THE ASSOCIATION OF SCIENCE
AND ENGINEERING TECHNOLOGY
PROFESSIONALS OF ALBERTA

Technical Exam

Formula Sheet Resource

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Overview

Purpose of Examination

The purpose of the Technical Examination is to identify competent technologists who possess technical competencies in their discipline, as outlined in a discipline-specific competency profile. The goal is to protect the public by granting designations only to those professionals who have the skill and knowledge necessary to perform their job in a safe and competent manner.

Examination Format

The examination consists of 110 multiple-choice questions, including questions with graphs, diagrams, and schematics and questions that require calculations. There are 10 experimental questions of the 110 that are not counted towards the candidate's exam score. These items are used for future exam development following the Embedded Field Testing Method. Each multiple-choice question has four answer options, only one of which is correct. Exam questions vary in the level of cognitive difficulty. The exam is closed-book, with online access to a formula sheet or exam resource and is three hours in duration.

Eligibility

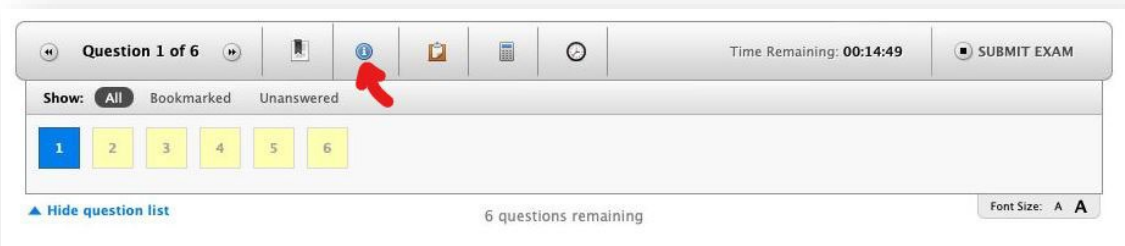
To be eligible to write the exam, candidates must have obtained the minimum required technologist level experience to apply for their desired designation within their technology association. For this reason, student and T.T. members may not register to write the exam.

Examination Registration

Applicants who are required to complete the Technical Examination will register for the examination at the time of application. Please see the ASET, CTTAM, or ASTTBC websites for current information on examination dates and deadlines.

Technical Exam Formula Sheets

Formula sheets and exam resources are available **virtually only** via the exam platform software accessed via the blue "I" icon (refer to screenshot). **Note:** this document serves as study material, physical copies of formula sheets will not be permitted or available at exam locations.



The formula sheet resource contains materials for all ASET Technical Exams, please ensure you are looking at the correct resource for the exam you are enrolled in. Candidates can confirm their exam registration in the ASET application portal or by contacting registration@aset.ab.ca

Architectural Technology

The Technical Exam – Architectural Technology contains 2 resources, Part 3 and Part 9 of the *National Building Code of Canada.*

Link to the National Building Code of Canada (2020): https://nrc-publications.canada.ca/eng/view/object/?id=515340b5-f4e0-4798-be69-692e4ec423e8

Civil Engineering Technology

Cost Estimating

Total Cost:	Unit Rate * Quantity
Depreciation (Straight Line):	Depreciation = (Initial Value – Salvage Value)
Compound Interest:	$A = P * [1 + (r/n)]^{n*t}$

Geometry

Interior Angles:	$(n - 2) * 180^\circ$
Triangle Width:	Width = Height * Slope Ratio
Triangle:	$h^2 = a^2 + b^2$

Areas

Trapezoid:	$A = (L_1 + L_2)/2 * H$
Square:	$A = s^2$
Rectangle:	$A = L * W$
Circle:	$A = \pi * R^2$
Ellipse:	$A = \pi/4 * D * d$
Triangle:	$A = ½ * b * h$
Sphere:	$A = 4 * \pi * R^2$

Volumes

End Area:	$V = [(A_1 + A_2) / 2] * L$
Average Area:	$V = [(A_1 + A_2) / 2] * H$
Square Prism:	$V = s^3$
Rectangular Prism:	$V = L * W * H$
Cylinder:	$V = \pi * r^2 * H$

Regular Cone:	$V = 1/3 * \pi * r^2 * h$
Sphere:	$V = 4/3 * \pi * R^3$

Mechanics

Center of Mass:	$x = \Sigma\, m_i\, x_i / \Sigma\, m_i$
Dry Density of Soil:	$\gamma_d = \gamma / (1 + w)$
	Where: γ_d = dry density γ = wet or bulk density W = water content expressed as fraction
Total Force:	Total Force = Area – Pressure
Force:	$F = m * a$
Newton's Third Law:	$Force_{Action} = Force_{Reaction}$
Energy:	$K = m * v^2$
Linear Expansion:	$\Delta L = L_1 * \alpha * (T_2 - T_1)$
Ohm's Law:	$E = I * R$

