Xi'an Jiaotong-Liverpool University
西交利物浦大学

School of Artificial Intelligence and Advanced Computing

MODULE HANDBOOK

DTS104TC
Numerical Methods

Module Leader: Long Huang

Second Part of Semester 2

2020-2021

SECTION A: Basic Information

- **Brief Introduction to the Module**

The module aims to provide an understanding of the basis of numerical computation and its connection to other subjects. It also enables students to use numerical methods in solving mathematical problems. The emphasis is to equip students with the knowledge to obtain numerical solutions to mathematical problems that otherwise may not be solved analytically. This module is to provide students with a solid foundation of knowledge for their future practical work in Big Data area.

- **Key Module Information**

Module name: Numerical Methods

Module code: DTS104TC

Credit value: 2.5

Semester in which the module is taught: Second Part of Semester 2, 2020-2021

Pre-requisites needed for the module: NA

Programmes on which the module is shared: BEng Data Science and Big Data Technology with Contemporary Entrepreneurialism

- **Delivery Schedule (subject to changes of timetable setting from Registry)**

Lectures	
Time (Week 8 – Week 12)	**Teaching mode: onsite/online**
Mon. 4-6 pm	**Mon. SC169 / Wed. SB102**
Wed. 9-11 am	**https://learningmall.xjtlu.edu.cn/course/view.php?id=1389**
Tutorial	
Time (Week 8 – Week 13)	**Teaching mode: onsite/online**
Thu. 11-1 pm for Class Group 1/D1	**BS394**
Thu. 2-4 pm for Class Group 2/D1	**BS394**
Fri. 2-4 pm for Class Group 3/D1	**BS2114 https://learningmall.xjtlu.edu.cn/course/view.php?id=1389**
Seminar	

Time (Week 14)	Teaching mode: online/onsite
Thu. 11-1 pm for Class Group 1/D1	**BS492**
Thu. 4-6 pm for Class Group 2/D1	**PB202**
Fri. 9-11 am for Class Group 3/D1	**MB119 https://learningmall.xjtlu.edu.cn/course/view.php?id=1389**

- **Module Leader and Contact Details**

Name: Dr. Long Huang

Brief Biography: Dr. Long Huang received his bachelor degree in Automation from Zhengzhou University of Light Industry in 2010. He earned his Ph.D. degree in Mechanical Engineering from The University of Maryland, College Park in 2014. Between 2014 and 2017, he was a senior consultant at Navigant Consulting Inc.'s Washington, D.C. office, working with The U.S. Department of Energy (DOE) on energy conservation rulemakings and testing procedure revisions. Prior to joining Xi'an Jiaotong-Liverpool University, he led the advanced thermo-fluid simulation team at Daikin Industries Ltd. in Osaka, Japan from 2017 to 2020. Currently, serving as a lecturer in School of Intelligent Manufacturing Ecosystem, his research focuses span from detailed heat transfer and fluid flow numerical modelling, thermo-fluid systems simulation and optimization, to developing and applying Cyber Physical Systems in various industrial applications.

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Preferred means of contact: E-mail

Teaching Assistant: Yue Wang

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SECTION B: What you can expect from the module

❑ Educational Aims of the Module

The module aims to provide an understanding of the basis of numerical computation and its connection to other subjects. It also enables students to use numerical methods in solving mathematical problems.

❑ Learning Outcomes

A. Apply numerical methods in a number of different contexts.
B. Solve systems of linear and nonlinear algebraic equations to specified precision.
C. Compute eigenvalues and eigenvectors by the power method.
D. Solve boundary value and initial problems to finite precision.
E. Develop quadrature methods for numerical integration.

❑ Assessment Details

There will be two components of assessments:

Initial Assessment

Sequence	**Method**	**Assessment Type (EXAM or CW)[2]**	**Learning outcomes assessed** *(use codes under Learning Outcomes)*	**% of Final Mark**	**Resit(Y/N/S)[3]**
001	Assignment	CW	A, B, C, D, E	80	S
002	Assignment	CW	A, B, E	20	S

- Coursework assignment 1 (80%): submission deadline 10th June 2021, 5pm.
- Coursework assignment 2 (20%): submission deadline 2nd June 2021, 5pm.

Resit Assessment

Sequence	**Assessment Type (EXAM or CW)**	**Learning outcomes assessed** *(use codes under Learning Outcomes)*	**% of Final Mark**
R001	CW	A, B, C, D, E	100

The resit assessment [exam] will assess all of the learning outcomes of the module, and will be weighted as 100% of the final module mark. Other components of the assessment, regardless of whether or not the student passed or failed, will not be included in the calculation of the final module mark, following resit assessment.

