Mathematics for prospective science and engineering undergraduates

Overview

This five-week course takes an introductory look at two topics that appear in most first-year physical science and engineering undergraduate courses.

Week	Topic	Content
1	Introduction to complex numbers	• imaginary and complex numbers • arithmetic with complex numbers • complex conjugate roots
2-3	Methods in differential equations	• solution by separations of variables • families of solutions • solution of first-order differential equations using an integrating factor • solution of linear homogeneous second-order differential equations • solution of linear non-homogeneous second-order differential equations
4-5	Modelling with differential equations	• problems in the context of kinematics, money, population and concentration • simple harmonic motion • damped and forced harmonic motion • coupled first-order differential equations

Detailed Programme : week 1

Carefully read the following sections in the *Complex Numbers* notes, and then attempt the following questions from the text book exercises, checking your answers with the Solution Bank as you go.

Notes	Exercises
1. Imaginary and complex numbers	Ex 1A Q 1a-e, 2a-c, 5
2. Quadratic equations	Ex 1B Q 3a-c, 4, 6
3. Multiplying complex numbers	Ex 1C Q 1a-c, 3, 6
4. Complex conjugation and division	Ex 1D Q 1a-b, 3, 9, 11, 14
5. Square root of a complex number	none
6. Roots of quadratic equations	Ex 1E Q 3, 4, 5, 9
7. Roots of cubic and quartic equations	Ex 1F Q 1, 3, 4, 10, 11, 12

Now do the *Complex Numbers* topic review on lined paper, and submit for assessment via OneNote by 12pm on Saturday 25 April.

Detailed Programme : weeks 2-3

Carefully read the following sections in the *Methods in Differential Equations* notes, and then attempt the following questions from the text book exercises, checking your answers with the Solution Bank as you go.

You may need to refer to page 7 of the Formula Booklet for standard integrals.

Notes	Exercises
1. Review of separation of variables	none
2. Family of solution curves	Ex 7A Q 1a-c
3. Exact first-order differential equations	Ex 7A Q 3
4. Integrating factors	Ex 7A Q 7, 9
5. Second-order homogeneous differential equations	Ex 7B Q 1ace, 2ace, 3ace, 4ace
6. Second-order non-homogeneous differential equations	Ex 7C Q 1a-f, 2
7. Repetition of the complementary function	Ex 7C Q 5
8. Using boundary conditions	Ex 7D Q 1, 3, 4

Now do the *Methods in Differential Equations* topic review on lined paper, and submit for assessment via OneNote by 12pm on Saturday 9 May.

Detailed Programme : weeks 4-5

Carefully read the following sections in the *Modelling with Differential Equations* notes, and then attempt the following questions from the text book exercises, checking your answers with the Solution Bank as you go.

You may need to refer to page 7 of the Formula Booklet for standard integrals.

Notes	Exercises
1. Modelling with first-order differential equations	Ex 8A Q 1, 4, 5, 7
2. Simple harmonic motion	Ex 8B Q 1, 2, 3
3. Damped harmonic motion	Ex 8C Q 1, 2, 3
4. Force harmonic motion	Ex 8C Q 6, 7, 8
5. Coupled first-order simultaneous differential equations	Ex 8D Q 1, 3, 4, 5, 8

Now do the *Modelling with Differential Equations* topic review on lined paper, and submit for assessment via OneNote by 12pm Wednesday 20 May.