Pressure

Total Pressure:	$P_{total} = P_{static} + P_{friction} + P_{surge}$

Other

Relative Fraction:	Actual length = Drawing Length * Scale
Elevation:	$Elevation_{Final} = Elevation_{Initial} - Distances_{Vert}$
Slope:	Slope = (Δ Elevation / Δ Length)
Grade:	$Grade_{\%}$ = (Δ Elevation / Δ Length) * 100
Pipe Outside Diameter	Pipe OD = Pipe ID + (2 * Wall Thickness)
Quadratic Equation	$a * x^2 + b * x + c = 0$

psi TO MPa CONVERSION

Conversion Calculation

- 1 MPa = 1,000,000 pascals (Pa)
- 1 psi = 6,894.76 pascals (Pa)
- MPa value x 1,000,000 Pa = psi value x 6,894.76 Pa
- MPa value = psi value / 145.038

Conversion Table

psi	MPa
0	0
100	0.689476
200	1.37895
300	2.06843
400	2.7579
500	3.44738
600	4.13685
700	4.82633
800	5.51581
900	6.20528
1000	6.89476
2500	17.2369
5000	34.4738
10 000	68.9476

PHYSICS

Mechanics

$$F = ma$$

$$\sigma = \frac{F}{A}$$

$$W = Fd$$

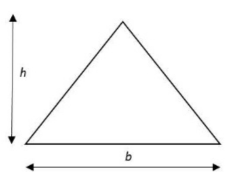
$$P = \frac{W}{t}$$

Variables

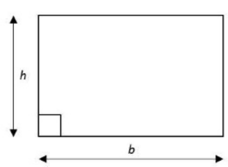
a	acceleration
A	area
d	displacement
F	force
m	mass
P	power
σ	stress
t	time
W	work

MATHEMATICS

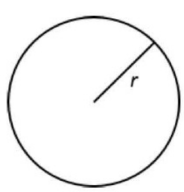
Geometry



Area = $\frac{1}{2}bh$



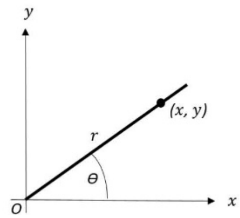
Area = bh



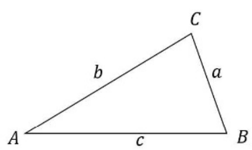
Area = πr^2

Circumference = $2\pi r$

Trigonometry



$\sin\theta = \frac{y}{r}$ $\cos\theta = \frac{x}{r}$ $\tan\theta = \frac{y}{x}$ $\cot\theta = \frac{x}{y}$ $\sec\theta = \frac{r}{x}$ $\csc\theta = \frac{r}{y}$



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

Law of Cosines: $a^2 = b^2 + c^2 - 2bc\cos A$

π rad = 180°

$a^2 + b^2 = c^2$

Basic Identities

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

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

$\sin(a+b) = \sin a\cos b + \cos a\sin b$ $\cos(a+b) = \cos a\cos b - \sin a\sin b$

