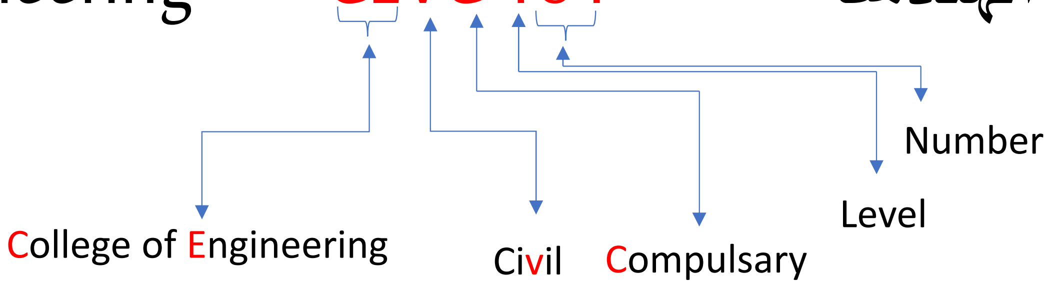
Introduction to Engineering - CEVC 101 - المدخل إلى الهندسة



4 credit hours = 2 Th + 4 Pr

4 ساعات معتمدة = 2 نظري + 4 عملي

4 عملي = 2 يوم الأحد (ترميم رياضيات) + 2 يوم الثلاثاء (مهارات الرسم الهندسي)

Test1: 15 points
Test2: 15 points
Practical Test : 20 points
(50 points)
Final Exam: 50 points

الاختبار الأول: 15 درجة
الاختبار الثاني: 15 درجة
الاختبار العملي: 20 درجة
(50 درجة)
الامتحان النهائي: 50 درجة

شرطان لدخول الامتحان النهائي
الحصول على 12.5 درجة من الاختبارات
والحضور في النظري والعملي بنسبة 85%

Mathematics Review & Supplement

الرياضيات مراجعة وتتمات

Engineering is a quantitative discipline that use the language of mathematics to make predictions.

Imagine the difficulty of designing a technology as complex as the space shuttle without using mathematics to quantify its mass, aerodynamics shape, and trajectory. Qualitative descriptions such as "it's heavy, pointy, and goes in a loop around the earth" are not very useful in the engineering world.

When engineers quantify relationships, they generally use algebra; thus, we begin our study of applied mathematics with a review of high school algebra.

الهندسة مهنة علمية (ارتياد) ذات نهج كمي تستخدم لغة الرياضيات لتقدم توقعات.

لنتخيل صعوبة تصميم منتج تقني معقد كمكوك الفضاء دون أن تُستخدم الرياضيات لتحديد: كتلته، شكله المناسب لتخفيف مقاومة الهواء، ومساره الدقيق حول الأرض. إن الاكتفاء بالحديث عنه بأوصاف كيفية (لاكمية) كالقول: "إنه ثقيل، مدبب ويدور حول الأرض" ليست مفيدا جدًا في عالم الهندسة".

فالهندسة مهنة أرقام وليس كلام.

يتبع المهندسون المنهج الكمي في تحديد العلاقات بين عناصر منتجاتهم وبينها وبين الاحتياجات التي تلبيها. ويعد الجبر أبسط أدوات الرياضيات التطبيقية التي يحتاجونها. وهكذا، سنبدأ مدخلنا إلى الهندسة بمراجعة جبر المدرسة الثانوية.

1. Operators and Antioperators

An operator is a mathematical rule that uniquely links numbers to other numbers.
The following example uses the addition operator to link any with a unique y:

$$y = 3 + x$$

x	$\Rightarrow$	y
1	$\Rightarrow$	4
2	$\Rightarrow$	5
3	$\Rightarrow$	6
4	$\Rightarrow$	7
etc.	$\Rightarrow$	Etc.

The antioperator is the inverse of the operator.
In this example, the antioperartor would have to accomplish the following link:

$$y - 3 = x$$

x	$\Leftarrow$	y
1	$\Leftarrow$	4
2	$\Leftarrow$	5
3	$\Leftarrow$	6
4	$\Leftarrow$	7
etc.	$\Leftarrow$	Etc.

Thus, we see that subtraction is the antioperation of addition. (we also say that addition is the antioperation of subtraction). By a similar argument, we can conclude that division is the antioperation of multiplication.

Operator	$(+)$ **Addition**	$(\times)$ **Multiplication**
Antioperator	$(-)$ **Subtraction**	$(\div)$ **Division**

The multiplication operator is indicated four different ways; the following four equations are equivalent:

$y = 2 \times x$ $y = 2 \cdot x$ $y = 2x$ $y = 2(x)$

The division operator is indicated three different ways; the following three equations are equivalent:

$y = 3 \div x$ $y = 3/x$ $y = \frac{3}{x}$

2. Algebra

Algebra provides methods to solve practical problems by using symbols (usually letters) for unknown quantities. For example, the following problem: $2x + 3 = 11$, can be solved by inspection:

