M.Sc. in Mathematical Modelling and Scientific Computing

Reading List

September 2011

1 Core Courses

1.1 A1 Mathematical Methods

1. J. P. Keener, *Principles of Applied Mathematics: Transformation and Approximation* (revised edition, Perseus Books, Cambridge, Mass., 2000).
2. E. J. Hinch, *Perturbation Methods* (Cambridge University Press, Cambridge, 1991).
3. J. R. Ockendon, S. D. Howison, A. A. Lacey and A. B. Movchan, *Applied Partial Differential Equations* (revised edition, Oxford University Press, Oxford, 2003).
4. R. Haberman, *Mathematical Models* (SIAM, Philadelphia, 1998).
5. S. D. Howison, *Practical Applied Mathematics: Modelling, Analysis, Approximation* (Cambridge University Press, Cambridge, 2005).
6. F. B. Hildebrand, *Methods of Applied Mathematics* (2nd edition, Dover Publications, 1992).
7. L.M. Hocking, *Optimal Control: An Introduction to the Theory with Applications* (Oxford University Press, 1991).
8. D. W. Jordan and P. Smith, *Nonlinear Ordinary Differential Equations, An Introduction to Dynamical Systems* (4th Edition, Oxford University Press, 2007).
9. P. G. Drazin, *Nonlinear Systems* (Cambridge University Press, Cambridge, 1992).

1.2 A2 Applied Partial Differential Equations

1. M. Renardy and R. C. Rogers, *An Introduction to Partial Differential Equations* (Springer–Verlag, New York, 2004).
2. J. P. Keener, *Principles of Applied Mathematics: Transformation and Approximation* (revised edition, Perseus Books, Cambridge, Mass., 2000).
3. J. R. Ockendon, S. D. Howison, A. A. Lacey and A. B. Movchan, *Applied Partial Differential Equations* (revised edition, Oxford University Press, Oxford, 2003).

1.3 B1 Numerical Solution of Differential Equations

1. K. W. Morton and D. F. Mayers, *Numerical Solution of Partial Differential Equations* (Cambridge University Press, 1994). Chapters 2, 3 (Secs. 3.1, 3.2), Chapter 4 (Secs. 4.1–4.6), Chapter 5.

2. E. Süli and D. Mayers, *An Introduction to Numerical Analysis* (Cambridge University Press, 2003). Chapter 12.

3. A. Iserles, *A First Course in the Numerical Analysis of Differential Equations* (Cambridge University Press, 1996). Chapters 1–5, 13, 14.

1.4 B1 & B2 Numerical Linear Algebra

1. L. N. Trefethen and D. Bau III, *Numerical Linear Algebra* (SIAM, 1997).

2. J. W. Demmel, *Applied Numerical Linear Algebra* (SIAM, 1997).

3. A. Greenbaum, *Iterative Methods for Solving Linear Systems* (SIAM, 1997).

4. G. H. Golub and C. F. van Loan, *Matrix Computations* (John Hopkins University Press, 3rd edition, 1996).

5. H. C. Elman, D. J. Silvester and A. J. Wathen, *Finite Elements and Fast Iterative Solvers* (Oxford University Press, 1995). Only Chapter 2.

1.5 B2 Finite Element Methods for Partial Differential Equations

1. S. C. Brenner and L. R. Scott, *The Mathematical Theory of Finite Element Methods* (Springer, 2nd edition, 2002). Chapters 0–3, Chapter 4 (Secs. 4.1–4.4), Chapter 5 (Secs. 5.1–5.7).

2. H. C. Elman, D. J. Silvester and A. J. Wathen, *Finite Elements and Fast Iterative Solvers* (Oxford University Press, 2005). Mainly Chapters 1 and 5.

3. C. Johnson, *Numerical Solution of Partial Differential Equations by the Finite Element Method* (Cambridge University Press, 1990). Chapters 1–4, Chapter 8 (Secs. 8.1–8.4.2), Chapter 9 (Secs. 9.1–9.5).

4. E. Süli and D. Mayers, *An Introduction to Numerical Analysis* (Cambridge University Press, 2003). Chapters 11 and 14 (for some introductory material).

