ME12002 – Engineering Mathematics

Detailed lecture plan — semester 1.

Week 1. Lecture 1 on Complex numbers. Sheet 1.
Motivation/need for them. Definition. Arithmetic operations. Geometric interpretation. Polar/exponential form.

Week 1. Lecture 2 on Complex numbers.
de Moivre's theorem. Euler's formula and identity. Roots of complex numbers. Further identities.

Week 2. Lecture 3 on Differentiation. Sheet2.
Definition. Notations. Use of limits. Higher derivative. Product rule.

Week 2. Lecture 4 on Differentiation.
Chain rule and proof. Functions of functions of functions etc.. Advanced cases. Quotient rule.

Week 3. Lecture 5 on Differentiation. Sheet 3.
Critical points. Primary/secondary criteria. Checklist.

Week 3. Lecture 6 on Integration. Sheet 4.
From sums to integrals. Definite and indefinite. Integration by substitution. f'/f form.

Week 4. Lecture 7 on Integration.
Ratios of polynomials and partial fractions. Top heavy ratios. Repeated factors. Irreducible quadratics.

Week 4. Lecture 8 on Integration. Sheet 5.
Integration by parts. Derivation of the Rees method - rules of implementation. Miscellaneous cases and examples.

Week 5. Lecture 9 on Series. Sheet 6.
Difference between series and sequences. Binomial theorem and Pascal's triangle. Why does 0!=1? Binomial series and examples.

Week 5. Lecture 10 on Series. Sheet 7 (Q1-Q10).
Taylor's series and Maclaurin. Derivation/justification. Two forms of Taylor's series. Examples.

Week 6. Reading week.

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Week 7. Lecture 11 on Series. Sheet 7 (Q11,12).
Convergence and d'Alembert's test. Examples of numerical series and power series. Radius of convergence. l'Hôpital's rule. Derivations. Examples.

Week 7 Lecture 12 on ODEs. Sheet 8.
Classification of ODEs. Reduction of ODEs and systems of ODEs to first-order form.

Week 8. Lecture 13 on ODEs.
Sep. of variables. 1^{st} order linear ODEs and integrating factors.

Week 8. Lecture 14 on ODEs. Sheet 9.
Linear constant-coefficient ODES. Homogeneous systems.

Week 9. Lecture 15 on ODEs. Sheet 9b. Optional.
Linear constant-coefficient ODES. Inhomogeneous systems 1.

Week 9. Lecture 16 on ODEs.
Linear constant-coefficient ODES. Inhomogeneous systems 2. **Sheet 10 (preliminary on Laplace Transforms).**

Week 10. Lecture 17 on Laplace Transforms. Sheet 10.
Definition. Examples. LT of derivatives. Solutions of some example ODEs

Week 10. Lecture 18 on Laplace Transforms.
The unit impulse. Solution of ODEs with the unit impulse as the forcing function.

Week 11. Lecture 19 on Laplace Transforms. Sheet 11.
The shift theorem in s. The unit step function. The shift theorem in t.

Week 11. Lecture 20 on Laplace Transforms.
Convolution. Examples. Use in ODE solutions.