Code No: 182AR **R22**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech I Year II Semester Examinations, September - 2023
ORDINARY DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS
(Common to CE, ME, ECE, EIE, AE, MIE, CSE (AI&ML), CSE (IOT), AI&DS, AI&ML)
Time: 3 Hours **Max. Marks: 60**

Note: This question paper contains two parts A and B.
i) **Part- A** for 10 marks, ii) **Part - B** for 50 marks.
- Part-A is a compulsory question which consists of ten sub-questions from all units carrying equal marks.
- Part-B consists of **ten questions** (numbered from 2 to 11) **carrying 10 marks each**. From each unit, there are two questions and the student should answer one of them. Hence, the student should answer five questions from Part-B.

PART- A

(10 Marks)

1.a)	Define an exact equation.	[1]
b)	Write the standard form of a linear differential equation, in x.	[1]
c)	Find general solution of the differential equation $y'' + y' - 2y = 0$.	[1]
d)	Find the PI of $(D^2 + 4D + 13)y = 2e^{-x}$.	[1]
e)	State first shifting theorem of Laplace transforms.	[1]
f)	State convolution theorem of Laplace transforms.	[1]
g)	Define a scalar point function.	[1]
h)	Define the divergence of a vector point function.	[1]
i)	Define work done by force $\bar{F}$ in moving a particle from A to B along the curve C.	[1]
j)	Define a volume integral.	[1]

PART - B

(50 Marks)

2.a) Solve $(e^x + 1)cosx\ dx + e^y sinxdy = 0$.
b) If the air is maintained at 20^0C and the temperature of the body cools from 100^0C to 80^0C in 10 minutes, find the temperature of the body after 20 minutes and when the temperature will be 40^0C? [5+5]

OR

3.a) Solve $(1 + y^2)dx = (tan^{-1}y - x)dy$.
b) Prove that the system of confocal and coaxial parabolas $y^2 = 4a(x + a)$ is self-orthogonal. [5+5]

4.a) Solve $(D^2 + 1)y = sinx\ sin2x$.
b) Solve $(D^2 + 4)y = tan2x$ by method of variation parameters. [5+5]

OR

5. An LCR circuit with battery emf $'Esinpt'$ is tuned to resonance so that $p^2 = \frac{1}{LC}$. If initially the current i and the charge Q be zero, then show that for small values of $\frac{R}{L}$, the current in the circuit at time t is given by $\frac{E}{2L}t\ sinpt$. [10]

6.a) Find the Laplace transform of $f(t) = e^{-2t} + 3sin2t - 2cos3t + t + 100$.

b) Use convolution theorem to find the inverse Laplace transform of $\frac{1}{(s+1)(s+2)}$. [5+5]

OR

7.a) Find the Laplace transform of Dirac delta function.

b) Using Laplace transform, solve the differential equation $(D^2 - 3D - 4)y = 2e^{-t}$ with $y(0) = 1 = y'(0)$. [4+6]

8.a) Find the directional derivative of $\emptyset = 2xy + z^2$ at $(1, -1, 3)$ in the direction of a vector $\bar{i} + 2\bar{j} + 3\bar{k}$.

b) If $\bar{r} = xi + yj + zk$, prove that div$\bar{r} = 3$ and curl $\bar{r} = 0$. [5+5]

OR

9.a) Find the values of a, b, and c so that the vector $\bar{F} = (x + y + az)\bar{i} + (bx + 2y - z)\bar{j} + (-x + cy + 2z)\bar{k}$ be irrotational.

b) Prove that $Curl\ (\bar{F} \times \bar{G}) = (\bar{G}.\nabla)\bar{F} - \bar{G}div\bar{F} - (\bar{F}.\nabla)\bar{G} + \bar{F}div\bar{G}$. [5+5]

10. If $\bar{F} = 3x^2y\bar{i} + (x^3 - 2yz^2)\bar{j} + (3z^2 - 2y^2z)\bar{k}$, then

a) Prove that $\bar{F}$ is conservative.

b) Find its scalar potential $\emptyset$.

c) Find the work done in moving a particle under this force field from $(2, 1, 1)$ to $(2, 0, 1)$. [10]

OR

11. Verify Green's theorem in plane for $\int_C (3x^2 - 8y^2)dx + (4y - 6xy)dy$, where C is the region bounded by the parabolas $y^2 = x$ and $x^2 = y$. [10]

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