

UNIVERSITY EXAMINATIONS



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UNISA 
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MAT3700

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MATHEMATICS III (ENGINEERING)

Duration 2 Hours

80 Marks

EXAMINATION PANEL AS APPOINTED BY THE DEPARTMENT

Use of a non-programmable pocket calculator is permissible

Closed book examination

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This examination question paper consists of 3 pages including this cover page plus

Formulae sheets (page (i) to (v), plus
A table of integrals (page (i) and (ii)) plus
A table of Laplace transforms (page iii)

Please answer all the questions in **numerical order** as far as possible

QUESTION 1

Solve the following differential equations:

$$1.1 \quad \frac{dy}{dx} + y \tan x = y^3 \sec^4 x \quad (7)$$

$$1.2 \quad (x + y) dx - x dy = 0 \quad (6)$$

$$1.3 \quad \cos^2 x \frac{dy}{dx} = y + 3 \quad (4)$$

[17]

QUESTION 2Find the general solutions of the following differential equations using **D-operator** methods:

$$2.1 \quad (D^2 - 5D + 6)y = e^{-2x} + \sin 2x \quad (6)$$

$$2.2 \quad (D^2 + 6D + 9)y = e^{-3x} \cosh 3x \quad (6)$$

[12]

QUESTION 3Solve for x in the following set of simultaneous differential equations by using **D-operator** methods:

$$\begin{aligned} (D-3)x + y &= -1 \\ -x + (D-1)y &= 4e^t \end{aligned} \quad (8)$$

[8]

QUESTION 4

$$4.1 \quad \text{Determine } L\{(t^2 - 1)H(t-1)\} \quad (4)$$

$$4.2 \quad \text{Determine } L^{-1}\left\{\frac{1}{s^2 + 6s + 8}\right\} \quad (4)$$

[8]

[TURN OVER]

QUESTION 5

Determine the unique solution of the following differential equation by using Laplace

transforms: $y''(t) + 4y'(t) + 4y(t) = 4e^{-2t}$, if $y(0) = -1$ and $y'(0) = 4$. (10)

[10]

QUESTION 6

For a certain electrical circuit the applicable differential equation is:

$$100 \frac{d^2 i}{dt^2} + 200 \frac{di}{dt} + \frac{i}{0,005} = 0, \text{ with initial conditions } i(0) = 0 \text{ and } i'(0) = 1.$$

Determine the unique solution for the current, i in terms of the time, t . (7)

[7]

QUESTION 7

7.1 If $B = \begin{bmatrix} -6 & 5 \\ 4 & 2 \end{bmatrix}$, find the eigenvalues of B . (4)

7.2 If $A = \begin{bmatrix} 3 & 2 & 2 \\ 0 & 2 & 1 \\ 0 & 0 & 4 \end{bmatrix}$, find an eigenvector corresponding to the eigenvalue $\lambda = 2$ (4)

[8]

QUESTION 8

A function $f(x)$ is defined over one period by $f(x) = \begin{cases} -\pi & -2 < x < 0 \\ \pi & 0 < x < 2 \end{cases}$

8.1 Sketch the function. (2)

8.2 From the graph determine if the function is odd, even or neither (1)

8.3 Find the Fourier series expansion for $f(x)$ (7)

[10]

