The University of Southern Queensland

Course specification

This version produced 7 Jul 2008.
The current and official versions of the course specifications are available on the web at <http://www.usq.edu.au/coursespecification/current>.
Please consult the web for updates that may occur during the year.

Description: Chaos

Subject	Cat-nbr	Class	Term	Mode	Units	Campus
MAT	8102	67363	2, 2007	ONC	1.00	Toowoomba

Academic group: FOSCI
Academic org: FOS003
Student contribution band: 2
ASCED code: 010101

STAFFING

Moderator: Harry Butler

REQUISITES

Pre-requisite: MAT2100 and MAT3103

OTHER REQUISITES

Recommended prior study: MAT3105 and STA2300 and CSC2409

RATIONALE

Dynamical systems describe how any system of interest evolves in time. Nonlinear dynamics generally give rise to chaos. A modern understanding and appreciation of chaos is essential for all scientists in any field of endeavour which seeks to understand and quantify evolution.

SYNOPSIS

Contact the Examiner to study this course by distance education. This course introduces concepts, analysis and appearances of chaos in dynamical systems, both theoretically and in applications. The approach is in the context of modern dynamical systems theory and relies mainly upon geometrical intuition rather than algebraic virtuosity. Starting from a classical view of dynamics, the course discusses strange attractors, the analysis of chaotic data series, and the period doubling and intermittent routes to chaos. This course is normally offered only in odd years.

OBJECTIVES

On completion of this course students will be able to:

1. appreciate the classic view of nonlinear dynamics (All assessment items);
2. demonstrate an understanding of the generic features of chaos and strange attractors in continuous time dynamical systems, and in discrete maps (All assessment items);
3. analyse an experimental data series for signs of chaos, and to compute some quantifiable characteristics (All assessment items);

4. demonstrate an understanding of some of the finer features of chaotic dynamics through analysis of the period doubling and intermittent routes to chaos (All assessment items).

TOPICS

	Description	Weighting (%)
1.	Order: state space, equilibria, oscillations, quasi-periodic dynamics, Fourier transforms	20.00
2.	Strange attractors: stretching and folding, Lyapunov exponents, 1D return maps, fractal microstructure	20.00
3.	Data analysis: state space reconstruction, inverse problem, chaotic prediction, noise	20.00
4.	Subharmonic cascade: return maps, period doubling, inverse cascade, renormalisation, universality	20.00
5.	Intermittency: bursts and laminar phases, 1/f noise, renormalisation	20.00

TEXT and MATERIALS required to be PURCHASED or ACCESSED

ALL textbooks and materials are available for purchase from USQ BOOKSHOP (unless otherwise stated). Orders may be placed via secure internet, free fax 1800642453, phone 07 46312742 (within Australia), or mail. Overseas students should fax +61 7 46311743, or phone +61 7 46312742. For costs, further details, and internet ordering, use the 'Textbook Search' facility at http://bookshop.usq.edu.au click 'Semester', then enter your 'Course Code' (no spaces).

Students will require access to computer facilities for simulations.
(Students will require access to computer facilities for simulations.)

REFERENCE MATERIALS

Reference materials are materials that, if accessed by students, may improve their knowledge and understanding of the material in the course and enrich their learning experience.

Electronic resources for this course may be available via its home page
http://www.sci.usq.edu.au/courses/mat8102
(Electronic resources for this course may be available via its home page
http://www.sci.usq.edu.au/courses/mat8102)

Abraham, RH & Shaw, CD 1992, *Dynamics, The Geometry of Behaviour*, Addison Wesley, Redwood City.

(Part 1, Periodic Behaviour; Part 2, Chaotic Behaviour; Part 3, Global Behaviour; Part 4, Bifurcation Behaviour)

Baker, GL & Gollub, JP 1996, *Chaotic Dynamics: An Introduction*, 2nd edn, Cambridge University Press, Cambridge.