Electrical Engineering Technology

BASIC

$V = IR$

$P = IV = \frac{V^2}{R} = I^2R$

$V_T = I_T Z$

$R_T = R_1 + R_2 + \ldots + R_N$

$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots + \frac{1}{R_N}$

$E = IZ$

$L_T = L_1 + L_2 + \cdots + L_N$

$\frac{1}{L_T} = \frac{1}{L_1} + \frac{1}{L_2} + \ldots + \frac{1}{L_N}$

$X_L = 2\pi fL$
$Z = R + jX_L$

$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots + \frac{1}{C_N}$

$C_T = C_1 + C_2 + \ldots + C_N$

$X_C = \frac{1}{2\pi fC}$
$Z = R + jX_L$

$CT = \frac{3}{2} * FLA$

$PT = \frac{V_{L-L}}{V_M}$
$V_M = voltmeter\ rating$

$Q = It$

$Ah = \frac{Wh}{V}$

POWER FACTOR

$PF = \frac{P}{S} = cos\varphi$

$P = I_L V_L \sqrt{3} PF$

$S = I_L V_L \sqrt{3}$

$Q = I_L V_L \sqrt{3} sin\varphi$

$PF_U = \frac{P}{S}, when\ P = S$

TRANSFORMERS

$V_P N_S = V_S N_P$

$I_P V_P = I_S V_S$

$n = \frac{N_P}{N_S} = \frac{V_P}{V_S}$

PERIODICITY

$f = \frac{1}{T}$

$\omega = 2\pi f$

$T = \frac{2\pi}{\omega}$

VOLTAGE DROP

$V_{DROP} = \frac{\sqrt{3}Rd}{A}$ *Three Phase*

$V_{DROP} = \frac{2Rd}{A}$ *Single Phase*

$A = Per\ 1000ft\ [304.8m]$
$R = Resistance$
$d = Distance$

PROBABILITY

$\frac{n!}{r!\,(n-r)!}p^r q^{n-r}$

$P(x \leq a) = \sum_{x=0}^{a} \binom{b}{x} p^x q^{b-x}$

$P(x \geq a) = \sum_{x=0}^{b} \binom{b}{x} p^x q^{b-x}$

MATHEMATICAL RELATIONSHIPS

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$a^2 + b^2 = c^2$

$(x - y)(x + y) = x^2 - y^2$

MAXWELL'S EQUATIONS

$\nabla \cdot E = \frac{\rho}{\varepsilon_o}$

$\nabla \cdot B = 0$

$\nabla \times E = -\frac{\partial B}{\partial t}$

$\nabla \times B = \mu_o \left(J + \varepsilon_o \frac{\partial B}{\partial t}\right)$

CALCULUS

$\iiint_V (\nabla \cdot \mathrm{F})\, dV = \oiint_S \mathrm{F} \cdot dS$

$\int_S \nabla \times \mathrm{F} \cdot dS = \oint_C \mathrm{F} \cdot d\mathrm{r}$

$\int u\, dv = uv - \int v\, du$

REPRESENTATION OF COMPLEX NUMBERS

$z = x = jy$

$x = rcos\varphi$

$y = rsin\varphi$

$z = re^{j\varphi}$

$r = \sqrt{x^2 + y^2}$

$\varphi = arctan\left(\frac{y}{x}\right)$

USEFUL RELATIONSHIPS

$1HP = 745.7w$

$25.4\ mm = 1\ inch$

$1.00\ m^2 = 10.7639\ ft^2$

$V_{RMS} = \frac{\sqrt{2}}{2} V_{PEAK\ DC}$

$V_{AVE} = \frac{\pi}{2} V_{PEAK}$

$SC\ multiplier = \frac{100}{\%Z}$

$j = \sqrt{-1}$

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

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

$\frac{d}{d\varphi}cos\varphi = -sin\varphi$

RESISTOR NETWORKS

$Average\ AC = 0.637 \times Peak\ or\ 0.9 \times RMS$ $RMS\ AC = 0.707 \times Peak\ or\ 1.11 \times Average$

BALANCED THREE-PHASE SYSTEMS

$V_{AB} = V_{AN} - V_{BN}$ $V_{BC} = V_{BN} - V_{CN}$ $V_{CA} = V_{CN} - V_{AN}$

DELTA CONNECTED LOADS

$I_{AB} = \frac{V_{AB}}{Z_{AB}}$ $I_{BC} = \frac{V_{BC}}{Z_{BC}}$ $I_{CA} = \frac{V_{CA}}{Z_{CA}}$

KIRCHOFF'S CURRENT LAW

$I_A = I_{AB} - I_{CA}$ $I_B = I_{BC} - I_{AB}$ $I_C = I_{CA} - I_{BC}$

FOUR-WYE CONNECTED LOAD

$I_A = \frac{V_{AN}}{Z_A}$ $I_B = \frac{V_{BN}}{Z_B}$ $I_C = \frac{V_{CN}}{Z_C}$

$I_N = I_A + I_B + I_C$

SERIES INDUCTANCE

$L_T = L_1 + L_2 + L_3 + \cdots$

SERIES REACTANCE

$X_{LT} = X_{L1} + X_{L2} + X_{L3} + \cdots$

MOTOR CALCULATIONS

$\frac{H_p \times 746}{eff \times pf} = VA$

GENERATOR CURRENT CALCULATIONS

$$I_1 = I_T \times \frac{Z_2}{Z_1 + Z_2}$$

$$I_1 = I_T \times \frac{Z_2}{Z_1 + Z_2}$$

WHEATSTONE BRIDGE FORMULA

$$R_X = \frac{R_2 R_3}{R_1}$$

POWER FACTOR

$$COS\ 0 = \frac{P\ Real\ Power}{S\ Apparent\ Power}$$

Electronics Engineering Technology

FUNDAMENTAL EQUATIONS

$V = I \times R$

$P = V \times I = \frac{V^2}{R} = I^2 \times R$

$G = \frac{1}{R}$

$R_T = R_1 + R_2 + \cdots R_N$

$R_T = \left(\frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_N}} \right)$

$t_{(\text{sec})} = \frac{1}{f_{(HZ)}}$

BALANCED BRIDGE CIRCUIT

$R_1 \cdot R_X = R_2 \cdot R_3$

$R_X = R_3 \cdot \frac{R_2}{R_1}$

BIPOLAR JUNCTION TRANSISTORS

$I_C = \beta \times I_B = h_{FE} \times I_B$

$V_{CE} = V_{CB} + V_{BE}$

$V_E \cong V_B - 0.6$

$I_E = I_C + I_B$

OPERATIONAL AMPLIFIERS

$A_{VCL} = \frac{V_O}{V_{IN}} = -\frac{R_f}{R_1}$

$A_{VCL} = \frac{V_O}{V_{IN}} = 1 + \frac{R_f}{R_1}$

$V_O = -R_f \left(\frac{V_{IN1}}{R_{IN1}} + \frac{V_{IN2}}{R_{IN2}} + \ldots \frac{V_{IN-N}}{R_{IN-N}} \right)$

