JHARKHAND
Rai University
RANCHI

PRACTICE SET
End Semester Examination, Spring- 2026

Program: B. Tech
Semester: II
Course: Mathematics II
Course Code: 8MC101

SECTION A (1 Marks)

Objective Question

1. **The integrating factor of dy/dx + Py = Q is:**
   A) $e^{\int Pdx}$
   B) $e^{\int Qdx}$
   C) 1/P
   D) PQ

2. **The equation (2xy + 3) dx+(x^2 + 4y) dy =0 is exact if:**
   A) ∂M/∂y=∂N/∂x
   B) M=N
   C) x=y
   D) None
3. **The equation dy/dx = (x + y) / x is:**
   A) Linear
   B) Homogeneous
   C) Exact
   D) Bernoulli
4. **The solution of dy / dx=0 is:**
   A) y = x
   B) y = constant
   C) y = x^2
   D) None
5. **Solution of dy/dx=x is:**
   A) y = x^2+ C
   B) y = x^2/2 + C
   C) y = x + C
   D) None
6. **If M dx + N dy = 0 and not exact, then we find:**
   A) Integrating factor

B) Derivative
C) Degree
D) Order

7. The equation dy/dx=x^2+y^2/x. y is:
A) Homogeneous
B) Linear
C) Exact
D) None

8. Solution of dy/dx + y=0 is:
A) $y = Ce^{-x}$
B) $y = Ce^{x}$
C) y = Cx
D) None

9. Bernoulli equation form is:
A) $dy / dx + Py = Q\,y^n$
B) dy / dx + Py = Q
C) y dx +x dy =0
D) None

10. The equation (y + x) dx + (x + y) dy=0 is:
A) Exact
B) Linear
C) Homogeneous
D) Both A and C

11. The general solution of a second order differential equation contains:
A) One arbitrary constant
B) Two arbitrary constants
C) Three arbitrary constants
D) None

12. If roots of auxiliary equation are real and distinct, solution is:
A) $C_1e^{ax}+C_2e^{bx}$
B) $C_1\cos ax+C_2\sin ax$
C) C_1+C_2x
D) None

13. If auxiliary roots are complex a ± ib , solution is:
A) $e^{ax}(C_1\cos bx+C_2\sin bx)$
B) $C_1e^{ax}+C_2e^{bx}$
C) C_1+C_2x
D) None

14. Solution of the differential equation $y''-4y=0$ is:
A) $C_1\cos 2x + C_2\sin 2x$
B) $C_1\cos 2x – C_2\sin 2x$
C) $C_1e^{2x} + C_2e^{-2x}$
D) None

15. The equation $y'' + y' + y^2 = 0$ is

A) Linear
B) Non-linear
C) Exact
D) Homogeneous linear

16. The solution of differential equation $d^2y/dx^2 + 2dy/dx + y = 0$ is;

A) $C_1 + C_2x$
B) $C_1 - C_2x$
C) $(C_1 + C_2x)\, e^{-2x}$
D) None

17. The general form of the linear differential equation of second order is

A) $d^2y/dx^2 + P\, dy/dx + Q\, y = R$
B) $d^2y/dx^2 + P\, dy/dx + Q\, y = 0$
C) $d^2y/dx^2 + Q\, y = R$
D) None

(Where P, Q, and R are function of only x or constant)

18. The solution of differential equation $d^2y/dx^2 + 4dy/dx + 5y = 0$ is;

A) $C_1\cos x + C_2\sin x$
B) $C_1\cos 2x - C_2\sin 2x$
C) $e^{-2x} (C_1\cos x + C_2\sin x)$
D) $e^{2x} (C_1\cos 2x + C_2\sin 2x)$

19. Order and degree of differential equation $(d^5ydx^5)^2 + y = 0$ is:

A) 5, 2
B) 2, 5
C) both
D) None

20. A partial differential equation involves:

A) One independent variable
B) Only ordinary derivatives
C) More than one independent variable
D) No derivatives

21. The equation $\partial^2z / \partial x^2 + \partial^2z / \partial y^2 = 0$ is called

A) Wave equation
B) Heat equation
C) Laplace equation
D) Poisson equation

22. Wave equation is:

A) Elliptic
B) Hyperbolic
C) Parabolic
D) None

23. Degree of PDE $(p^2+q^2)^2=1$

$\varphi(x+y+z, x^2+y^2+z^2)=0$ 24. **The equation Pp + Qq = R is known as**

A) Lagrange equation
B) Charpit equation
C) Bernoulli's equation
D) Clairaut's equation

25. The general solution of (y – z) p + ((z – x) q =x – y is

A) $\varphi(x+y+z, x^2+y^2+z^2)=0$
B) $\varphi(xyz, x+y+z)=0$
C) $\varphi(xyz, x^2+y^2+z^2)=0$
D) $\varphi(x-y-z, x^2-y^2-z^2)=0$