Full marks = 80

Examiners: First: Ms L E Greyling

Second: Dr J M Manale

External: Dr. J N Mwambakana

FORMULA SHEET

ALGEBRA <u>Laws of indices</u> $a^m \times a^n = a^{m+n}$ $\frac{a^m}{a^n} = a^{m-n}$ $(a^m)^n = a^{mn} = (a^n)^m$ $a^{\frac{m}{n}} = \sqrt[n]{a^m}$ $a^{-n} = \frac{1}{a^n}$ and $a^n = \frac{1}{a^{-n}}$ $a^0 = 1$ $\sqrt{ab} = \sqrt{a}\sqrt{b}$ $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$ <u>Logarithms</u> <i>Definitions</i> If $y = a^x$ then $x = \log_a y$ If $y = e^x$ then $x = \ln y$ $\log(A \times B) = \log A + \log B$ $\log\left(\frac{A}{B}\right) = \log A - \log B$ $\log A^n = n \log A$ $\log_a A = \frac{\log_b A}{\log_b a}$ $a^{\log_a f} = f \quad \therefore e^{\ln f} = f$	Factors $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$ $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$ Partial fractions $\frac{f(x)}{(x+a)(x+b)(x+c)} = \frac{A}{(x+a)} + \frac{B}{(x+b)} + \frac{C}{(x+c)}$ $\frac{f(x)}{(x+a)^3(x+b)} = \frac{A}{(x+a)} + \frac{B}{(x+a)^2} + \frac{C}{(x+a)^3} + \frac{D}{(x+b)}$ $\frac{f(x)}{(ax^2 + bx + c)(x+d)} = \frac{Ax + B}{(ax^2 + bx + c)} + \frac{C}{(x+d)}$ Quadratic formula If $ax^2 + bx + c = 0$ then $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
Determinants $\begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix} = a_{11} \begin{vmatrix} a_{22} & a_{23} \\ a_{32} & a_{33} \end{vmatrix} - a_{12} \begin{vmatrix} a_{21} & a_{23} \\ a_{31} & a_{33} \end{vmatrix} + a_{13} \begin{vmatrix} a_{21} & a_{22} \\ a_{31} & a_{32} \end{vmatrix}$ $= a_{11}(a_{22}a_{33} - a_{32}a_{23}) - a_{12}(a_{21}a_{33} - a_{31}a_{23}) + a_{13}(a_{21}a_{32} - a_{31}a_{22})$	

[TURN OVER]

SERIES**Binomial Theorem**

$$(a+b)^n = a^n + na^{n-1}b + \frac{n(n-1)}{2!}a^{n-2}b^2 + \frac{n(n-1)(n-2)}{3!}a^{n-3}b^3 +$$

$$\text{and } |b| < |a|$$

$$(1+x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \frac{n(n-1)(n-2)}{3!}x^3 + \dots$$

$$\text{and } -1 < x < 1$$

Maclaurin's Theorem

$$f(x) = f(0) + \frac{f'(0)}{1!}x + \frac{f''(0)}{2!}x^2 + \frac{f'''(0)}{3!}x^3 + \dots + \frac{f^{(n-1)}(0)}{(n-1)!}x^{n-1} + \dots$$

Taylor's Theorem

$$f(x) = f(a) + \frac{f'(a)}{1!}(x-a) + \frac{f''(a)}{2!}(x-a)^2 + \frac{f'''(a)}{3!}(x-a)^3 + \dots + \frac{f^{(n-1)}(a)}{(n-1)!}(x-a)^{n-1} + \dots$$

$$f(a+h) = f(a) + \frac{h}{1!}f'(a) + \frac{h^2}{2!}f''(a) + \dots + \frac{h^{n-1}}{(n-1)!}f^{(n-1)}(a) + \dots$$

COMPLEX NUMBERS

$$1. \quad z = a + bj = r(\cos \theta + j \sin \theta) = r\angle\theta = re^{j\theta},$$

$$\text{where } j^2 = -1$$

$$\text{Modulus: } r = |z| = \sqrt{a^2 + b^2}$$

$$\text{Argument } \theta = \arg z = \arctan \frac{b}{a}$$

2. Addition .

$$(a + jb) + (c + jd) = (a + c) + j(b + d)$$

3 Subtraction .

$$(a + jb) - (c + jd) = (a - c) + j(b - d)$$

4 If $m + jn = p + jq$, then $m = p$ and $n = q$

5. Multiplication : $z_1 z_2 = r_1 r_2 \angle (\theta_1 + \theta_2)$

6. DIVISION $\frac{z_1}{z_2} = \frac{r_1}{r_2} \angle (\theta_1 - \theta_2)$

7. De Moivre's Theorem

$$[r\angle\theta]^n = r^n \angle n\theta = r^n (\cos n\theta + j \sin n\theta)$$

8. $z^{\frac{1}{n}}$ has n distinct roots

$$z^{\frac{1}{n}} = r^{\frac{1}{n}} \angle \frac{\theta + k360^\circ}{n} \text{ with } k = 0, 1, 2, \dots, n-1$$

9. $re^{j\theta} = r(\cos \theta + j \sin \theta)$

$$\therefore \Re(re^{j\theta}) = r \cos \theta \text{ and } \Im(re^{j\theta}) = r \sin \theta$$

