UNIT 501 ADVANCED MATHEMATICS FOR ELECTRICAL AND ELECTRONIC ENGINEERING

Lesson 1 to 4: Calculus **Suggested Teaching Time:** 3.5 hours/session

Learning Outcome: Be able to use calculus to solve engineering problems

Topic	Suggested Teaching	Suggested Resources
Introducing calculus; differentiation	Tutor to introduce themselves to the students and give an overview of what is expected from the unit: Structure and content of the unit and how it will be assessed and the resources available. 1.1 The first two sessions are centred on the evaluation of the following rules of differentiation through practice and application: **First-** and **second-order partial derivatives; the chain rule for partial derivatives, total differential** for a function of several variables. Recap on the covered learning outcomes at the end of the session and hand out homework on the related topics, as a means of differentiation, allowing all levels to work at their own pace.	**Book:** Bird, J., O., *Higher Engineering Mathematics* 2010, Newnes. ISBN: 9781856177672 Croft, A., Hargeaves, M., Davison, R., *Mathematics: A Foundation for Electronic, Electrical, Communications and Systems Engineers* 4th Edn 2012, Prentice-Hall, ISBN-13: 978-0273719779 Stroud, K. A., *Higher Engineering Mathematics* 2nd Edn 2008, BS Publications ISBN: 1441661611 **Websites:** http://www.mathumatiks.com/
	Recap on previous classroom session and homework on differentiation. 1.5 & 1.6 The remaining two sessions will start with a recap on partial derivatives before finding the Form and solve problems involving **First order (variables separable; exact equations; linear equations** using an **integrating factor), second order (initial** and **boundary value problems; complementary functions** and **particular integrals)** Recap on the covered learning outcomes at the end of the session and hand out homework on the related topics, as a means of differentiation, allowing all levels to work at their own pace.	

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UNIT 501 ADVANCED MATHEMATICS FOR ELECTRICAL AND ELECTRONIC ENGINEERING

Lesson 5 to 8: Calculus

Suggested Teaching Time: 3.5 hours/session

Learning Outcome: Be able to use calculus to solve engineering problems

Topic	Suggested Teaching	Suggested Resources
Calculus and engineering problems	Recap on previous classroom session and homework related to solving problems first- and second-order differentials. 1.4 The first four sessions set the platform for the coming two sessions to find and solve **Indefinite**, **definite** and **standard integrals** of complex functions such as **algebraic** and **trigonometric functions**; **Heaviside function**, **Dirac delta function**. Recap on the covered learning outcomes at the end of the session and hand out homework on the related topics, as a means of differentiation, allowing all levels to work at their own pace.	**Book:** Bird, J., O., *Higher Engineering Mathematics* 2010, Newnes. ISBN: 9781856177672 Croft, A., Hargeaves, M., Davison, R., *Mathematics: A Foundation for Electronic, Electrical, Communications and Systems Engineers* 4th Edn 2012, Prentice-Hall, ISBN-13: 978-0273719779 Stroud K A, Higher Engineering Mathematics 2nd ED 2008, BS Publications ISBN: 1441661611 **Websites:** http://www.mathumatiks.com/
	Recap on previous session and homework involving integrals. 1.2 The next two sessions relate to obtaining Laplace transforms for **algebraic and trigonometric functions; Heaviside function, Dirac delta function.** Recap on the covered learning outcomes at the end of the session and hand out homework on the related topics, as a means of differentiation, allowing all levels to work at their own pace.	

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UNIT 501 ADVANCED MATHEMATICS FOR ELECTRICAL AND ELECTRONIC ENGINEERING

Lesson 9 to 10: Calculus

Suggested Teaching Time: 3.5 hours/session

Learning Outcome: Be able to use calculus to solve engineering problems

Topic	Suggested Teaching	Suggested Resources
Calculus and engineering problems	Recap on previous session and homework, related to Laplace Transforms. 1.3 The coming two sessions will develop from the previous sessions on Laplace transforms to obtaining the inverse Laplace transforms of complex functions for **algebraic** and **trigonometric functions; Heaviside function, Dirac delta function**. Recap on the covered learning outcomes at the end of the session and hand out homework on the related topics, as a means of differentiation, allowing all levels to work at their own pace.	**Books:** Bird, J., O., *Higher Engineering Mathematics* 2010, Newnes. ISBN: 9781856177672 Stroud, K. A., *Higher Engineering Mathematics* 2nd Edn 2008, BS Publications ISBN: 1441661611

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Lesson 11 to 14: Apply numerical analysis **Suggested Teaching Time:** 3.5 hours/session

Learning Outcome: Be able to apply numerical analysis to solve engineering problems

Topic	Suggested Teaching	Suggested Resources
Numerical analysis and engineering problems	Recap on previous session and homework for Inverse Laplace transforms to a new topic that relates to the application of numerical analysis. 2.1 The first two sessions will use numerical iterative methods such as **Bisection method**; **Secant method; Newton's method** to find the roots of a function. Recap on the covered learning outcomes at the end of the session and hand out homework on the related topics, as a means of differentiation, allowing all levels to work at their own pace.	**Books:** Bird, J., *Electrical and Electronic Principles and Technology*, 4th Ed 2010, Newnes. ISBN 978-0-08-089056-2 Croft, A., Hargeaves, M., Davison, R., *Mathematics: A Foundation for Electronic, Electrical, Communications and Systems Engineers* 4th Edn 2012, Prentice-Hall, ISBN-13: 978-0273719779
	Recap on previous session and homework on iterative methods. 2.2 The next two sessions will involve the application of numerical methods such as **Euler** and **improved Euler; Taylor series; Runge-Kutta; forward, backward** and **central finite-difference methods** for the solution of ordinary differential equation models that include **initial-value problems, boundary-value problems** of engineering systems. Recap on the covered learning outcomes at the end of the session and hand out homework on the related topics, as a means of differentiation, allowing all levels to work at their own pace.	