26. The auxiliary equation of $(\boldsymbol{y^2z/x})\boldsymbol{p}+\boldsymbol{xzq}=\boldsymbol{y^2}$ is

A) $dx/y^2z = dy/zx = dz/y^2$
B) $dx/x^2 = dy/y^2 = dz/zx$
C) $dx/1/x^2 = dy/1/y^2 = dz/1/zx$
D) None

27. The general solution of the linear partial differential equation Pp + Qq = R is

A) $\varphi(u,v)=1$
B) $\varphi(u,v)=-1$
C) $\varphi(u,v)=0$
D) None

28. The general solution of (y + z) p - ((z + x) q = x – y is

A) $\varphi(x+y+z, x^2+y^2+z^2)=0$
B) $\varphi(xyz, x+y+z)=0$
C) $\varphi\left(xyz, x^2+y^2+z^2\right)=0$
D) $\varphi(x+y+z, x^2+y^2-z^2)=0$

29. Particular integral of $(D^2 - D'^2)$ z = cos (x + y)

A) x/2 cos (x + y)
B) x sin (x + y)
C) x cos (x + y)
D) x/2 sin (x + y)

30. The solution of $\frac{\partial^2 z}{\partial x^2}-\frac{\partial^2 z}{\partial y^2}=0$ is

A) z = f (x + y) + g (x – y)

B) z = f (x + y) + g (x + y)
C) z = f (x + y) – g (x – y)
D) z = f ($x^2 + y^2$)

Unit 1
Section B (10 Marks)

1. Solve the differential equation $(x^3 - x)\frac{dy}{dx} - (3x^2 - 1)y = x^5 - 2x^3 + x$ **CO 1 Evaluate**
2. Solve the differential equation $x\frac{dy}{dx} + y = x^2 logx$ **CO 1 Evaluate**
3. Solve the differential equation $x^2dy + y(x + y)dx = 0$ **CO 1 Evaluate**
4. Solve the differential equation $(ysec^2x + secx.tanx)dx + (tanx + 2y)dy = 0$
CO 1 Evaluate
5. Solve the differential equation$\left(1 + e^{\frac{x}{y}}\right) + e^{\frac{x}{y}}\left(1 - \frac{x}{y}\right)\frac{dy}{dx} = 0$ **CO 1 Evaluate**

Section C (20 Marks)

6. (a) Solve dy / dx = $e^{(x-y)} + x^2e^{-y}$
(b)If the population of a country doubles in 50 years, in how many years will it treble under the assumption that the rate of increase is proportional to the number of inhabitants.
CO 1 Evaluate

7. (a) Integrate $(1 + x^2)\frac{dy}{dx} + 2xy - 4x^2 = 0$. Obtain equation of the curve satisfying this equation and passing through the origin.

(b) The number of bacteria in a yeast culture grows at a rate which is proportional to the number present. If the population of a colony of yeast bacteria triples in 1 hours, find the number of bacteria which will be present at the end of 5 hours. **CO 1 Evaluate**

Unit 1I
Section B (10 Marks)

7. Solve $\frac{d^3y}{dx^3} - 3\frac{d^2y}{dx^2} + 4\frac{dy}{dx} - 2y = e^x + cosx$ **CO 2 Evaluate**
8. Solve $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} - 3y = 2e^{2x} + 10sin3x$ given that y (0) = 2 and y' (0) = 4. **CO 2 Evaluate**
9. Solve $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 3y = 2xe^{3x} + cos3x$ **CO 2 Evaluate**
10. Apply the method of variation of parameters to solve $\frac{d^2y}{dx^2} + y = tanx$ **CO 2 Evaluate**
11. Solve x^2 d^2y/dx^2 + x dy/dx + y = sin(logx^2) **CO 2 Evaluate**

Section C (20 Marks)

12. (a) Solve the differential equation $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 3y = x^2$
13. The differential equation satisfied by a beam uniformly loaded (W kg/meter) with one end fixed and the second end subjected to tensile force P, is given by E.I. d^2y/dx^2 = Py – ½ Wx^2 show that the elastic curve for the beam with conditions y = 0 =dy/dx at x = 0, is given by y =

$W/Pn^2 (1 - \cosh nx) + Wx^2/2P$ where $n^2 = P/E.I.$ Where E = Modulus of elasticity, I = Moment of inertia of the cross section, P = Tensile force. **CO 2 Evaluate**

14. (a) Solve the differential equation $x^2\frac{d^3y}{dx^3} + 3x\frac{d^2y}{dx^2} + \frac{dy}{dx} = x^2 logx$

(b) Apply the method of variation of parameters to solve $\frac{d^2y}{dx^2} - y = \frac{2}{1+e^x}$ **CO 2 Evaluate**

UNIT III

Section B (10 Marks)

15. Solve in series the equation $\frac{d^2y}{dx^2} + x^2y = 0$ **CO 3 Evaluate**

16. Define ordinary and singular point of differential equation $y'' + P(x)y' + Q(x)y = 0\ at\ x = x_0$. Hence determine whether $x = 0$ is an ordinary and singular point of the differential equation $2x^2\frac{d^2y}{dx^2} + 7x(x+1)\frac{dy}{dx} - 3y = 0$. **CO 3 Evaluate**