10. $e^{a+jb} = e^a (\cos b + j \sin b)$

11. $\ln re^{j\theta} = \ln r + j\theta$

GEOMETRY

- 1 Straight line. $y = mx + c$
 $y - y_1 = m(x - x_1)$
 Perpendiculars, then $m_1 = \frac{-1}{m_2}$
- 2 Angle between two lines
 $\tan \theta = \frac{m_1 - m_2}{1 + m_1 m_2}$
- 3 Circle:
 $x^2 + y^2 = r^2$
 $(x - h)^2 + (y - k)^2 = r^2$
- 4 Parabola:
 $y = ax^2 + bx + c$
 axis at $x = \frac{-b}{2a}$
- 5 Ellipse
 $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$
- 6 Hyperbola:
 $xy = k$
 $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ (round x - axis)
 $-\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ (round y - axis)

MENSURATION

- 1 Circle (θ in radians)
 $\text{Area} = \pi r^2$
 $\text{Circumference} = 2\pi r$
 $\text{Arc length } s = r\theta$
 $\text{Sector area} = \frac{1}{2} r^2 \theta = \frac{1}{2} sr$
 $\text{Segment area} = \frac{1}{2} r^2 (\theta - \sin \theta)$
- 2 Ellipse:
 $\text{Area} = \pi ab$
 $\text{Circumference} = \pi(a + b)$
- 3 Cylinder
 $\text{Volume} = \pi r^2 h$
 $\text{Surface area} = 2\pi rh + 2\pi r^2$
- 4 Pyramid:
 $\text{Volume} = \frac{1}{3} \text{area base} \times \text{height}$
- 5 Cone.
 $\text{Volume} = \frac{1}{3} \pi r^2 h$
 $\text{Curved surface} = \pi r \ell$
- 6 Sphere:
 $A = 4\pi r^2$
 $V = \frac{4}{3} \pi r^3$
- 7 Trapezoidal rule:
 $A = h \left(\frac{y_1 + y_n}{2} + y_2 + y_3 + \dots + y_{n-1} \right)$
- 8 Simpsons rule:
 $A = \frac{s}{3} ((F + L) + 4E + 2R)$
- 9 Prismoidal rule
 $V = \frac{h}{6} (A_1 + 4A_2 + A_3)$

HYPERBOLIC FUNCTIONS

$$\sinh x = \frac{e^x - e^{-x}}{2}$$

Definitions. $\cosh x = \frac{e^x + e^{-x}}{2}$

$$\tanh x = \frac{e^x - e^{-x}}{e^x + e^{-x}}$$

Identities

$$\cosh^2 x - \sinh^2 x = 1$$

$$1 - \tanh^2 x = \operatorname{sech}^2 x$$

$$\coth^2 x - 1 = \operatorname{cosech}^2 x$$

$$\sinh^2 x = \frac{1}{2}(\cosh 2x - 1)$$

$$\cosh^2 x = \frac{1}{2}(\cosh 2x + 1)$$

$$\sinh 2x = 2 \sinh x \cosh x$$

$$\cosh 2x = \cosh^2 x + \sinh^2 x$$

$$= 2 \cosh^2 x - 1$$

$$= 1 + 2 \sinh^2 x$$

TRIGONOMETRY*Identities*

$$\sin^2 \theta + \cos^2 \theta = 1$$

$$1 + \tan^2 \theta = \sec^2 \theta$$

$$\cot^2 \theta + 1 = \operatorname{cosec}^2 \theta$$

$$\sin(-\theta) = -\sin \theta$$

$$\cos(-\theta) = +\cos \theta$$

$$\tan(-\theta) = -\tan \theta$$

$$\tan \theta = \frac{\sin \theta}{\cos \theta}$$

Compound angle addition and subtraction formulae:

$$\sin(A + B) = \sin A \cos B + \cos A \sin B$$

$$\sin(A - B) = \sin A \cos B - \cos A \sin B$$

$$\cos(A + B) = \cos A \cos B - \sin A \sin B$$

$$\cos(A - B) = \cos A \cos B + \sin A \sin B$$

$$\tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$$

$$\tan(A - B) = \frac{\tan A - \tan B}{1 + \tan A \tan B}$$

Double angles:

$$\sin 2A = 2 \sin A \cos A$$

$$\cos 2A = \cos^2 A - \sin^2 A$$

$$= 2\cos^2 A - 1$$

$$= 1 - 2\sin^2 A$$

$$\sin^2 A = \frac{1}{2}(1 - \cos 2A)$$

$$\cos^2 A = \frac{1}{2}(1 + \cos 2A)$$

$$\tan 2A = \frac{2 \tan A}{1 - \tan^2 A}$$

Products of sines and cosines into sums or differences.