Berge, P, Pomeau, Y & Vidal, C 1984, *Order Within Chaos: Towards a Deterministic Approach to Turbulence*, Wiley, New York.

Buhmann, MD 2000, Radial basis functions, *Acta Numerica*, Vol 9, no. , pp1-38.

Ford, J 1989, Chapter 12 in The New Physics, *What is Chaos, That We Should Be Mindful of It?*, P Davies, Cambridge University Press, Cambridge.

Gleick, J 1988, *Chaos: Making of A New Science*, Penguin, New York.

Hall, N 1992, *New Scientist Guide to Chaos*, Penguin, London.

Nicolis, G 1989, Chapter 11 in The New Physics, *Physics of Fair-From-Equilibrium Systems and Self Organisation*, P Davies, Cambridge University Press, Cambridge.

Ruelle, D 1993, *Chance and Chaos*, Penguin, London.

Ruelle, D 1989, *Chaotic Evolution and Strange Attractors: The statistical analysis of time series for deterministic nonlinear systems*, Cambridge University Press, Cambridge.

Schroeder, M 1990, *Fractals, Chaos, Power Laws: Minutes From An Infinite Paradise*, Freeman, New York.

Schuster, HG 1995, *Deterministic Chaos, An Introduction*, 3rd edn, Physik-Verlag, Weinheim.

Stewart, I 1987, Chapters 13-16, *The Problems of Mathematics*, Oxford University Press, New York.

STUDENT WORKLOAD REQUIREMENTS

ACTIVITY	HOURS
Assessment	43.00
Consultation	7.00
Directed Study	115.00

ASSESSMENT DETAILS

Description	Marks out of	Wtg(%)	Due date
ORDER	20.00	10.00	10 Aug 2006
STRANGE ATTRACTORS	20.00	10.00	24 Aug 2006
DATA ANALYSIS	20.00	10.00	14 Sep 2006
SUBHARMONIC CASCADE	20.00	10.00	19 Oct 2006
SUMMARY ASSESSMENT	100.00	60.00	16 Nov 2006

IMPORTANT ASSESSMENT INFORMATION

1 Attendance requirements:
It is the students' responsibility to attend and participate appropriately in all activities (such as lectures, tutorials, laboratories and practical work) scheduled for them, and to study all material provided to them or required to be accessed by them to maximise their chance of meeting the objectives of the course and to be informed of course-related activities and administration.

2 Requirements for students to complete each assessment item satisfactorily:
To complete each of the assessment items satisfactorily, students must obtain at least 50% of the marks available for each assessment item.

3 Penalties for late submission of required work:

If students submit assignments after the due date without prior approval then a penalty of 20% of the total marks available for the assignment will apply for each working day late.

4 Requirements for student to be awarded a passing grade in the course:
To be assured of receiving a passing grade a student must achieve at least 50% of the total weighted marks available for the course.

5 Method used to combine assessment results to attain final grade:
The final grades for students will be assigned on the basis of the weighted aggregate of the marks obtained for each of the summative assessment items in the course.

6 Examination information:
There is no examination in this course.

7 Examination period when Deferred/Supplementary examinations will be held:
As there are no examinations in this course, there will be no deferred or supplementary examinations.

8 University Regulations:
Students should read USQ Regulations 5.1 Definitions, 5.6. Assessment, and 5.10 Academic Misconduct for further information and to avoid actions which might contravene University Regulations. These regulations can be found at the URL http://www.usq.edu.au/corporateservices/calendar/part5.htm or in the current USQ Handbook.

ASSESSMENT NOTES

9 The due date for an assignment is the date by which a student must despatch the assignment to the USQ. The onus is on the student to provide proof of the despatch date, if requested by the Examiner.

10 Students may be required to provide a copy of assignments submitted for assessment purposes. Such copies should be despatched to the USQ within 24 hours of receipt of a request to do so.

OTHER REQUIREMENTS

1 Students will require access to e-mail and internet access to USQConnect for this course.