$V_O = -\left(\frac{1}{C_f \times R_1} \right) \int V_{IN} \cdot dt$

$V_O = -(C_1 \times R_f) \frac{dV_{IN}}{dt}$

AMPLIFIERS

$A_{V(dB)} = 20 \times \log_{10} \left(\frac{V_O}{V_{IN}} \right)$

$A_{P(dB)} = 10 \times \log_{10} \left(\frac{P_O}{P_{IN}} \right)$

$A_{P(dBm)} = 10 \times \log_{10} \left(\frac{P_O}{1mW} \right)$

$i_O = \frac{V_O}{R_{LOAD}}$

$R_O = \frac{V_{OC} - V_O}{i_O}$

RLC CIRCUITS

$E = I \times Z$

$Z^2 = R^2 + X^2$

$\omega = 2 \times \pi \times f$

$X_C = \frac{1}{\omega \cdot C}$

$X_L = \omega \cdot L$

$\tau = R \cdot C$

$$\tau = \frac{L}{R}$$

$$I_C = C\frac{dV}{dt}$$

$$V = L\frac{dI}{dt}$$

$$Z = R + j\cdot\omega\cdot L - \frac{j}{\omega\cdot C}$$

$$f_r = \frac{1}{2\cdot\pi\sqrt{L\cdot C}}$$

SYSTEM SPECIFICATIONS

$$Effeciency_{(\%)} = \frac{P_O}{P_{IN}\times 100\%}$$

$$Error_{(\%)} = \frac{Measured - Actual}{Actual}\times 100\%$$

$$Error = Measured - Actual$$

$$Error_{TOT} = \sqrt{Error_1^2 + Error_2^2 + \cdots Error_N^2}$$

$$ACC_{(\%)} = \sqrt{ACC_{1(\%)} + ACC_{2(\%)} + \ldots ACC_{N(\%)}}$$

POWER SUPPLIES

$$V_{RMS} = \frac{V_{PK}}{\sqrt{2}}$$

$$V_{AVE} = V_{PK} \times 0.637$$

$$V_{REG(\%)} = \frac{V_{NO-LOAD} - V_{RATED-LOAD}}{V_{NO-LOAD}} \times 100\%$$

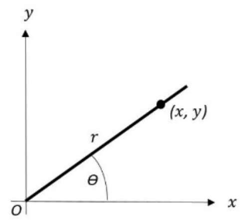
MISCELLANEOUS

$$1RU = 44.45mm$$

Engineering Design & Drafting Technology

TRIGONOMETRY

Basic Trigonometry



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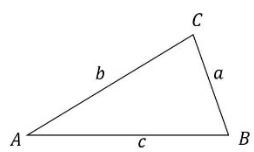

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$\sin(a+b) = \sin a\cos b + \cos a\sin b$ $\cos(a+b) = \cos a\cos b - \sin a\sin b$

NOMINAL PLATE SIZING & WEIGHT CHART

Imperial Units

- ***1 lb/ft² = 4.88 kg/m²***

Nominal Size Thickness ***(inches)***	**Weight** ***(lb/ft²)***
3/16	7.65
1/4	10.20
5/16	12.75
3/8	15.30
7/16	17.85
1/2	20.40
9/16	22.95
5/8	25.50
11/16	28.05
3/4	30.60
13/16	33.15
7/8	35.70
1	40.80
1 1/8	45.90
1 1/4	51.00
1 3/8	56.10
1 1/2	61.20
1 5/8	66.30
1 3/4	71.40
1 7/8	76.50
2	81.60
2 1/8	86.70
2 1/4	91.80
2 1/2	102.00
2 3/4	112.20
3	122.40
3 1/4	132.60
3 1/2	142.80
3 3/4	153.00
4	163.20
4 1/4	173.40
4 1/2	183.60
5	204.00
5 1/2	224.40
6	244.80
6 1/2	265.20
7	285.60
7 1/2	306.00
8	326.40
9	367.20
10	408.00

Metric Units

Plate Thickness (mm)	Weight (kg/m2)
1.6	12.6
2.0	15.7
2.5	19.6
3	23.6
3.2	25.1
4	31.4
5	39.3
6	47.1
8	62.8
10	78.5
12.5	98.1
15	118
20	157
22.5	177
25	196
30	236
32	251
35	275
40	314
45	353
50	393
55	432
60	471
65	510
70	550
75	589
80	628
90	707
100	785
110	864
120	942
130	1051
150	1178
160	1256
180	1413
200	1570
250	1963

