TMTH 204 FINAL EXAM FORMULA SHEET

CHAPTER 5: *Graphs*

slope $m = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$ **equation** $y = mx + b$

CHAPTER 11: *Determinants*

Second-Order Determinant $\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = a_1 b_2 - a_2 b_1$

Cramer's Rule for 2 by 2 system $x = \dfrac{\begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}}, \qquad y = \dfrac{\begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}}$

Third-Order Determinant:

$$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = a_1 b_2 c_3 + a_3 b_1 c_2 + a_2 b_3 c_1 - a_3 b_2 c_1 - a_1 b_3 c_2 - a_2 b_1 c_3$$

Cramer's Rule for 3 by 3 system:

$$x = \frac{\begin{vmatrix} k_1 & b_1 & c_1 \\ k_2 & b_2 & c_2 \\ k_3 & b_3 & c_3 \end{vmatrix}}{\Delta}, \qquad y = \frac{\begin{vmatrix} a_1 & k_1 & c_1 \\ a_2 & k_2 & c_2 \\ a_3 & k_3 & c_3 \end{vmatrix}}{\Delta}, \qquad z = \frac{\begin{vmatrix} a_1 & b_1 & k_1 \\ a_2 & b_2 & k_2 \\ a_3 & b_3 & k_3 \end{vmatrix}}{\Delta}, \quad \text{where } \Delta = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} \neq 0$$

CHAPTER 12: *Matrices*

Product of Two Matrices $\begin{pmatrix} a & b & c \\ d & e & f \end{pmatrix} \begin{pmatrix} u & x \\ v & y \\ w & z \end{pmatrix} = \begin{pmatrix} au + bv + cw & ax + by + cz \\ du + ev + fw & dx + ey + fz \end{pmatrix}$

Inverse Matrix $AA^{-1} = A^{-1}A = I$

Solution to system of equations $AX = B$ is $X = A^{-1}B$

CHAPTER 14: *Quadratic Equations*

Quadratic Formula If $ax^2 + bx + c = 0$ and $a \neq 0$, then $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

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CHAPTER 15: *Oblique Triangles and Vectors*

$\sin\theta = \sin(180° - \theta)$ $\quad$ $\cos\theta = \cos(360° - \theta)$ $\quad$ $\tan\theta = \tan(180° + \theta)$

Law of Sines $\quad \dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

Law of Cosines: $\quad a^2 = b^2 + c^2 - 2bc\cos A$ $\quad$ or $\quad \cos A = \dfrac{b^2+c^2-a^2}{2bc}$

$b^2 = a^2 + c^2 - 2ac\cos B$ $\quad$ or $\quad \cos B = \dfrac{a^2+c^2-b^2}{2ac}$

$c^2 = a^2 + b^2 - 2ab\cos C$ $\quad$ or $\quad \cos C = \dfrac{a^2+b^2-c^2}{2ab}$

CHAPTER 17: *Graphs of the Trigonometric Functions*

Angle Conversions $\quad 1 \text{ rev} = 360° = 2\pi \text{ rad}$

Sine Wave as a Function of Time: $\quad y = \text{a}\sin(\omega t + \varphi)$

amplitude $= |\text{a}|$ $\quad$ angular velocity $= \omega$ $\quad$ period $= \dfrac{2\pi}{\omega}$

frequency $= \dfrac{\omega}{2\pi}$ $\quad$ phase angle $= \varphi$ $\quad$ phase shift $= -\dfrac{\varphi}{\omega}$

Cosine and Sine Curves Related $\quad \cos\theta = \sin(\theta + 90°)$

Sinusoidals as Phasors:

$a\sin(\omega t + \varphi)$ is identified with $a\,\angle\varphi$

$a\cos(\omega t + \varphi)$ is identified with $a\,\angle(\varphi + 90°)$

Addition of a Sine Wave and a Cosine Wave:

$A\sin\omega t + B\cos\omega t = R\sin(\omega t + \varphi)$ $\quad$ where $R = \sqrt{A^2 + B^2}$ and $\varphi = \arctan\dfrac{B}{A}$

CHAPTER 18: *Trigonometric Identities and Equations*

$\csc\theta = \dfrac{1}{\sin\theta}$ $\quad$ $\sec\theta = \dfrac{1}{\cos\theta}$ $\quad$ $\cot\theta = \dfrac{1}{\tan\theta}$

$\tan\theta = \dfrac{\sin\theta}{\cos\theta}$ $\quad$ $\cot\theta = \dfrac{\cos\theta}{\sin\theta}$

$\sin^2\theta + \cos^2\theta = 1$ $\quad$ $\tan^2\theta + 1 = \sec^2\theta$ $\quad$ $1 + \cot^2\theta = \csc^2\theta$

Sum and Difference Identities:

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

$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$

$\tan(A \pm B) = \dfrac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$

Double Angle Identities:

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

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

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

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

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

Function Values of Special Angles:

θ		$\sin\theta$	$\cos\theta$	$\tan\theta$	$\cot\theta$	$\sec\theta$	$\csc\theta$
30°	$\frac{\pi}{6}$	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{3}}{3}$ or $\frac{1}{\sqrt{3}}$	$\sqrt{3}$	$\frac{2\sqrt{3}}{3}$ or $\frac{2}{\sqrt{3}}$	2
45°	$\frac{\pi}{4}$	$\frac{\sqrt{2}}{2}$ or $\frac{1}{\sqrt{2}}$	$\frac{\sqrt{2}}{2}$ or $\frac{1}{\sqrt{2}}$	1	1	$\sqrt{2}$	$\sqrt{2}$
60°	$\frac{\pi}{3}$	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	$\sqrt{3}$	$\frac{\sqrt{3}}{3}$ or $\frac{1}{\sqrt{3}}$	2	$\frac{2\sqrt{3}}{3}$ or $\frac{2}{\sqrt{3}}$

CHAPTER 21: *Complex Numbers*

The Imaginary Unit and its Powers $j = \sqrt{-1}$, $j^2 = -1$, $j^3 = -j$, $j^4 = 1$, $j^5 = j$, ...

Complex Number in Rectangular Form $a + jb$ real part $= a$, imaginary part $= b$

Complex Number in Polar Form $r\angle\theta$ magnitude $= r$, polar angle $= \theta$

Polar to Rectangular Form $r\angle\theta = a + jb$, where $a = r\cos\theta$ and $b = r\sin\theta$

Rectangular to Polar Form $a + jb = \sqrt{a^2 + b^2}\ \angle\tan^{-1}\left(\frac{b}{a}\right)$

Complex Current, Voltage, and Impedance:

Given $i = I_{max}\sin(\omega t + \varphi)$, $\boldsymbol{I} = I_{eff}\,\angle\varphi$, where $I_{eff} = \frac{I_{max}}{\sqrt{2}}$

Given $v = V_{max}\sin(\omega t + \varphi)$, $\boldsymbol{V} = V_{eff}\,\angle\varphi$, where $V_{eff} = \frac{V_{max}}{\sqrt{2}}$

$\boldsymbol{Z} = R + jX = \sqrt{R^2 + X^2}\,\angle\varphi$, where $X = X_L - X_C$ and $\varphi = \tan^{-1}\left(\frac{X}{R}\right)$

Ohm's Law for AC circuits $\boldsymbol{V} = \boldsymbol{Z}\,\boldsymbol{I}$