2 Special Topics

2.1 Dynamics and Energy Minimisation

1. F. Verhulst, *Nonlinear differential equations and dynamical systems* (2nd Edition, Springer, 1996).

2. D. W. Jordan and P. Smith, *Nonlinear Ordinary Differential Equations, An Introduction to Dynamical Systems* (4th Edition, Oxford University Press, 2007).

3. J. K. Hale and H. Kocak, *Dynamics and Bifurcations* (Springer, 1991).

4. G. Buttazzo, M. Giaquinta, and S. Hildebrandt, *One-dimensional Variational Problems* (Oxford Lecture Series in Mathematics, Vol. 15, Oxford University Press, 1998).

5. U. Brechtken-Manderscheid, *Introduction to the Calculus of Variations* (Chapman and Hall, 1991).

6. H. Sagan, *Introduction to the Calculus of Variations* (Dover, 1992).

7. J. C. Robinson, *Infnite-Dimensional Dynamical Systems: An Introduction to Dissipative Parabolic PDEs and the Theory of Global Attractors*, (Cambridge Texts in Applied Mathematics, Cambridge University Press, 2001).

2.2 Mathematical Ecology and Biology

1. J. D. Murray, *Mathematical Biology, Volume I: An Introduction* (3rd edition, Springer, 2002).

2. J. D. Murray, *Mathematical Biology, Volume II: Spatial Models and Biomedical Applications* (3rd edition, Springer, 2003).

3. J. Keener and J. Sneyd, *Mathematical Physiology* (1st edition, Springer, Berlin, 1998).

4. N. F . Britton, *Essential Mathematical Biology* (Springer, London, 2003).

2.3 Mathematical Geoscience

1. A. C. Fowler, *Mathematical Geoscience* (Springer, 2011).

2. K. Richards, *Rivers* (Methuen, 1982).

3. G. B. Whitham, *Linear and Nonlinear Waves* (Wiley, New York, 1974).

4. W. S. B. Paterson, *The Physics of Glaciers* (3rd edition, Pergamon Press, 1994).

5. J. T. Houghton, *The Physics of Atmospheres* (3rd edition, Cambridge University Press, Cambridge, 2002).

2.4 Perturbation Methods

1. E. J. Hinch, *Perturbation Methods* (Cambridge University Press, 1991). Chapters 1–3, 5–7.

2. C. M. Bender and S. A. Orszag, *Advanced Mathematical Methods for Scientists and Engineers* (Springer, 1999). Chapters 6, 7, 9–11.

3. J. Kevorkian and J. D. Cole, *Perturbation Methods in Applied Mathematics* (Springer–Verlag, 1981). Chapters 1, 2.1–2.5, 3.1, 3.2, 3.6, 4.1, 5.2.

2.5 Solid Mechanics

1. O. Gonzales and A. Stuart, *A First Course in Continuum Mechanics* (Cambridge University Press, 2008).
2. M. E. Gurtin, *An Introduction to Continuum Mechanics* (Academic Press, 1981).
3. P. G. Ciarlet, *Mathematical Elasticity, Vol I Three-dimensional Elasticity* (North–Holland, 1988).
4. S. S. Antman, *Nonlinear Problems of Elasticity,* (Springer, 1995).
5. J. E. Marsden and T. J. R. Hughes, *Mathematical Foundations of Elasticity* (Prentice–Hall, 1983).

2.6 Statistical Mechanics

1. D. Chandler, *Introduction to Modern Statistical Mechanics* (Oxford University Press, 1987).
2. M. Kardar, *Statistical Physics of Particles* (Cambridge University Press, 2007).
3. M. Kardar, *Statistical Physics of Fields* (Cambridge University Press, 2007).
4. F. Schwabl, *Statistical Mechanics* (Springer-Verlag, 2002).
5. J. P. Sethna, *Entropy, Order Parameters, and Complexity* (Oxford University Press, 2006).

2.7 Stochastic Differential Equations

1. B. Øksendal, *Stochastic Differential Equations: An introduction with applications* (Universitext, Springer, 6th edition, 2003). Chapters II, III, IV, V, part of VI, VIII (F).
2. F. C. Klebaner, *Introduction to Stochastic Calculus with Applications* (Imperial College Press, 1998, second edition 2005). Sections 3.1–3.5, 3.9, 3.12, Chapters 4, 5, 11.
3. H. P. McKean, *Stochastic Integrals* (Academic Press, New York and London, 1969).
4. N. Ikeda and S. Watanabe, *Stochastic Differential Equations and Diffusion Processes* (North-Holland Publishing Company, 1989).
5. I. Karatzas and S. E. Shreve, *Brownian Motion and Stochastic Calculus,* Graduate Texts in Mathematics 113 (Springer-Verlag, 1988).

