Code: Programming for Problem Solving(24AF1000ES106)

# UNIT-I: FUNDAMENTAL OF THE COMPUTER AND COMPUTING CONCEPTS

- **1.** What Is Computer? Explain Generation Of Computer.
- **2.** Write Classification of Computer?
- **3.** Explain Basic Anatomy of computer? Draw Block diagram.
- 4. Define Input Device? List Input Devices Explain any 4 input devices.
- 5. What is Processor? Explain working of processor with diagram.
- 6. Define Output Device? List Output Devices Explain any 4 output devices.
- 7. What is Memory Management? Explain Primary memory and secondary memory.
- 8. Define computer software? Explain types of computer software?
- **9.** What is the main role of utility software in the computer system?
- **10.** What are the main function of operating system? Explain how an is manages hardware and software resources.
- **11.** Explain basic concept of networking? What are the different types of networks (LAN, MAN, WAN) and their key characteristics?
- **12.** Write a difference between LAN MAN AND WAN.
- **13.** What is programming language? Explain types of programming language
- 14. What is Error Checking? List types of Errors Explain any 3 Errors in brief
- **15.** Explain basic structure of C. with one example
- **16.** Describe the purpose of flowcharts and algorithms in programming.
- **17.** What is flow chart? Explain the different symbols used in a flowchart.
- **18.** Write the Algorithm and draw the flowchart to solve the following problems: Addition of two number

# **UNIT II:- Types, Operators and Expressions**

- 1. Explain the rules for naming variables in C and provide examples.
- 2. Describe the different data types in C and their sizes. How do you determine the size of a data type?
- **3.** Write a C program that demonstrates the use of constants. Include examples of integer, floating-point and character constants.
- 4. How do you declare variables of different data types in C? Provide sample code for declaring and initializing variables.
- 5. Write a C program that performs basic arithmetic operations (addition, subtraction, multiplication, and division) and displays the results.
- **6.** Explain the difference between relational and logical operators in C. Provide examples of each and their usage.

- 7. Demonstrate type conversion in C by writing a program that converts an **int** to a **float** and vice versa. Include examples of implicit and explicit type conversion.
- **8.** Write a C program that uses increment and decrement operators. Show how they affect variable values in both pre-increment/decrement and post-increment/decrement forms.
- **9.** Explain bitwise operators in C and provide examples of their usage in manipulating binary data.

**10.** Write a C program that uses assignment operators to modify the values of variables. Include examples of compound assignment operators (e.g. +=, -=).

# **UNIT III:- Control Flow**

- 1. What is the difference between statements and blocks in C?
- 2. Explain the syntax and usage of the if-else statement with an example.
- 3. How does the else-if construct differ from the if-else statement? Provide an example.
- 4. Describe **nested if-else** statements with an example.
- 5. Describe the switch statement and its usage with a code example.
- 6. Compare and contrast the while loop and the for loop in C. Provide examples for both.
- 7. What is the purpose of the do-while loop and how does it differ from while? Provide an example.
- 8. Write a program using a **for** loop to find the factorial of a number.
- **9.** How do the break and continue statements affect loop execution? Illustrate with examples.
- **10.** Explain the use of go to statements and labels in C programming with an example.
- **11.** What are the basic components of a function in C and how do you define and call a function?
- **12.** Explain the difference between **inbuilt functions** and **user-defined functions** with examples.
- **13.** Define **recursion** and write a recursive function to calculate the sum of the first N natural numbers.
- **14.** Discuss the concept of external variables in C. How do scope rules apply to these variables?

# **UNIT IV:- Arrays and Pointers in C**

- 1. What is an array in C and how do you declare and initialize a one-dimensional array?
- 2. Explain how to initialize an array with specific values in C. Provide an example.
- 3. How can you access and modify individual elements of an array? Illustrate with code.
- **4.** What is a character array in C and how is it different from a regular array? Provide examples.
- **5.** Explain the concept of multidimensional arrays. How do you declare and initialize a two-dimensional array?
- 6. How do you access elements in a multidimensional array? Provide an example with code.
- 7. Write a program to find the sum of all elements in a one-dimensional array.
- 8. How do you copy elements from one array to another in C? Provide an example.