Fundamentals of Technology

1. MATHEMATICS

Identities and Properties

$y = mx + b$

$\sin\theta = \dfrac{O}{H}$

$\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

$\sec\theta = \dfrac{1}{\cos\theta}$

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

$\cot x = \dfrac{\cos x}{\sin x}$

$\sin(2x) = 2\sin x\ \cos x$

$\cos(2x) = \cos^2 x - \sin^2 x$

$\mathrm{A} = \dfrac{\phi r^2}{2} = \dfrac{\mathrm{sr}}{2}$

$\mathrm{A} = \dfrac{1}{2}\mathrm{bh}$

$m = \dfrac{(y_2 - y_1)}{(x_2 - x_1)}$

$\cos\theta = \dfrac{A}{H}$

$a^2 = b^2 + c^2 - 2bc\cos A$

$\cot\theta = \dfrac{1}{\tan\theta}$

$1 + \cot^2\theta = \csc^2\theta$

$A = \pi r^2$

$a^2 + b^2 = c^2$

$x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$\tan\theta = \dfrac{\sin\theta}{\cos\theta}\ or\ \dfrac{O}{A}$

$\csc\theta = \dfrac{1}{\sin\theta}$

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

$\phi = \dfrac{s}{r}$

$\mathrm{c} = 2\pi\mathrm{r}$

$\mathrm{v} = \mathrm{r}\omega$

$y = \log_b x \Leftrightarrow x = b^y$

$\ln(xy) = \ln x + \ln y$

$\ln\left(\dfrac{x}{y}\right) = \ln x - \ln y$

$\ln(x^n) = n\ln x$

$e^{\ln x} = x$

$m = \dfrac{(y_2 - y_1)}{(x_2 - x_1)}$

Differentiation

$\dfrac{dy}{dx} = \lim_{h\to 0}\dfrac{f(x+h) - f(x)}{h}$

$\dfrac{dC}{dx} = 0$

$\dfrac{dx^n}{dx} = nx^{n-1}$

$\dfrac{d(u \pm v)}{dx} = \dfrac{du}{dx} \pm \dfrac{dv}{dx}$

$\dfrac{d(uv)}{dx} = u\dfrac{dv}{dx} + v\dfrac{du}{dx}$

$\dfrac{d\left(\frac{u}{v}\right)}{dx} = \dfrac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$