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Lesson 15 to 19: Apply numerical analysis **Suggested Teaching Time:** 3.5 hours/session

Learning Outcome: Be able to apply numerical analysis to solve engineering problems

Topic	Suggested Teaching	Suggested Resources
Numerical analysis and engineering problems	Recap previous session and homework related to the application of numerical methods. 2.3 Progress from 2.1 to the Application of iterative numerical methods (**finite difference methods** for partial differential equations; solution of sets of linear equations by **Jacobi iterative method**; **Gauss-Seidel iterative method**) to the solution of partial differential equation models of engineering systems Recap on the covered learning outcomes at the end of the session and hand out homework on the related topics, as a means of differentiation, allowing all levels to work at their own pace.	**Books:** Bird, J. *Basic Engineering Mathematics* 5th Edn, Newnes, ISBN:13: 978-1856176972 Croft, A., Hargeaves, M., Davison, R., *Mathematics: A Foundation for Electronic, Electrical, Communications and Systems Engineers* 4th Edn 2012, Prentice-Hall, ISBN-13: 978-0273719779 Stroud, K. A., *Higher Engineering Mathematics* 2nd Edn 2008, BS Publications ISBN: 1441661611 **Software package:** MultiSim, Excel
	Recap on previous session and homework for the application of iterative numerical methods. 2.4 Represent numerical values on diagrams (**Bode**, **Nyquist**, **Nicholls**, **log log, Argand**). Links with electrical principle might be useful here to extract respective diagrams from simulation. Recap the covered learning outcomes at the end of the session and hand out homework on the related topics, as a means of differentiation, allowing all levels to work at their own pace.	

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Lesson 20 to 22: Mathematical expressions used in waveform **Suggested Teaching Time:** 3.5 hours/session

Learning Outcome: Be able to apply numerical analysis to solve engineering problems

Topic	Suggested Teaching	Suggested Resources
Numerical analysis and engineering problems	Recap on previous session and homework. 3.1 The coming two sessions will relate to the new topic of being able to analyse a periodic waveform using mathematical expressions such as: **Polynomial, Taylor series, Fourier Series, Fourier analysis.** Recap on the covered learning outcomes at the end of the session and hand out homework on the related topics, as a means of differentiation, allowing all levels to work at their own pace.	Books: Hughes, T., *Electrical and Electronic Technology*, 10th Edn 2008, Revised by J. Hiley, K. Brown, I. MacKenzie-Smith. Pearson Prentice Hall. ISBN 978-0-13-206011-0 Bird, J. *Basic Engineering Mathematics* 5th Edn, Newnes, ISBN:13: 978-1856176972
	Recap on previous session and homework. 3.2 Analyse basic waveform descriptions using orthogonal functions for: **square, triangular, saw-tooth, exponential, pulse waveforms** Recap on the covered learning outcomes at the end of the session and hand out homework on the related topics, as a means of differentiation, allowing all levels to work at their own pace.	

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Lesson 22 to 24: Mathematical expressions used in waveform **Suggested Teaching Time:** 3.5 hours/session

Learning Outcome: Understand mathematical expressions used in waveform descriptions

Topic	Suggested Teaching	Suggested Resources
Mathematical expressions in waveform descriptions	Recap on previous session and homework. 3.3 Analyse a random waveform using elements of probability theory in the form of **joint and conditional probabilities**, **the probability density function**, **the autocorrelation function** Recap on the covered learning outcomes at the end of the session and hand out homework on the related topics, as a means of differentiation, allowing all levels to work at their own pace.	**Books:** Hughes, T., *Electrical and Electronic Technology*, 10th Edn 2008, Revised by J. Hiley, K. Brown, I. MacKenzie-Smith. Pearson Prentice Hall. ISBN 978-0-13-206011-0 Bird, J. *Basic Engineering Mathematics* 5th Edn, Newnes, ISBN:13: 978-1856176972
	Recap on previous session and homework. 3.4 Analyse an aperiodic waveform using mathematical expressions such as: **Fourier series, the Fourier transform, the Laplace transform, the pole-zero description.** Recap on the covered learning outcomes at the end of the session and hand out homework on the related topics, as a means of differentiation, allowing all levels to work at their own pace.	

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Books:

Tooley, M and Dingle, L (2004).
Higher National Engineering. 2nd ed.
London: Newnes ISBN 0-750-66177-1

Croft, A., Davison, R., and Hargreaves, M. (1995).
Introduction to Engineering Mathematics.
Wokingham ISBN 0-201-62442-7

Also recommend:

Stroud, K. A., and Booth, D. J., (2009).
Foundation mathematics
Basingstoke: Palgrave Macmillan ISBN 9780230579071

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