- 9. Write a program to transpose a matrix (two-dimensional array).
- **10.** How do you find the largest and smallest elements in a one-dimensional array? Provide a code example.
- **11.** Write a C program to demonstrate the use of a pointer to an integer. Initialize an integer variable, assign its address to a pointer and use the pointer to modify the value of the integer.
- **12.** Create a C program that uses a pointer to a character to handle strings. Initialize a string using a pointer and print its characters one by one.
- **13.** Write a program to illustrate the use of a pointer to a float. Initialize a float variable, assign its address to a pointer and use the pointer to change the value of the float.

# **UNIT V:- Structures in C and File Management**

- 1. What is a structure in C programming and how is it defined? Explain the use of structures in organizing complex data.
- **2.** How can you pass a structure to a function in C? Discuss the methods of passing structures to functions and the implications of each method.
- **3.** Explain what an array of structures is in C programming. How is it defined and used? Provide an example of accessing elements within an array of structures.
- 4. What are pointers in structures and how are they used? Discuss how you can declare a pointer to a structure and the operations that can be performed with it.
- 5. What is the purpose of defining a file in C programming and how is a file opened for various operations? Explain the process and functions involved in opening a file.
- **6.** Describe the process of closing a file in C programming. Why is it important to close a file and what are the consequences of not doing so?
- 7. How do you read data from a file in C? Explain the various functions available for reading data from files and their use cases.
- **8.** What are the different methods for writing data to a file in C? Discuss the functions used for writing data and how to handle errors during file writing.
- **9.** How do file position management functions work in C? Explain the use of **fseek()**, **ftell()** and rewind() in managing file pointers.
- **10.** Describe the concept of buffering in file I/O operations in C. How does buffering affect the performance of file read and write operations?

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# Dr. Vasantraodada Patil Shetkari shikshan Mandal's PADMABHOOSHAN VASANTRAODADA PATIL INSTITUTE OF TECHNOLOGY, SANGLI, MAHARASHTRA 416304

DEPARTMENT OF FIRST YEAR ENGINEERING

Course Name & Code: Communication Skills (24AF1000VS109)

# **Unit I – Communication and communication processes**

- **Q.1.** Define communication? Explain communication process.
- **Q.2**. What are the functions of communication?
- Q.3. Distinguish between verbal and non-verbal communication
- **Q** 4. What are the benefits of oral communication?
- **Q.5** Write a detailed note on barriers to communication.
- Q.6 Explain non-verbal communication.
- Q.7 Write short notes on the following concept.
- **Q.8.** List the different forms of communication.
- Q.9. Describe how communication helps in relationship building.
- Q.10. How would you apply effective communication techniques in a team setting?
- Q.11.Demonstrate how non-verbal communication can influence a conversation.
- Q12. Write Short Notes on the following concepts:
  - **a.** Body language
  - **b.** Skimming and scanning
  - c. Listening Skills
  - d. Reading Skills
  - e. Seven C's of Communication
- Q.13. Examine the statement, "Listening is the mother of speaking".
- Q14. Compare verbal and nonverbal communication.

# Unit II –Verbal and non-verbal communication

- Q.1 Define group discussion (GD). Explain the principles and practice of GD?
- Q.2 Explain public speaking. Distinguish between elocution and debate.
- Q.3 Write a detailed note on presentation skills.
- Q.4 Elaborate interview technique.
- **Q.5** Write brief notes on the following:
  - a. Extempore
  - **b.** Presentation skills
  - c. Non-verbal communication
  - d. Use of language in spoken communication
  - e. Elocution
- Q.6 Define verbal and non-verbal communication.

Q.7 List the key elements of effective public speaking.

Q8. What is group discussion, and why is it important in professional settings?

Q.9 Recall the different types of non-verbal communication used during a presentation.

Q.10 Identify two principles of group discussion.

Q.11 Explain the role of body language in non-verbal communication during an interview.

Q12. Describe how tone of voice can impact spoken communication.

Q.13 How does non-verbal communication affect the effectiveness of a group discussion?