6. L. C. G. Rogers and D. Williams, *Diffusions, Markov Processes and Martingales Vol1 (Foundations) and Vol 2 (Itô Calculus)* (Cambridge University Press, 1987 and 1994).

2.8 Topics in Fluid Mechanics

1. J. S. Turner, *Buoyancy Effects in Fluids* (Cambridge University Press, Cambridge, 1973).
2. A. E. Gill, *Atmosphere-Ocean Dynamics* (Academic Press, San Diego, 1982).
3. J. Pedlosky, *Geophysical Fluid Dynamics* (Springer-Verlag, Berlin, 1979).
4. D. A. Drew and S. L. Passman, *Theory of Multicomponent Fluids* (Springer-Verlag, Berlin, 1999).
5. L. G. Leal, *Advanced Transport Phenomena* (Cambridge University Press, Cambridge, 2007).
6. D. Weaire and S. Hutzler, *The Physics of Foams* (Oxford University Press, Oxford, 1999).
7. G. K. Batchelor, H. K. Moffatt and M. G. Worster (eds.), *Perspectives in Fluid Dynamics* (Cambridge University Press, Cambridge, 2000).

2.9 Viscous Flow

1. D. J. Acheson, *Elementary Fluid Dynamics* (Oxford University Press, 1990). Chapters 2, 6, 7, 8.
2. H. Ockendon and J. R. Ockendon, *Viscous Flow* (Cambridge Texts in Applied Mathematics, 1995).
3. G. K. Batchelor, *An Introduction to Fluid Dynamics* (Cambridge University Press, Cambridge, 2000).
4. C. C. Lin and L. A. Segel, *Mathematics Applied to Deterministic Problems in Natural Sciences* (Society of Industrial and Applied Mathematics, 1998).
5. L. A. Segel, *Mathematics Applied to Continuum Mechancis* (Society for Industrial and Applied Mathematics, 2007).

2.10 Applied Complex Variables

1. G. F. Carrier, M. Krook and C. E. Pearson, *Functions of a Complex Variable* (Society for Industrial and Applied Mathematics, 2005).
2. M. J. Ablowitz and A. S. Fokas, *Complex Variables: Introduction and Applications* (2nd edition, Cambridge University Press, Cambridge, 2003).

3. J. R. Ockendon, S. D. Howison, A. A. Lacey and A. B. Movchan, *Applied Partial Differential Equations* (Oxford University Press, Oxford, 1999) Pages 195–212.

2.11 Approximation of Functions

1. L. N. Trefethen, *Approximation Theory and Approximation Practice* (copies will be supplied by the lecturer).

2.12 Continuous Optimization

1. J. Nocedal and S. J. Wright, *Numerical Optimisation* (Springer, 1999).

2.13 Elasticity and Plasticity

1. R. Ogden, *Nonlinear Elastic Deformations* (Dover, 1984).
2. S. S. Antman, *Nonlinear Problems of Elasticity* (Springer, 2005).
3. R. M. Hill, *Mathematical Theory of Plasticity* (Oxford Clarendon Press, 1998).
4. A. E. H. Love, *Treatise on the Mathematical Theory of Elasticity* (Dover, 1944).
5. L. D. Landau and E. M. Lifshitz, *Theory of Elasticity* (Pergamon Press, 1986).

2.14 Mathematical Methods for Signal Processing

1. A. V. Oppenheim and R. W. Schafer, *Digital Signal Processing* (Prentice Hall, 1975).
2. Z.-P. Liang, Paul C. Lauterbur, *Principles of MRI: A Signal Processing Perspective* (SPIE Press, 2000).

2.15 Mathematical Models of Financial Derivatives

1. T. Bjork, *Arbitrage Theory in Continuous Time* (Oxford University Press, 1998).
2. P. Wilmott, S. D. Howison and J. Dewynne, *Mathematics of Financial Derivatives* (Cambridge University Press, 1995).
3. A. Etheridge, *A Course in Financial Calculus* (Cambridge University Press, 2002).
4. S. E. Shreve, *Stochastic Calculus for Finance* (Volumes I and II, Springer, 2004).
5. J. Hull, *Options Futures and Other Financial Derivative Products* (4th edition, Prentice Hall, 2001).

