

Al-Mustaqbal University / College of Engineering & Technology

Department Of Communication Engineering Class (1st)

Subject (calculus 1) / Code (TE-UOMUS-094241217-574)

Lecturer (M.Sc. Fatimatulzahraa Adnan)

2nd term - Lecture No.1 & Lecture Name (integration)

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## Integration

## 5-1- Indefinite integrals:

The set of all anti derivatives of a function is called indefinite integral of the function.

Assume u and v denote differentiable functions of x, and a, n, and c are constants, then the integration formulas are:-

$$1) \int du = u(x) + c$$

2) 
$$\int a \cdot u(x) dx = a \int u(x) dx$$

3) 
$$\int (u(x) \mp v(x)) dx = \int u(x) dx \mp \int v(x) dx$$

4) 
$$\int u^n du = \frac{u^{n+1}}{n+1} + c$$
 when  $n \neq -1$  &  $\int u^{-1} du = \int \frac{1}{u} du = \ln u + c$ 

5) 
$$\int a^u du = \frac{a^u}{\ln a} + c \implies \int e^u du = e^u + c$$

## **EX-1** – Evaluate the following integrals:

$$1) \int 3x^2 dx$$

$$6) \int \frac{x+3}{\sqrt{x^2+6x}} dx$$

$$2) \int \left(\frac{1}{x^2} + x\right) dx$$

7) 
$$\int \frac{x+2}{x^2} dx$$

$$3) \int x \sqrt{x^2 + 1} \, dx$$

$$8) \int \frac{e^x}{1+3e^x} dx$$

$$4) \int \left(2t+t^{-1}\right)^2 dt$$

$$9) \int 3x^3 \cdot e^{-2x^4} dx$$

$$5) \int \sqrt{(z^2-z^{-2})^2+4} \, dz$$

$$10) \int 2^{-4x} dx$$

<u>Sol.</u> –

1) 
$$\int 3x^2 dx = 3 \int x^2 dx = 3 \frac{x^3}{3} + c = x^3 + c$$



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2)  $(x^{-2} + x)dx = \int x^{-2} dx + \int x dx = \frac{x^{-1}}{1} + \frac{x^{2}}{2} + c = -\frac{1}{x} + \frac{x^{2}}{2} + c$ 3)  $\int x\sqrt{x^2+1} dx = \frac{1}{2} \int 2x(x^2+1)^{\frac{1}{2}} dx = \frac{1}{2} \frac{(x^2+1)^{\frac{3}{2}}}{\frac{3}{2}} + c = \frac{1}{3} \sqrt{(x^2+1)3} + c$ 4)  $\int (2t+t^{-1})^2 dt = \int (4t^2+4+t^{-2})dt = 4\frac{t^3}{2}+4t+\frac{t^{-1}}{2}+c = \frac{4}{3}t^3+4t-\frac{1}{t}+c$ 5)  $\int \sqrt{(z^2-z^{-2})^2+4} dz = \int \sqrt{z^4-2+z^{-4}+4} dz = \int \sqrt{z^4+2+z^{-4}} dz$  $= \int \sqrt{(z^2 + z^{-2})^2} dz = \int (z^2 + z^{-2}) dz = \frac{z^3}{3} + \frac{z^{-1}}{1} + c = \frac{1}{3}z^3 - \frac{1}{5} + c$ 6)  $\int \frac{x+3}{\sqrt{x^2+6x^2}} dx = \frac{1}{2} \int (2x+6) \cdot (x^2+6x)^{-1/2} dx$  $= \frac{1}{2} \cdot \frac{(x^2 + 6x)^{1/2}}{1/2} + c = \sqrt{x^2 + 6x} + c$ 7)  $\int \frac{x+2}{x^2} dx = \int \left(\frac{x}{x^2} + \frac{2}{x^2}\right) dx = \int \left(x^{-1} + 2x^{-2}\right) dx = \ln x + \frac{2x^{-1}}{-1} + c = \ln x - \frac{2}{x} + c$ 8)  $\int \frac{e^x}{1+3e^x} dx = \frac{1}{3} \int 3e^x (1+3e^x)^{-1} dx = \frac{1}{3} \ln(1+3e^x) + c$ 9)  $\int 3x^3 \cdot e^{-2x^4} dx = -\frac{3}{6} \int -8x^3 e^{-2x^4} dx = -\frac{3}{6} \cdot e^{-2x^4} + c$ 10)  $\int 2^{-4x} dx = -\frac{1}{4} \int 2^{-4x} \cdot (-4dx) = -\frac{1}{4} \cdot 2^{-4x} \cdot \frac{1}{4} + c$