Q.14 Summarize the key techniques for delivering an effective extempore speech.

Q.15 Illustrate the difference between addressing small groups and large audiences in public speaking.

Q.16 Demonstrate how to use eye contact effectively when making a presentation.

Q.17 Apply the principles of group discussion in a mock debate about a current event.

Q.18 How would you adjust your speaking style when addressing a small group compared to a large audience?

Q.19 Use non-verbal cues to convey confidence and authority during an interview.

Q.20 What strategies would you use to engage your audience during an extempore speech?

# Unit III- Study of sounds in English

Q.1 Sketch a diagram of speech organs. Explain speech organs.

Q.2 What is Stress/Accent?

**Q.3** Write a note on intonation.

**Q.4** What is meant by syllable?

Q.5 Transcribe any 100 words in English

Q.6 Define phonetics and its importance in the study of English sounds.

Q7 List the primary speech organs involved in sound production.

Q.8 What is the phonemic script, and why is it used in phonetics?

Q.9 Identify three different types of speech sounds in English (e.g., vowels, consonants, diphthongs).

Q.10 Recall the function of the vocal cords in sound production.

Q.11 Explain how the articulators (tongue, teeth, and lips) contribute to sound production.

Q.12 Describe the difference between voiced and voiceless sounds in English.

Q.13 How does the study of phonetics help in improving pronunciation?

Q.14 Summarize the role of the tongue in producing different vowel sounds.

Q15. Illustrate the distinction between a phoneme and an allophone in English.

Q.16 Demonstrate how to articulate the difference between /p/ and /b/ using knowledge of voiced and voiceless sounds.

Q.17 Apply the phonemic script to transcribe common English words like "cat" and "dog."

Q.18 Show how the study of speech organs can aid in correcting mispronunciations.

Q.19 Use phonetic symbols to represent the vowel sounds in the words "beat" and "bit."

Q.20 What techniques would you use to teach articulation of English sounds to non-native speakers?

# **Unit IV – English Grammar**

#### Q. Fill up correct articles wherever necessary

- 1.\_\_\_\_\_advertisement should be brief.
- 2. We can't entertain \_\_\_\_\_ complaint of this kind
- 3. He doesn't take\_\_\_\_\_sugar in his tea.
- 4. Mr Prakash is \_\_\_\_\_\_active member of the communist party.
- 5. What\_\_\_\_\_excellent speech he made!
- 6. \_\_\_\_\_\_ milk, \_\_\_\_\_\_ butter and \_\_\_\_\_\_ cheese are nourishing foods
- 7. Mr Smith has been working as \_\_\_\_\_accountant since 1996
- 8. It is universal truth that \_\_\_\_\_\_\_ anger destroys one's peace of mind.
- 9. He set \_\_\_\_\_\_ example before others.

10.\_\_\_\_\_More you read , \_\_\_\_\_more you know.

11.\_\_\_\_\_stone hit him on\_\_\_\_\_head.

12.Only\_\_\_\_\_rich can afford\_\_\_\_\_comforts of\_\_\_\_\_modern times.

13). He began his life as \_\_\_\_\_\_ ordinary lawyer at district courts but retired as \_\_\_\_\_ Chief Justice of India.

- 14) \_\_\_\_\_ movie is based on the real life incident.
- 15) They bought \_\_\_\_\_ car last evening.
- 16) He is \_\_\_\_\_ excellent boy.
- 17) I need \_\_\_\_\_ kilogram of salt.
- 18) He has \_\_\_\_\_ extraordinary thinking ability.
- 19) I ate\_\_\_\_\_ sandwich for lunch

# Answers 1)an 2)a 3)no article4)an 5)an6) no article, no article ,no article7) an 8)an9)an 10)the 11)the,the12)a,the13)the ,the,the14)an,the 15) the 16) a 17)an 18) a 19)an 29) a

