

Government Engineering College, Nawada

Department of Applied Science & Humanities (Mathematics)

Assignment Sheet-I

Session	: 2019-20(Even Sem.)	Semester	: II
Course/	: B. Tech./ CE	Paper Name	: Mathematics-II
Branch			(101202)
Module	: 3A	Topic Covered	: FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS

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Note: Following are the problems which are required to be done by the students for an overall understanding of the topics.

- Find the order and degree of the following differential equations. State also whether they are linear or non-linear (i) $\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{5/2} = \frac{d^2y}{dx^2}$ (ii) $\frac{d^2y}{dx^2} + 5\frac{dy}{dx} + 6y = 0$ (iii) $y'' + xy' + 3y = 5x$ (iv) $(y')^2 + 3xy' + y = 0$ (v) $y' = \sin y$
- Eliminate the arbitrary constants and obtain the following differential equations satisfied by it (i) $y = a \cos \theta x + b \sin \theta x$, θ : fixed constant (ii) $y = c \cos(pt - a)$, p : fixed constant (iii) $x^2 + y^2 = a^2$ (iv) $y = 2cx - c^2(v)$ (v) $x^2 + y^2 - 2ay = 0$.
- Reduce to separable form and solve the following differential equations (i) $(xy' - y) \cos(y/x) + x = 0$ (ii) $xy' = e^{-xy} - y$ (iii) $\frac{dy}{dx} = e^{x-y} + x^2e^{-y}$ (iv) $x^2(1-y)dy + y^2(1+x)dx = 0$ (v) $\sec^2 x \tan y dx + \sec^2 y \tan x dy = 0$ (vi) $y' = \cos(x+y) + \sin(x+y)$ (vii) $\sin^3 x \frac{dy}{dx} = \sin y$.
- Solve the following differential equations (i) $\frac{dy}{dx} = \frac{x^2y}{x^3+y^3}$ (ii) $(x^2 - y^2)dx - xy dy = 0$ (iii) $(1 + e^{x/y}) + e^{x/y}(1 - x/y)dy = 0$ (iv) $(x^2 + 4y^2 + xy)dx - x^2dy = 0$ (v) $(3xy + y^2) dx + (x^2 + xy)dy = 0$.
- Solve the following differential equations (i) $\frac{dy}{dx} = \frac{x-y-2}{2x-2y-3}$ (ii) $\frac{dy}{dx} = \frac{2x-6y+7}{x-3y+4}$ (iii) $\frac{dy}{dx} = \frac{x+2y-3}{2x+y-3}$.
- Solve the following differential equations (i) $(x^2 + 1)\frac{dy}{dx} + 2xy = 4x^2$ (ii) $x\frac{dy}{dx} + y = y^2 \log x$ (iii) $x\frac{dy}{dx} = 2y + x^4 + 6x^2 + 2x$ (iv) $(1 + y^2)dx = (\tan^{-1}y - x)dy$ (v) $(x+1)\frac{dy}{dx} - y = e^{3x}(x+1)^2$ (vi) $(1+x^2)\frac{dy}{dx} + y = e^{\tan^{-1}x}$
- Solve the following differential equations (i) $(y^2e^{xy^2} + 4x^3)dx + (2xye^{xy^2} - 3y^2)dy = 0$ (ii) $(2x^3 + 3y^2x - 7x)dx + (3x^2y + 2y^3 - 8y)dy = 0$ (iii) $(x^2y - 2xy^2)dx - (x^3 - 3x^2y)dy = 0$ (iv) $(1 - xy)ydx - x(1 + xy)dy = 0$ (v) $(xy^3 + y)dx + 2(x^2y^2 + x + y^4)dy = 0$ (vi) $y(xy + 2x^2y^2)dx + x(xy - x^2y^2)dy = 0$ (vii) $(\cos y + y \cos x)dx + (\sin x - x \sin y)dy = 0$.
- Solve: (i) $x\frac{dy}{dx} + y = x^3y^6$ (ii) $y' + 4xy + xy^3 = 0$ (iii) $y' - y = y^2(\sin x + \cos x)$.
- Solve: (i) $\left(\frac{dy}{dx}\right)^2 - 5\frac{dy}{dx} + 6 = 0$ (ii) $\left(\frac{dy}{dx}\right)^2 + 2x\frac{dy}{dx} - 3x^2 = 0$ (iii) $x^4\left(\frac{dy}{dx}\right)^2 - x\frac{dy}{dx} - y = 0$.

10. Solve: (i) $y = 2px + y^2p^3$ (ii) $y = xy' + (y')^2$ (iii) $y = xy' - e^{2y'}$ (iv) $y = xy' - \frac{1}{y'}$.
11. Find the orthogonal trajectories of the hyperbolas $x^2 - y^2 = c$.
12. Find the orthogonal trajectories of the family of circles passing through the points (0, 2) and (0, -2).
13. Find the orthogonal trajectories of the following family of curves (i) $r = c(1 + \cos\theta)$ (ii) $r^2 = c \sin(2\theta)$.
14. A body is heated to 100°C and placed in air at 20°C . After one hour its temperature is 60°C . How much additional time is required for it to cool to 30°C .
15. In a radioactive decay, initially 50 mg of the material is present and after two hours, the material has lost 10% of its original mass. Find the mass at any time t and the half-life of the material.
16. A particle falls down from rest in the air whose resistance is prepositional to the square of the velocity. Find the velocity as a function of x .

Text / Reference Books:

1. Peter V. O' Neil, A text book of Engineering Mathematics, Thomson (Cengage Learning), 2nd Edition, 2010.
2. B.S.Grewal, Advanced Engineering Mathematics, Khanna Publishars, 40th Edition, 2010.
3. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, New York, 2005.
4. B.V. Ramanna, "Higher Engineering Mathematics", Tata Mcgraw Hill Publishing Company Ltd., 2008.
5. R.K. Jain and S.R.K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 2008.

Rejesh Kumar
19/03/2020
(Signature of the Faculty Member with date)