$\dfrac{dy}{dx} = f'[g(x)]gg'(x)$

$\dfrac{d(\sin u)}{dx} = \cos u\dfrac{du}{dx}$

$\dfrac{d(\cos u)}{dx} = -\sin u\dfrac{du}{dx}$

$$\frac{d(\tan u)}{dx} = \sec^2 u \frac{du}{dx}$$

$$\frac{d(\cot u)}{dx} = -\csc^2 u \frac{du}{dx}$$

$$\frac{d(\sec u)}{dx} = \sec u \tan u \frac{du}{dx}$$

$$\frac{d(\csc u)}{dx} = -\csc u \cot u \frac{du}{dx}$$

$$\frac{d}{dx}[\ln u] = \frac{1}{u}\frac{du}{dx}$$

$$\frac{d}{dx}[e^u] = e^u \frac{du}{dx}$$

$$dy = 2t(y^2 + 9)dt$$

$$\frac{dy}{y^2 + 9} = 2tdt$$

$$\frac{1}{3}\tan^{-1}\left(\frac{y}{3}\right) = t^2 + C$$

$$\tan^{-1}\left(\frac{y}{3}\right) = 3t^2 + C$$

$$\frac{y}{3} = \tan(3t^2 + C)$$

$$y = \tan(3t^2 + C)$$

Integration

$$\int (du + dv) = u + v + c$$

$$\int u^n du = \frac{u^{n+1}}{n+1} + C \ (n \neq -1)$$

$$\int \frac{du}{u} = \int u^{-1} du = \ln\ |u| + C$$

$$\int e^u du = e^u + C$$

$$\int \sin u \, \mathrm{du} = -\cos u + C$$

$$\int \cos u \, \mathrm{du} = \sin u + C$$

$$\int \sec^2 u \, du = \tan u + C$$

$$\int \csc^2 u \, \mathrm{du} = -\cot u +$$

$$\int \sec u \tan u \, \mathrm{du} = \sec u + C$$

$$\int \csc u \cot u \, \mathrm{du} = -\csc u + C$$

$$\int \tan u \, \mathrm{du} = -\ln|\cos u| + C$$

$$\int \cot u \, \mathrm{du} = \ln|\sin u| + C$$

$$\int \sec u \, \mathrm{du} = \ln|\sec u + \tan u| + C$$

$$\int \csc u \, \mathrm{du} = \ln|\csc u - \cot u| + C$$

$$\int u \, dv = uv - \int v \, du$$

$$\int \frac{dy}{y^2 + 9} = \int 2tdt$$

$$\int \frac{du}{a^2 + u^2} = \frac{1}{a}\tan^{-1}\frac{u}{a} + C$$

2. STATISTICS

Descriptive Statistics

$$\mu = \frac{\sum_{i=1}^{N} X_i}{N}$$

$$\bar{x} = \frac{\sum_{j=1}^{n} X_i}{N}$$

$$\sigma^2 = \frac{\sum (x_i - \mu)^2}{N}$$

$$\sigma = \sqrt{\frac{\sum (x_i - \mu)^2}{N}}$$

$$s^2 = \frac{\sum (x_i - \bar{x})^2}{N - 1}$$

$$s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n - 1}}$$

Probability

$$L_p = (\mathrm{n} + 1)\ \frac{p}{100}$$

$$P(A \ or \ B) = P(A) + P(B) - P(A \ and \ B)$$

$$P(B|A) = \frac{P(A \ and \ B)}{P(A)}$$

$P(A \text{ or } B) = P(A) + P(B)$ *for mutually exclusive events*

$P(A \text{ and } B) = P(A) \cdot P(B)$ *if A and B are independent*

$P(A \text{ or } B) = P(A) \cdot P(B|A))$ *if A and B are dependent*

$$P(B|A) = \frac{P(A|B) \cdot P(B)}{P(A|B) \cdot P(B) + P(A|B) \cdot P(B)}$$

3. PHYSICS

Kinematics

$$v_{ave} = \frac{\Delta d}{\Delta t}$$

$$d = v_i t + \frac{1}{2}at^2$$

$$|v_c| = \frac{2\pi r}{T}$$

$$v_f^2 = v_i^2 + 2ad$$

$$|a_c| = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$$

Waves

$$T = 2\pi\sqrt{\frac{m}{k}}$$

$$T = \frac{1}{f}$$

$$v = f\lambda$$

$$f = \left(\frac{v}{v \pm v_s}\right) f_s$$

$$m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$$

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

$$\frac{\sin\theta_1}{\sin\theta_2} = \frac{n_2}{n_1} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2}$$

$$\lambda = \frac{d \sin\theta}{n}$$

$$\lambda = \frac{xd}{nl}$$

Dynamics

$$a = \frac{F_{net}}{m}$$

$$|F_f| = \mu|F_N|$$

$$F_S = -kx$$

$$|F_g| = \frac{Gm_1 m_2}{r^2}$$

$$|g| = \frac{Gm}{r^2}$$

$$g = \frac{F_g}{m}$$

Electricity and Magnetism

$v = ir$

$|F_e| = \frac{kq_1q_2}{r^2}$

$|E| = \frac{kq}{r^2}$

$E = \frac{F_e}{q}$

$|E| = \frac{\Delta V}{\Delta d}$

$\Delta V = \frac{\Delta E}{q}$

$I = \frac{q}{t}$

$|F_m| = Il \perp |B|$

$|F_m| = qv \perp |B|$

Momentum and Energy

$p = mv$

$F\Delta t = m\Delta v$

$W = |F||d| \cos\theta$

$W = \Delta E$

$P = \frac{W}{t}$

$E_k = \frac{1}{2}mv^2$

$E_p = mgh$

$E_p = \frac{1}{2}kx^2$

Atomic Physics

$W = hf_o$

$E_{k_{max}} = q_eV_{stop}$

$E = hf = \frac{hc}{\lambda}$

$N = N_o\left(\frac{1}{2}\right)^n$

Quantum Mechanics and Nuclear Physics

$\Delta E = \Delta mc^2$

$p = \frac{h}{\lambda}$

$E = pc$

$\Delta\lambda = \frac{h}{mc}(1 - \cos\theta)$

4. CHEMISTRY

$\rho = \frac{m}{v}$

$P_1V_1 = P_2V_2$

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$A = L * W$

1 kg = 9.81 N

$PV = nRT$

$PV = k$

$k = \frac{V}{T}$

$x(ppm) = 10000 * x_{(\%)}$ $\qquad$ $Stress = \frac{Force}{Area}$ $\qquad$ ppm = $1*10^{-6}/10^{2}$