# Q. Fill in the blanks with correct prepositions.

- 1. I am always at home\_\_\_\_\_\_ Sunday morning.
- 2. Our shop has announced a clearance sale\_\_\_\_\_Durga Puja
- 3. He has been in the hospital \_\_\_\_\_\_January
- 4. Encoding is the process of changing information \_\_\_\_\_logical, coded language
- 5. Silver is the best conductor \_\_\_\_\_heat
- 6. My house is \_\_\_\_\_\_ to the city post office
- 7. I go to college daily \_\_\_\_\_9 o' clock
- 8. The crowed pressed \_\_\_\_\_ the fence.
- 9. Come and sit \_\_\_\_\_me.
- 10. He sat \_\_\_\_\_\_table to write a letter.
- 11. His house is \_\_\_\_\_ my house.
- 12. The bird is flying \_\_\_\_\_ the bridge.
- 13. Kiara and kiya sit \_\_\_\_\_\_ each other in the garden.

14) Th

ere is a break of ten minutes \_\_\_\_\_ classes.

15) She was frightened \_\_\_\_\_ the noise.

Answers 1) on 2) at 3) since4) to 5) of 6) near 7)at 8) against9)by/beside 10)at 11) in front of 12) over 13) beside 14) between 15) by

# Q. Do as directed.

1. He threw the goods \_\_\_\_\_\_ the walls(Use proper preposition)

2. He is \_\_\_\_\_ me in the office(Use proper preposition)

3. \_\_\_\_\_Horse is a faithful animal(Use correct article)

4. \_\_\_\_love is \_\_\_\_\_inspiration to \_\_\_\_\_man.(Use correct article)

5. It is difficult to produce\_\_\_\_\_Newton(Use correct article)

6) He is riding a horse. ( Make future continuous)

7. Iron is \_\_\_\_\_\_ useful metal. ( Use correct article)

8. She arrived \_\_\_\_\_ railway station ( use correct preposition)

9) She puts her document \_\_\_\_\_\_ the table. (Use correct preposition.

10) They are \_\_\_\_\_ University for \_\_\_\_\_ conference.

(Use correct preposition and articles)

Answers: 1)against 2) under 3)the 4)no article, an, no article5) a

# 6) he will be riding a horse 7) a 8) at 9) near/ behind/ under/ on

10) at/ the/the

# Q. Correct the following sentences.

1. Dog (are) honest animal (Simple Present Tense)

2. He (run) a marathon this Sunday (Simple Present Tense)

3. She (go) to hometown every weekend (Simple Future Tense)

4. I (work) in this company for ten years (Present Perfect Continuous Tense)

5. I (go) to Simla yesterday (Simple Past Tense)

6. Mohan\_\_\_\_\_(swim) with his friends this afternoon (simple past tense)

7. Kate \_\_\_\_\_(love) animals. (Simple present tense)

8. I \_\_\_\_\_(listen) to music. (Present continuous tense)

9. He \_\_\_\_\_(walk) since morning. (Present perfect continuous tense)

10. I \_\_\_\_\_(finish) my project by tomorrow. (Simple future tense)

# Unit V- Writing Skills, Reading Skills and Listening Skills

Q.1 What are the features of good language?

**Q.3** Explain email writing?

Q.5 Elaborate report writing? Write a report on your college annual function.

**Q.6** Write an application for the post of executive engineer. Attach curriculum vitae/resume/ biodata to it.

Q.7 Define the key features of good language in professional writing.

Q.8 List the different types of reports used in technical writing.

Q.9 What is the difference between formal and informal emails?

Q.10 Identify the main sections of a technical report.

Q.11 Recall the basic structure of a job application letter.

Q.12 Explain the importance of using clear and concise language in writing emails.

Q.13 Describe the key elements that make a report well-structured.

Q.14 How does the tone of a letter differ when writing a job application compared to a resignation letter?

Q.15 Summarize the typical format of a technical report, including its essential components.

Q.16 Illustrate the difference between the direct and indirect approaches in letter writing.

Q.17 Apply the correct format for writing a formal business email to a potential employer.

Q.18 Demonstrate how to organize information in a technical report to make it easy to read and understand.

Q.19 Write a job application letter for a software engineering position using appropriate expressions and style.

Q.20 Use bullet points and headings effectively to organize a technical report on a project's progress.

Q.21 How would you structure an email requesting information from a client while maintaining a professional tone?

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