$$\sin A \cos B = \frac{1}{2}(\sin(A + B) + \sin(A - B))$$

$$\cos A \sin B = \frac{1}{2}(\sin(A + B) - \sin(A - B))$$

$$\cos A \cos B = \frac{1}{2}(\cos(A + B) + \cos(A - B))$$

$$\sin A \sin B = -\frac{1}{2}(\cos(A + B) - \cos(A - B))$$

Sums or differences of sines and cosines into products:

$$\sin x + \sin y = 2 \sin \left[\frac{x + y}{2} \right] \cos \left[\frac{x - y}{2} \right]$$

$$\sin x - \sin y = 2 \cos \left[\frac{x + y}{2} \right] \sin \left[\frac{x - y}{2} \right]$$

$$\cos x + \cos y = 2 \cos \left[\frac{x + y}{2} \right] \cos \left[\frac{x - y}{2} \right]$$

$$\cos x - \cos y = -2 \sin \left[\frac{x + y}{2} \right] \sin \left[\frac{x - y}{2} \right]$$

DIFFERENTIATION

$$1. \frac{dy}{dx} = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

$$2. \frac{d}{dx} k = 0$$

$$3. \frac{d}{dx} ax^n = anx^{n-1}$$

$$4. \frac{d}{dx} fg = f \cdot g' + g \cdot f'$$

$$5. \frac{d}{dx} \frac{f}{g} = \frac{g f' - f g'}{g^2}$$

$$6. \frac{d}{dx} [f(x)]^n = n[f(x)]^{n-1} \cdot f'(x)$$

$$7. \frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dv} \cdot \frac{dv}{dx}$$

8. Parametric equations

$$\frac{dy}{dx} = \frac{\frac{dy}{d\theta}}{\frac{dx}{d\theta}}$$

$$\frac{d^2y}{dx^2} = \frac{\frac{d}{d\theta} \left(\frac{dy}{dx} \right)}{\frac{dx}{d\theta}}$$

9 Maximum/minimum

For turning points: $f'(x) = 0$

Let $x = a$ be a solution for the above

If $f''(a) > 0$, then a minimum

If $f''(a) < 0$, then a maximum

For points of inflection $f''(x) = 0$

Let $x = b$ be a solution for the above

Test for inflection. $f(b-h)$ and $f(b+h)$

Change sign or $f'''(b) \neq 0$ if $f'''(b)$ exists

$$10. \frac{d}{dx} \sin^{-1} f(x) = \frac{f'(x)}{\sqrt{1-[f(x)]^2}}$$

$$11. \frac{d}{dx} \cos^{-1} f(x) = \frac{-f'(x)}{\sqrt{1-[f(x)]^2}}$$

$$12. \frac{d}{dx} \tan^{-1} f(x) = \frac{f'(x)}{1+[f(x)]^2}$$

$$13. \frac{d}{dx} \cot^{-1} f(x) = \frac{-f'(x)}{1+[f(x)]^2}$$

$$14. \frac{d}{dx} \sec^{-1} f(x) = \frac{f'(x)}{f(x)\sqrt{[f(x)]^2 - 1}}$$

$$15. \frac{d}{dx} \operatorname{cosec}^{-1} f(x) = \frac{-f'(x)}{f(x)\sqrt{[f(x)]^2 - 1}}$$

