E 355 Engineering Economics
Formula Sheet
EXAM #1

$i = Interest\ Rate$
$N = Number\ of\ Periods\ (n = 0,1, \dots, N)$
$P = Present\ Value\ (Present\ Worth) - n = 0$
$F = Future\ Worth\ (at\ some\ time\ n)$
$A = Annual\ Worth\ or\ Annual\ Equivalence$
$S = Salvage\ Value\ (n = N)$

<u>Note</u>:
$P = PV = NPV = PW = NPW$
$F = FW$
$A = AW = AE\ \ Similar\ to\ annual\ cost\ AC = EUAC$
$EUAC = Equivalent\ Uniform\ Annualized\ Cost$

$Simple\ Interest:\ F = P(1 + iN)$
$Compound\ Interest: F = P(1 + i)^N$
$Discounting: P = F(1 + i)^{-N}$

$$i_m = \frac{r}{M}$$
$$i_a = (1 + \frac{r}{M})^M - 1$$
$$i_a = e^r - 1$$
<u>Where</u>:
$i_m = Periodic\ Interest\ rate$
$i_a = Effective\ annual\ interst\ rate$
$r = Nominal\ interest\ rate$
$M = \#\ of\ compounding(interest)\ periods\ per\ year$

<u>Compound Amount Factor</u>:
$F = P(1 + i)^N = P\left(F/P, i, N\right)$ – *Used to find the Future Worth (FW) of a present value*
$$F = A\left[\frac{(1+i)^N - 1}{i}\right] = A\left(F/A, i, N\right)$$
<u>Present Worth Factor</u>:
$P = F(1 + i)^{-N} = F(P/F, i, N)$ – *Used to find the Present Worth (PW) of a future value*
$$P = A\left[\frac{(1 + i)^N - 1}{i(1 + i)^N}\right] = A(P/A, i, N)$$
<u>Annual Worth Factor</u>:
$$A = F\left[\frac{i}{(1 + i)^N - 1}\right] = F\left(A/F, i, N\right)$$
$$A = P\left[\frac{i(1 + i)^N}{(1 + i)^N - 1}\right] = P\left(A/P, i, N\right)$$

<u>Single Project Evaluation:</u>

If PW, AW, FW > 0 ➔ ACCEPT

If PW, AW, FW $= 0$ ➔ INDIFFERENT

If PW, AW, FW < 0 ➔ REJECT

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Present Worth Key Equations

$$PW = -P + A(P/A,i,N) + F(P/F,i,N)$$

$$PW = -P + \sum_{n=0}^{N} F(P/F,i,n) + F(P/F,i,N)$$

$$PW = AE(P/A,i,N)$$

$$PW = FW(P/F,i,N)$$

where,

P = initial investment (n = 0)

A = annual cost / revenue (n = 1, 2, … , N)

F = future costs, salvage value or expected income from sale of the item (n = N)

PW = present worth of the investment taking A, F, i and N into account

AE = annual equivalence / worth of the investment taking P, F, i and N into account

FW = future worth of the investment taking P, A, i and N into account

i = interest rate, MARR

N = project life (n = 1, 2, … , N)

Annual Worth Key Equations

$$AW = -P({}^{A}/_{P}, i, N) + A + F({}^{A}/_{F}, i, N)$$

$$AW = -P({}^{A}/_{P}, i, N) + A + S({}^{A}/_{F}, i, N)$$

$$AW = PW({}^{A}/_{P}, i, N)$$

$$AW = FW({}^{A}/_{F}, i, N)$$

Annual Equivalent Worth Analysis

$$AE = -P({}^{A}/_{P}, i, N) + A + F({}^{A}/_{F}, i, N)$$

Future Worth Key Equations

$$FW = -P({}^{F}/_{P}, i, N) + A({}^{F}/_{A}, i, N) + F$$

$$FW = -P({}^{F}/_{P}, i, N) + A({}^{F}/_{A}, i, N) + S$$

$$FW = PW({}^{F}/_{P}, i, N)$$

$$FW = AE({}^{F}/_{A}, i, N)$$

Equivalent Uniform Annual Cost: $EUAC(i)$

$$EUAC(i) = CR(i) + [O+M](i)$$

$$EUAC = P(A/P, i, n) - S(A/F, i, n) + O\&M$$

$$CR_{EUAC} = (P - S)\left(\frac{A}{F}, i, n\right) + Pi$$

$$CR_{EUAC} = (P-S)(A/P,i,n) + Si$$

Where P = Initial Cost S = Salvage Value

Capital Recovery Cost = CR = Pi

$$CR = P({}^{A}/_{P}, i, N) - S({}^{A}/_{F}, i, N)$$

Total AC = CR + [O&M]