17. Find power series solution of the equation $(x^2 + 1)\frac{d^2y}{dx^2} + x\frac{dy}{dx} - xy = 0$ about $x = 0$. **CO 3 Evaluate**

18. Prove that $xJ_n{}'(x) = -nJ_n(x) + xJ_{(n-1)}(x)$ **CO 3 Apply**

19. Prove that $J_2{}'(x) = (1 - \frac{4}{x^2})J_1(x) + \frac{2}{x}J_0(x)$ where $J_n(x)$ is the Bessel function of first kind. **CO 3 Apply**

Section C (20 Marks)

20. (a) Find solution in series form about x = 0 of the differential equation

$3x\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + y = 0$

(b) Prove that $J_{\left(\frac{1}{2}\right)}(x) = \sqrt{\frac{2}{\pi x}}\ sinx$ **CO 3 Apply**

21. (a) Prove that $P_n(x) = \frac{1}{2^n\ n!}\frac{d^n}{dx^n}(x^n - 1)^n$.

(b) Express $f(x) = 4x^3 + 6x^2 + 7x + 2$ in terms of Legendre Polynomials. **CO 3 Evaluate**

UNIT IV

Section B (10 Marks)

22. Solve $\frac{\partial^2 z}{\partial x\partial y} = sinx.siny\ if\ \frac{\partial z}{\partial y} = -2siny$ when $x = 0, and\ z = 0$ when y is an odd multiple of $\frac{\pi}{2}$. **CO 4 Evaluate**

23. Solve $(mz - ny)\frac{\partial z}{\partial x} + (nx - lz)\frac{\partial z}{\partial y} = (ly - mx)$ **CO 4 Evaluate**

24. Solve $(z + y)\frac{\partial z}{\partial x} - (x + z)\frac{\partial z}{\partial y} = (-y + x)$ **CO 4 Evaluate**

25. Write Charpites subsidiary equation and hence solve px +qy = pq **CO 4 Evaluate**

26. Solve $\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial x\partial y} - 6\frac{\partial^2 z}{\partial y^2} = \cos(2x + y)$ **CO 4 Evaluate**

Section C (10 Marks)

27. Consider an elastic string tightly stretched between two points O and A. Let O be the origin and OA as x – axis. On giving a small displacement to the string, perpendicular to its length

(parallel to the y – axis). Let y be the displacement at the point P (x, y) at any time. The wave equation Solve $\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$ using the method of separation of variables. **CO 4 Evaluate**

28. Find the solution of the wave equation Solve $\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$ such that $y = P_O cospt, (P_o is\ constant)\ when\ x = l\ and\ y = 0\ when\ x = 0.$ **CO 4 Evaluate**

UNIT V

Section B (10 Marks)

29. If $u = x + y + z;\ \ v = x^2 + y^2 + z^2;\ \ w = xy + yz + zx;$ prove that grad u, grad v and grad w are coplanar vectors. **CO 5 Evaluate**

30. Find the value of constant $\lambda\ and\ \mu$ so that the surface $\lambda x^2 - \mu yz = (\lambda + 2)x,\ \ 4x^2 y + z^3 = 4$ intersect orthogonally at the point (1, - 1, 2). **CO 5 Evaluate**

31. Find the divergence and curl of $\vec{v} = (xyz)\hat{\imath} + (3x^2 y)\hat{\jmath} + (xz^2 - y^2 z)$ at (2, -1, 1). **CO 5 Evaluate**

32. Find the directional derivative of $\phi(x, y, z) = x^2 yz + 4xz^2$ at (1, -2, 1) in the direction of $2\hat{\imath} - \hat{\jmath} - 2\hat{k}$. **CO 5 Evaluate**

33. If $\vec{v} = \frac{x\hat{\imath}\ +\ y\hat{\jmath}\ +\ z\hat{k}}{\sqrt{x^2\ + y^2\ + z^2}}$, find the value of div$\vec{v}$. **CO 5 Evaluate**

Summary Sheet:

CO Wise

CO	**Q. No**	**Marks**
CO1	1,2,3,4,5,6,7	90
CO2	8,9,10,11,12,13,14	90
CO3	15,16,17,18, 19,20,21	90
CO4	22,2324,25,26,27,28	90
CO5	29,30,31,32,33	50
Total		**410**

Unit Wise

Unit	**Q. No**	**Marks**
Unit 1	1,2,3,4,5,6,7	90
Unit 2	8,9,10,11,12,13,14	90
Unit 3	15,16,17,18, 19,20,21	90
Unit 4	22,2324,25,26,27,28	90
Unit 5	29,30,31,32,33	50
Total		**410**

Blooms Taxonomy Level (BTL) Wise

BTL	Q. No	Marks
LOT	1,2,3,4,5,6,8,9,10,11,12,15,16,17,18,19,22,23,24,25, 26,29,30,31,32,33	250
HOT	6,7,13,14,20,21,27,28	160
Total		

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Disclaimer: - This is a Practice set. The Question in End term examination will differ from the Practice set. This Practice set is meant for practice only.