$$16. \frac{d}{dx} \sinh^{-1} f(x) = \frac{f'(x)}{\sqrt{[f(x)]^2 + 1}}$$

$$17. \frac{d}{dx} \cosh^{-1} f(x) = \frac{f'(x)}{\sqrt{[f(x)]^2 - 1}}$$

$$18. \frac{d}{dx} \tanh^{-1} f(x) = \frac{f'(x)}{1-[f(x)]^2}$$

$$19. \frac{d}{dx} \coth^{-1} f(x) = \frac{f'(x)}{[f(x)]^2 - 1}$$

$$20. \frac{d}{dx} \operatorname{sech}^{-1} f(x) = \frac{-f'(x)}{f(x)\sqrt{1-[f(x)]^2}}$$

$$21. \frac{d}{dx} \operatorname{cosech}^{-1} f(x) = \frac{f'(x)}{f(x)\sqrt{[f(x)]^2 + 1}}$$

$$22. \text{Increments } \delta z = \frac{\partial z}{\partial x} \delta x + \frac{\partial z}{\partial y} \delta y + \frac{\partial z}{\partial w} \delta w$$

23 Rate of change

$$\frac{dz}{dt} = \frac{\partial z}{\partial x} \frac{dx}{dt} + \frac{\partial z}{\partial y} \frac{dy}{dt} + \frac{\partial z}{\partial w} \frac{dw}{dt}$$

INTEGRATION

$$1 \text{ By parts } \int u dv = uv - \int v du$$

$$3 \text{ Mean value } = \frac{1}{b-a} \int_a^b y dx$$

$$2 \int_a^b f(x) dx = F(b) - F(a)$$

$$4 \text{ (R.M.S)}^2 = \frac{1}{b-a} \int_a^b y^2 dx$$

TABLE OF INTEGRALS

- | | |
|---|--|
| 1. $\int x^n dx = \frac{x^{n+1}}{n+1} + c, \quad n \neq -1$ | 2. $\int (u+v)dx = \int udx + \int vdx$ |
| 3. $\int audx = a \int udx, \quad a \text{ a constant}$ | 4. $\int [f(x)]^n f'(x)dx = \frac{[f(x)]^{n+1}}{n+1} + c, \quad n \neq -1$ |
| 5. $\int \frac{f'(x)}{f(x)} dx = \ln f(x) + c$ | 6. $\int f'(x)e^{f(x)} dx = e^{f(x)} + c$ |
| 7. $\int f'(x)a^{f(x)} dx = \frac{a^{f(x)}}{\ln a} + c$ | 8. $\int f'(x)\sin f(x)dx = -\cos f(x) + c$ |
| 9. $\int f'(x)\cos f(x)dx = \sin f(x) + c$ | 10. $\int f'(x)\tan f(x)dx = \ln \sec f(x) + c$ |
| 11. $\int f'(x)\cot f(x)dx = \ln \sin f(x) + c$ | |
| 12. $\int f'(x)\sec f(x)dx = \ln [\sec f(x) + \tan f(x)] + c$ | |
| 13. $\int f'(x)\operatorname{cosec} f(x)dx = \ln [\operatorname{cosec} f(x) - \cot f(x)] + c$ | |
| 14. $\int f'(x)\sec^2 f(x)dx = \tan f(x) + c$ | |
| 15. $\int f'(x)\operatorname{cosec}^2 f(x)dx = -\cot f(x) + c$ | |
| 16. $\int f'(x)\sec f(x) \tan f(x)dx = \sec f(x) + c$ | |
| 17. $\int f'(x)\operatorname{cosec} f(x) \cot f(x)dx = -\operatorname{cosec} f(x) + c$ | |
| 18. $\int f'(x)\sinh f(x)dx = \cosh f(x) + c$ | |
| 19. $\int f'(x)\cosh f(x)dx = \sinh f(x) + c$ | |
| 20. $\int f'(x)\tanh f(x)dx = \ln \cosh f(x) + c$ | |
| 21. $\int f'(x)\coth f(x)dx = \ln \sinh f(x) + c$ | |
| 22. $\int f'(x)\operatorname{sech}^2 f(x)dx = \tanh f(x) + c$ | |

$$23. \int f'(x) \operatorname{cosech}^2 f(x) dx = -\coth f(x) + c$$

$$24. \int f'(x) \operatorname{sech} f(x) \cdot \tanh f(x) dx = -\operatorname{sech} f(x) + c$$

$$25. \int f'(x) \operatorname{cosech} f(x) \cdot \coth f(x) dx = -\operatorname{cosech} f(x) + c$$