Molarity = Moles of Solute/Volume of Solution in Litres

PERIODIC TABLE OF ELEMENTS

Atomic Number
Symbol
Atomic Weight

I	II											III	IV	V	VI	VII	VIII
1 *H* 1.0079																	2 *He* 4.0026
3 *Li* 6.941	4 *Be* 9.0122											5 *B* 10.811	6 *C* 12.011	7 *N* 14.007	8 *O* 15.999	9 *F* 18.998	10 *Ne* 20.179
11 *Na* 22.990	12 *Mg* 24.305											13 *Al* 26.981	14 *Si* 28.086	15 *P* 30.974	16 *S* 32.066	17 *Cl* 35.453	18 *Ar* 39.948
19 *K* 39.098	20 *Ca* 40.078	21 *Sc* 44.956	22 *Ti* 47.88	23 *V* 50.941	24 *Cr* 51.996	25 *Mn* 54.938	26 *Fe* 55.847	27 *Co* 58.933	28 *Ni* 58.69	29 *Cu* 63.546	30 *Zn* 65.39	31 *Ga* 69.723	32 *Ge* 72.61	33 *As* 74.921	34 *Se* 78.96	35 *Br* 79.904	36 *Kr* 83.80
37 *Rb* 85.468	38 *Sr* 87.62	39 *Y* 88.906	40 *Zr* 91.224	41 *Nb* 92.906	42 *Mo* 95.94	43 *Tc* (98)	44 *Ru* 101.07	45 *Rh* 102.91	46 *Pd* 106.42	47 *Ag* 107.87	48 *Cd* 112.41	49 *In* 114.82	50 *Sn* 118.71	51 *Sb* 121.75	52 *Te* 127.60	53 *I* 126.90	54 *Xe* 131.29
55 *Cs* 132.91	56 *Ba* 137.33	57* *La* 138.91	72 *Hf* 178.49	73 *Ta* 180.95	74 *W* 183.85	75 *Re* 186.21	76 *Os* 190.2	77 *Ir* 192.22	78 *Pt* 195.08	79 *Au* 196.97	80 *Hg* 200.59	81 *Tl* 204.38	82 *Pb* 207.2	83 *Bi* 208.98	84 *Po* (209)	85 *At* (210)	86 *Rn* (222)
87 *Fr* (223)	88 *Ra* 226.02	89** *Ac* 227.03	104 *Rf* (261)	105 *Ha* (262)													
*Lanthanide Series			58 *Ce* 140.12	59 *Pr* 140.91	60 *Nd* 144.24	61 *Pm* (145)	62 *Sm* 150.36	63 *Eu* 151.96	64 *Gd* 157.25	65 *Tb* 158.92	66 *Dy* 162.50	67 *Ho* 164.93	68 *Er* 167.26	69 *Tm* 168.93	70 *Yb* 173.04	71 *Lu* 174.97	
**Actinide Series			90 *Th* 232.04	91 *Pa* 231.04	92 *U* 238.03	93 *Np* 237.05	94 *Pu* (244)	95 *Am* (243)	96 *Cm* (247)	97 *Bk* (247)	98 *Cf* (251)	99 *Es* (252)	100 *Fm* (257)	101 *Md* (258)	102 *No* (259)	103 *Lr* (260)	

Instrumentation Engineering Technology

- A/D – analog-to-digital
- CAN – Controller Area Network
- D/A – digital-to-analog
- DCS – distributed control system
- DP – differential pressure
- FAT – Factory Acceptance Testing
- FB – function block
- HART – Highway Addressable Remote Transducer
- IA – instrument air
- ISA – Instrument Society of America
- LAN – Local Area Network
- LVDT – linear variable differential transformer
- mA - milliamp
- Magmeter – Magnetic Flow Meter
- MMI – man-machine interface
- NEMA – National Electrical Manufacturers Association
- P&ID – Piping and Instrumentation Diagram
- PFD – Process Flow Diagram
- PID – proportional-integral-derivative
- PLC – programmable logic controller
- PSI – pounds per square inch
- PV – process variable
- RLC – resistor (R) inductor (L) capacitor (C)
- RMS – root mean square
- SG – specific gravity
- SIF – safety instrumented function
- SIL – safety integrity level
- SIS – safety instrumented system
- VFD – variable frequency drive
- WAN – wide area network

Mechanical Engineering Technology

$$MA = \frac{f_{output}}{f_{input}}$$

$$A = \pi r^2 = \frac{\pi d^2}{4}$$

$$Power = \frac{Work}{Time} = \frac{Fs}{t}$$

$$P_{ABS} = P_{gage} + P_{atm}$$

$$Rate\ of\ Heat\ Transfer = Q = \frac{kA(T_{Hot} - T_{Cold)}t}{d}$$

$$Volume\ Flow\ Rate = Q = Av$$

$$K = \frac{1}{2}mv^2$$

$$P = \frac{F}{A}$$

$$Efficiency = \frac{MA}{Velocity\ Ratio} * 100\%$$

$$\Delta L = L_1 * \alpha * (T_2 - T_1)$$

$$System\ Flow\ Rate, GPM = \frac{BTUH}{500 * \Delta T}\ (For\ Water)$$

$$Velocity\ Ratio = \frac{Distance\ moved\ by\ effort}{Distance\ moved\ by\ load}$$

