Gajendra Purohit

Legend in CSIR-UGC NET & IIT-JAM

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Bernoulli's equation :

An equation of the form $\frac{dy}{dx}+Py=Qy^n$, where P and Q are constant or function of x alone and n is constant except 0 and 1 is called Bernoulli's equation.

Working rule :

$$\frac{1}{y^n}\frac{dy}{dx}+Py^{1-n}=Q \qquad \ldots.(1)$$

Suppose $y^{1-n}=t$

$$(1-n)y^{-n}\frac{dy}{dx}=\frac{dt}{dx}$$

Put in (1)

$$\frac{1}{(1-n)}\frac{dt}{dx}+P(x)t=Q(x)$$

$$\frac{dt}{dx}+(1-n)P.t=(1-n)Q$$

Which is FOFD linear DE,

Q.1. Consider the ODE $ty' - 3y = t^2y^{1/2}$, $y(1) = 1$. Find the value of $y(2)$

(a) 14 (b) 16

(c) 0 (d) 8

Q.2. Solution of the differential equation

$$xy' + \sin 2y = x^3 \sin^2 y \text{ is}$$

(a) $\cot y = -x^3 + c x^2$ (b) $2\cot y = x^3 + 2c x^2$

(b) $\tan y = -x^3 + c x^2$ (d) $2\tan y = x^3 + 2c x^2$

Q4. Consider the differential equation $\frac{dy}{dx} = ay - by^2$, where $a, b > 0$ and $y(0) = y_0$. As $x \to +\infty$ the solution $y(x)$ tends to

(a) 0

(b) a/b

(c) b/a

(d) y_0

EXACT DIFFERENTIAL EQUATION

Now consider the differential equation Mdx + Ndy = 0

An equation of the form Mdx + Ndy = 0 that is said to be exact

if $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$ holds.

Then solution of this differential equation

$$\int_{y=cons.} Mdx = \int_{neglect\ terms\ contain\ x.} Ndy$$

Rules for finding IF

Rule – I :

If $\frac{1}{N}\left[\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right]$ is a function of x alone say f(x).Then $e^{\int f(x)dx}$ is

an integrating factor of Mdx + Ndy = 0

Rule – II .

If $\frac{1}{M}\left(\frac{\partial N}{\partial x}-\frac{\partial M}{\partial y}\right)$ is a function of y, say f(y)

then $e^{\int f(y)dy}$ is an integrating factor of Mdx + Ndy = 0

Rule III :

If $Mdx + Ndy = 0$ is homogeneous and $Mx + ny \neq 0$, then

$\frac{1}{Mx + Ny}$ is the integrating factor of $Mdx + Mdy = 0$

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Rule – IV :

If $Mdx + Ndy = 0$ is of the form,

$f_1(xy).ydx + f_2(xy).xdy = 0$ and then $\frac{1}{Mx - Ny}$ is the integrating factor.

Rule – V :

If the given differential equation $Mdx + Ndy = 0$ is of the form

$x^{\alpha} y^{\beta} (mydx + nxdy) + x^{\alpha`} y^{\beta`} (m`ydx + n`xdy) = 0$

Where α, β, m, n, $\alpha`$, $\beta`$, m` and n` are constants. Then the given equation has $x^h y^k$ as integrating factor.

Where h and k are obtained by the condition, so that given equation become exact $\left(\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}\right)$. Then by comparing both sides we get the values h and k

Q6. Let $y(x)$ be the solution of the differential equation $(xy + y + e^{-x})dx + (x + e^{-x})dy = 0$ satisfying $y(0) = 1$.

Then $y(-1)$ is equal to **IIT JAM- 2017**

(a) $\frac{e}{e-1}$ (b) 0

(c) $\frac{e}{1-e}$ (d) e

Q7 . Let y(x) is a integrating factor of the differential equation

$$\left(y+\frac{1}{3}y^3+\frac{1}{2}x^2\right)dx+\frac{1}{4}(x+xy^2)dy=0$$

then y(x) is **IIT JAM -2018**

(a) Even function (b) Odd function

(c) Periodic function (d) Trignometric function

Q8. If $x^h y^k$ is an integrating factor of the differential equation $y(1+xy)dx + x(1-xy)dy = 0$, then the value of $h + k$ is

IIT JAM 2019

(a) Divisible by 8

(b) Divisible by 2

(c) Divisible by 5

(d) None of these

Q9. The non-zero value of n for which the differential equation $(3xy^2 + n^2x^2y)dx + (nx^3 + 3x^2y)dy = 0$, $x \neq 0$, becomes exact is **IIT JAM 2016**

(a) -3 (b) -2

(c) 2 (d) 3

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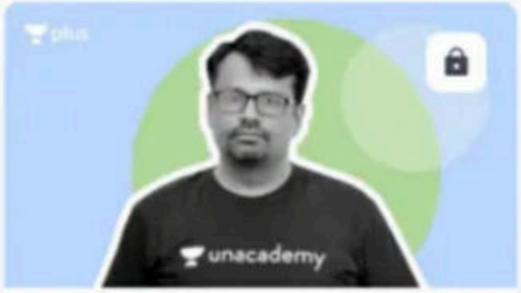

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Educator highlights

- Works at **Pacific Science College**
- Studied at **M.Sc., NET, PhD(Algebra), MBA(Finance), BEd**
- PhD, NET | Plus Educator For CSIR NET | Youtuber (260K+Subs.) | Director Pacific Science College |
- Lives in **Udaipur, Rajasthan, India**
- Unacademy Educator since

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