$$26. \int \frac{f'(x)}{[f(x)]^2 - a^2} dx = -\frac{1}{a} \operatorname{arc} \coth \left(\frac{f(x)}{a} \right) + c$$

$$27. \int \frac{f'(x)}{a^2 - [f(x)]^2} dx = \frac{1}{a} \operatorname{arc} \tanh \left(\frac{f(x)}{a} \right) + c$$

$$28. \int \frac{f'(x)}{[f(x)]^2 + a^2} dx = \frac{1}{a} \operatorname{arc} \tan \left(\frac{f(x)}{a} \right) + c$$

$$29. \int \frac{f'(x)}{\sqrt{a^2 - [f(x)]^2}} dx = \operatorname{arc} \sin \left(\frac{f(x)}{a} \right) + c$$

$$30. \int \frac{f'(x)}{\sqrt{[f(x)]^2 + a^2}} dx = \operatorname{arc} \sinh \left(\frac{f(x)}{a} \right) + c$$

$$31. \int \frac{f'(x)}{\sqrt{[f(x)]^2 - a^2}} dx = \operatorname{arc} \cosh \left(\frac{f(x)}{a} \right) + c$$

$$32. \int f'(x) \sqrt{a^2 - [f(x)]^2} dx = \frac{a^2}{2} \operatorname{arc} \sin \left(\frac{f(x)}{a} \right) + \frac{f(x)}{2} \sqrt{a^2 - [f(x)]^2} + c$$

$$33. \int f'(x) \sqrt{[f(x)]^2 + a^2} dx = \frac{a^2}{2} \ln \left| f(x) + \sqrt{[f(x)]^2 + a^2} \right| + \frac{f(x)}{2} \sqrt{[f(x)]^2 + a^2} + c$$

$$34. \int f'(x) \sqrt{[f(x)]^2 - a^2} dx = -\frac{a^2}{2} \ln \left| f(x) + \sqrt{[f(x)]^2 - a^2} \right| + \frac{f(x)}{2} \sqrt{[f(x)]^2 - a^2} + c$$

TABLE OF LAPLACE TRANSFORMS

Study Guide 2 page 20 and page 51	
$f(t) = \mathcal{L}^{-1}\{F(s)\}$	$F(s) = \mathcal{L}\{f(t)\}$
a	$\frac{a}{s}$
t^n	$\frac{n!}{s^{n+1}}, \quad n = 1, 2, 3, \dots$
e^{bt}	$\frac{1}{s-b}$
$\sin at$	$\frac{a}{s^2 + a^2}$
$\cos at$	$\frac{s}{s^2 + a^2}$
$\sinh at$	$\frac{a}{s^2 - a^2}$
$\cosh at$	$\frac{s}{s^2 - a^2}$
$t^n e^{bt}$	$\frac{n!}{(s-b)^{n+1}}, \quad n = 1, 2, 3, \dots$
$t \sin at$	$\frac{2as}{(s^2 + a^2)^2}$
$t \cos at$	$\frac{s^2 - a^2}{(s^2 + a^2)^2}$
$t \sinh at$	$\frac{2as}{(s^2 - a^2)^2}$
$t \cosh at$	$\frac{s^2 + a^2}{(s^2 - a^2)^2}$
$e^{bt} \sin at$	$\frac{a}{(s-b)^2 + a^2}$
$e^{bt} \cos at$	$\frac{(s-b)}{(s-b)^2 + a^2}$
$e^{bt} \sinh at$	$\frac{a}{(s-b)^2 - a^2}$
$e^{bt} \cosh at$	$\frac{(s-b)}{(s-b)^2 - a^2}$
$H(t-c)$	$\frac{e^{-cs}}{s}$
$H(t-c)F(t-c)$	$e^{-cs} f(s)$
$\delta(t-a)$	e^{-as}
Study Guide 2 page 55	
$\mathcal{L}\{f(t)\} = F(s)$	
$\mathcal{L}\{f'(t)\} = sF(s) - f(0)$	
$\mathcal{L}\{f''(t)\} = s^2 F(s) - sf(0) - f'(0)$	
$\mathcal{L}\{f'''(t)\} = s^3 F(s) - s^2 f(0) - sf'(0) - f''(0)$	