$x = 1$: $2(1) + 3 \neq 11.$

$x = 2$: $2(2) + 3 \neq 11.$

$x = 3$: $2(3) + 3 \neq 11.$

$x = 4$: $2(4) + 3 = 11.$

$x = 5$: $2(5) + 3 \neq 11.$

$x = 6$: $2(6) + 3 \neq 11.$

However many complex problems cannot be solved by inspection, so the rules in table(1). are often employed

Table (1) Algebra Rules

Rule		Addition	Multiplication
Commutative	تبديلية	$a + b = b + a$	$ab = ba$
Associative	تجميعية	$(a + b) + c = a + (b + c)$	$(ab)c = a(bc)$
Cancellation	الحذف	$a + c = b + c \Leftrightarrow a = b$	$ac = bc$ and $c \neq 0 \Rightarrow a = b$
Distributive	توزيعية	$a(b + c) = ab + ac$	
Identity	الحيادي	$a + 0 = a$	$a \cdot 1 = a$
Zero	الصفر	$a + (-a) = 0$	$a \cdot 0 = 0$
Another important rule is that division by zero is not permitted.			

Rather than solve the previous equation by inspection, it may be systematically solved by using the rule in Table(1).

$$2x + 3 = 11$$
$$\Downarrow$$
$$2x + 3 + (-3) = 11 + (-3)$$
$$\Downarrow$$
$$2x = 8$$
$$\Downarrow$$
$$\left(\tfrac{1}{2}\right)2x = \left(\tfrac{1}{2}\right)8$$
$$\Downarrow$$
$$x = 4$$

The general procedure can be described as "think of an operation to perform to each side of the equation to simplify it through the various algebraic rules." The important requirement is that whatever done to one side of the equation must be done to the other side. This can be generalized to other operations such as logarithms, exponents, and trigonometric functions that will be discussed later.

3. Simultaneous Equations

Frequently in engineering, it is necessary to solve simultaneous algebraic equations.
Consider the following two equations:

$$23 = 4x + 5y$$
$$36 = 6x + 8y$$

We are seeking values for x and y that satisfy both equations simultaneously. The first equation may be solved explicitly for x, allowing it to be substituted into the second equation:

$$x = \frac{23 - 5y}{4}$$

$$36 = 6\left(\frac{23 - 5y}{4}\right) + 8y \Rightarrow 4(36) = 6(23) - 30y + 32y \Rightarrow 144 = 138 + 2y \Rightarrow y = 3$$

$$x = \frac{23 - 5(3)}{4} = \frac{8}{4} = 2$$

Thus, the simultaneous solution is $x = 2$ and $y = 3$.

An alternative approach is shown below in which one equation is multiplied by a factor that causes one term to be eliminated when the two equations are added

$$-\frac{6}{4}(23) = -\frac{6}{4}(4x + 5y)$$
$$+$$
$$36 = 6x + 8y$$

$$36 - 34.5 = 6x - 6x + 8y - 7.5y \Rightarrow 1.5 = 0.5y \Rightarrow y = 3 \; and \;\; 36 = 6x + 8(3) \Rightarrow 6x = 12 \Rightarrow x = 2$$

Again the solution is $x = 2$ and $y = 3$.

In the previous example , there were two unknowns which required two equations to determine a solution. If there were three unknowns, then three equations would be required. This can be generalized by saying, “for n unknowns, n equations are required.” An important caution is that the n equations must be independent, meaning one equation is not simply a multiple of the other. For example, if there are two unknowns x and y and the following two equations:

$$2 = 4x + 5y$$
$$4 = 8x + 10y$$

We cannot solve for x and y because the second equation is simply twice the first equation; no new information is provided.

4. Summary

An operator is a rule that links a first number to a second number. An antioperator reverses the operator and links the second number to the first.

المؤثر أو المعامل: قاعدة تربط عدد أول بعدد ثاني. والمؤثر المعاكس يربط الثاني بالأول.

Algebraic rules can be used to solve single equations or simultaneous equations. The governing principle is that whatever is done to one side of the equation must also be done to the other side. When solving simultaneous equations, it is necessary for the equations to be independent.

تُستخدم القواعد الجبرية لحل المعادلات وحيدة المجهول أو متعددة المجاهيل. والمبدأ الحاكم في منهج الحل هو أن ما يجري على أحد طرفي المعادلة يجب أن يجري على الطرف الآخر. من الضروري أن تكون المعادلات المشتركة مستقلة.

Further Readings

A. R. Eide, R. D. Jenison, L. H. Mashaw, and L. L. Northup; Engineering Fundamentals and Problem Solving.

Problems

1. Solve for x in the following equations:

a. $3.4x + 7.4 = 6.7$

b. $-4 + 5x = 8$

c. $3x + 5 - 2x - 8 = 0$

d. $689(x - 32) = 42$

e. $49x - 78 + x(87 + 43) = 89$

f. $876 = 67x + (98 + 82)x + 17$

g. $56x + 782 = 43x - 17$

h. $94(x + 15) = 67(x - 43)$

2. Solve for x and y in the following simultaneous equations:

a. $7.8x + 3.7y = 87$
$9.8x + 5.6y = 13$

b. $5x + 7y = 19$
$3x + 5y = 10$

c. $8x = 5y - 17$
$9y = 2x + 5$

d. $22 = 5x + 2y$
$12 = 2x + 10y$