2.16 Mathematical Physiology

1. J. Keener and J. Sneyd, *Mathematical Physiology* (Springer–Verlag, 1998).

2. J. D. Murray, *Mathematical Biology* (Springer–Verlag, 2nd edition, 1993 or 3rd editions, Volumes I and II, 2003).

3. L. A. Segel, *Modeling Dynamic Phenomena in Molecular and Cellular Biology* (Cambridge University Press, 1984).

4. L. Glass and M. C. Mackey, *From Clocks to Chaos* (Princeton University Press, 1988).

5. P. Grindrod, *Patterns and Waves* (Oxford University Press, 1991).

6. R. M. Berne and M. N. Levy, *Principles of Physiology* (2nd edition, Mosby, St. Louis, 1996).

7. J. R. Levick, *An Introduction to Cardiovascular Physiology* (3rd edition, Butterworth–Heinemann, Oxford, 2000).

8. A. C. Guyton and J. E. Hall, *Textbook of Medical Physiology* (10th edition, W. B. Saunders Co., Philadelphia, 2000).

2.17 Nonlinear Systems

1. S. H. Strogatz, *Nonlinear Dynamics and Chaos with Applications to Physics, Biology, Chemistry and Engineering* (Westview Press, 2000).

2. E. Ott, *Chaos in Dynamical Systems* (2nd edition, Cambridge University Press, Cambridge, 2002).

3. P. Cvitanović, R. Artuso, R. Mainieri, G. Tanner, G. Vattay, N. Whelan and A. Wirzba, *Chaos: Classical and Quantum* (Niels Bohr Institute, Copenhagen, 2008).

4. J. Guckenheimer and P. Holmes, *Nonlinear Oscillations, Dynamical Systems, and Bifurcation of Vector Fields* (Springer-Verlag, 1983).

5. G. L. Baker and J. P. Gollub, *Chaotic Dynamics: An Introduction* (Second edition, Cambridge University Press, Cambridge, 1996).

6. P. G. Drazin, *Nonlinear Systems* (Cambridge University Press, Cambridge, 1992).

7. S. Wiggins, *Introduction to Applied Nonlinear Dynamical Systems and Chaos* (Second edition, Springer, 2003).

2.18 Numerical Solution of Differential Equations II

1. A. Iserles, *A First Course in the Numerical Analysis of Differential Equations* (Cambridge University Press, 1996). Chapters 7, 10 and 11.

2. K. W. Morton and D. F. Mayers, *Numerical Solution of Partial Differential Equations* (2nd edition Cambridge University Press, 2005). Chapters 6 and 7.

3. G. D. Smith, *Numerical Solution of Partial Differential Equations: Finite Difference Methods* (Clarendon Press, Oxford, 1985). Chapter 5.

2.19 Waves and Compressible Flow

1. H. Ockendon and J. R. Ockendon, *Waves and Compressible Flow* (Springer, 2004).

2. J. R. Ockendon, S. D. Howison, A. A. Lacey and A. B. Movchan, *Applied Partial Differential Equations* (revised edition, Oxford University Press, Oxford, 2003). Sections 2.5, 4.5–7.

3. D. J. Acheson, *Elementary Fluid Dynamics* (Oxford University Press, 1990). Chapter 3.

4. J. Billingham and A. C. King, *Wave Motion* (Cambridge University Press, 2000). Chapters 1–4, 7 and 8.

5. M. J. Lighthill, *Waves in Fluids* (Cambridge University Press, 1978).

6. G. B. Whitham, *Linear and Nonlinear Waves* (Wiley, 1973).

2.20 Mathematics for Simulation

1. J. P. Kaipio and E. Somersalo, *Statistical and Computational Inverse Problems* (Springer, Berlin, 2004).

2. S. M. LaValle, *Planning Algorithms* (Cambridge University Press, 2006).

2.21 Spectral Methods for ODEs and PDEs

1. L. N. Trefethen, *Spectral Methods in Matlab* (SIAM, 2000).