FLUID POWER TECHNOLOGY

$$F = P * A$$

$$W = F * d$$

$$P = \frac{W}{t} = \frac{F \times d}{t}$$

$$P = F * v$$

$$w = m * g$$

$$\rho = \frac{m}{v}$$

$$\eta_o = \frac{HP_{OUT}}{HP_{IN}} = \frac{Power\ Out}{PowerIn}$$

$$OHP = \frac{T \times N}{63025}(US\ Customary)$$

$$P_{OUT} = \frac{T \times N}{9550}(SI)$$

$$v = \frac{Q}{A}$$

$$P = \frac{F}{A}$$

$$HP = \frac{F * d}{550t}$$

APPLIED MECHANICS

$R_y = \sum F_y$

$R_y = \sum F_y$

$R = \sqrt{{R_x}^2 + {R_y}^2}$

$M = F * d$

$\sum F_x = 0, \sum F_y = 0, \sum M = 0$

$\mu = \frac{F_{max}}{N}$

$v = \frac{s}{t} = \frac{\Delta s}{\Delta t}$

$a = \frac{\Delta v}{\Delta t}$

$s = v_o t + \frac{1}{2} a t^2$

$v = v_o + at$

$v^2 = v_o^2 + 2as$

$\theta = \omega_o t + \frac{1}{2} \alpha t^2$

$\omega = \omega_o + 2\alpha\theta$

$\omega^2 = \omega_o^2 + 2\alpha\theta$

$F = ma$

$U = Fs$

$P = \frac{Fs}{t} = \frac{U}{t}$

MACHINE ELEMENTS IN MECHANICAL DESIGN

$\tau = \frac{T_r}{J}$

$\tau_{max} = \frac{T_c}{J}$

$J = \frac{\pi}{32} D^4$

$T = KDP$

GEOMETRY

$V = \left(\frac{\pi}{4}\right) * D^2 * L$

$ax^2 + bx + c = 0$

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

$c^2 = a^2 + b^2 - 2ab \cos C$

$A = s^2$

$A = L * W$

PUMPS

$HP_1 = \frac{TN}{63025}$

$kW_1 = \frac{TN}{9550}$

MOTORS

$HP_O = \frac{TN}{63025}$

$kW_O = \frac{TN}{9550}$

CYLINDERS

$F_E = pA_p$

$HP_O = \frac{Fd}{550t} = \frac{Fv}{550}$

$kW_O = \frac{Fd}{1000t} = \frac{Fv}{1000}$

DYNAMICS

$k = \sqrt{\frac{I_C}{A} or I_C = k^2 m}$

$a_n = \frac{v^2}{r} = \omega^2 r$

$s = r\theta$

$v = r\omega$

$a = r\alpha$

$\sum M = I_C \alpha$

$U = T * \theta$

$PE = mgh$

$P = \frac{T * \theta}{t} = T * \omega$

$\%EFFICIENCY = \frac{POWER\ OUT}{POWER\ IN} * 100$

MISCALLANEOUS

$P_{abs} = P_{gage} + P_{atm}$

$A_1 v_1 = A_2 v_2$

Petroleum Engineering Technology

Volumetric Formulae

$$OGIP = \frac{Ah\phi(1 - S_w)}{B_{gi}}$$

$$OOIP = \frac{Ah\phi(1 - S_w)}{B_{gi}}$$

$$EUR = OOIP * RF$$

$$Remaining\ EUR = EUR - N_P$$

$$EUR = OGIP * RF$$

Water Saturation

$$S_w = \left[\left(\frac{a}{\Phi^m}\right) * \left(\frac{R_w}{R_t}\right)\right]^{\frac{1}{n}}$$

$$S_w = \left[F * \left(\frac{R_w}{R_t}\right)\right]^{\frac{1}{n}}$$

$$F = \left(\frac{a}{\Phi^m}\right)$$

$$R_o = F * R_w$$

$$S_w = \left[\left(\frac{R_o}{R_t}\right)\right]^{\frac{1}{n}}$$

Present Value

$$PV = FV * \frac{1}{(1 + r)^n}$$

$$PV = \frac{C_1}{(1 + r)^n}$$

Gas Laws

$$PV = Constant$$

$$P_1V_1 = P_2V_2$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{P}{T} = Constant$$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} = Constant$$

$$PV = mRT$$

$$\frac{V}{T} = Constant$$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

Material Balance

$$G_{fgi}E_g + N_{foi}E_o + WE_w + V_{pi}E_f + W_e = \left(G_p - G_I\right)\left(\frac{B_g - B_oR_v}{1 - R_vR_s}\right) + N_p\left(\frac{B_o - B_gR_s}{1 - R_vR_s}\right) + \left(W_p - W_I\right)B_w$$

$$PV = nR_oT$$

Specific Gravity

$$SG = \frac{\rho_{fluid}}{\rho_{H_2O}}$$

Static Gradient

$$P = P_{grad} * h$$

Hydrostatic Pressure

$$P = h * \rho * g$$

Key Conversions

1 bbl = 0.159 m^3

1 psi = 6.895 kPa

1 ft = 0.3048 m