❑ Methods of Learning and Teaching

The teaching philosophy of the module follows very much the philosophy of Syntegrative Education. This has meant that the teaching delivery pattern, which follows more intensive block teaching, allows more meaningful contribution from industry partners. This philosophy is carried through also in terms of assessment, with reduction on the use of exams and increase in coursework, especially problem-based assessments that are project focused. The delivery pattern provides space in the semester for students to concentrate on completing the assessments.
This module will be delivered by a combination of formal lectures, seminars and tutorials.

❑ Syllabus & Teaching Plan

Syllabus:
In this module, we study the following numerical methods and how they may be applied in different contexts:

(a) Solution of non-linear equations in one variable and multi-variables, Newton-Raphson, Jacobian Matrix and error behaviour and its consequences.
(b) Norms, Spectral Radius, Gauss elimination and LU factorization for solving systems of equations. Partial pivoting.
(c) Iterative methods (Gauss Seidel, Jacobi, SOR), convergence of linear iterative methods.
(d) The eigenvalue problem: the power method and inverse power method
(e) Ordinary and partial differential equations, multi-step methods, finite difference methods.
(f) Lagrange interpolation and quadrature methods: trapezoidal rule, Simpson's rule, Gaussian quadrature; numerical solution of initial value problems and Fredholm integral equations.

The emphasis is to equip students with the knowledge to obtain numerical solutions to mathematical problems that otherwise may not be solved analytically

Teaching Plan:
Lecture Schedule

Week Number and/or Date	**Lecture/Seminar/ Field Trip/Other**	**Topic/Theme/Title**
Week 8 Monday	Lecture 1	Solution of non-linear equations
Week 8 Wednesday	Lecture 2	Solving systems of equations
Week 9 Monday	Lecture 3	Iterative methods

Week 9 Wednesday	Lecture 4	Convergence of linear iterative methods.
Week 10 Monday	Lecture 5	The power method
Week 10 Wednesday	Lecture 6	Inverse power method
Week 11 Monday	Lecture 7	Ordinary differential equations
Week 11 Wednesday	Lecture 8	Partial differential equations
Week 12 Monday	Lecture 9	Lagrange interpolation and quadrature methods
Week 12 Wednesday	Lecture 10	Initial value problems

Tutorial Schedule

Week **Number and/or Date**	Tutorial	Topic/Theme/Title
Week 8	Tutorial 1	Syllabus(a)
Week 9	Tutorial 2	Syllabus(b)
Week 10	Tutorial 3	Syllabus(c)
Week 11	Tutorial 4	Syllabus(d)
Week 12	Tutorial 5	Syllabus(e)
Week 13	Tutorial 6	Syllabus(f)

- **Seminar Schedule**

Week **Number and/or Date**	**Topic/Theme/Title**	**Lecturer/Instructor**
Week 14 for all groups	Question and Answer Session	Long Huang

- **Reading Materials**

No mandatory textbooks for this module.

The following books are recommended as reference textbooks.

Title	Author	ISBN/Publisher
NUMERICAL ANALYSIS., 3RD EDITION	TIMOTHY SAUER	9780134697321 /PEARSON
AN INTRODUCTION TO NUMERICAL ANALYSIS 1ST EDITION	ENDRE SULI	978-052100794 /CAMBRIDGE UNIVERSITY
NUMERICAL METHODS FOR ENGINEERS	STEVEN C. CHAPRA, RAYMOND P. CANALE	9780073397924 /MCGRAW-HILL
NUMERICAL METHODS FOR ENGINEERS AND SCIENTISTS	J.N. SHARMA	9781842653654 /ALPHA SCIENCE
MATLAB: A PRACTICAL INTRODUCTION TO PROGRAMMING AND PROBLEM SOLVING	ATTAWAY, STORMY	9780124058767 /BUTTERWORTH-HEINEMANN

NUMERICAL METHODS USING MATLAB	GEOGRE LINDFIELD and JOHN PENNY	9780123869425

SECTION C: Additional Information

- **Student Attendance**

  Students who are able to be on campus are reminded of the Academic Policy requiring no less than 80% attendance at classes. Failure to observe this requirement may lead to failure or exclusion from resit or retake examinations.

- **Student Feedback**

  The University is keen to elicit student feedback to make improvements for each module in every session. It is the University policy that the preferred way of achieving this is by means of an Online Module Evaluation Questionnaire Survey. Students will be invited to complete the questionnaire survey for this module at the end of the semester.

  You are strongly advised to read the policies mentioned below very carefully, which will help you better perform in your academic studies. All the policies and regulations related to your academic study can be found in 'Student Academic Services' section under the heading "Policies and Regulations" on E-bridge.

- **Plagiarism, Cheating, and Fabrication of Data.**

  Offences of this type can result in attendance at a University-level committee and penalties being imposed. You need to be familiar with the rules. Please see the "Academic Integrity Policy" available on e-Bridge in the 'Student Academic Services' section under the heading 'Policies and Regulations'.

- **Rules of submission for assessed coursework**

  The University has detailed rules and procedures governing the submission of assessed coursework. You need to be familiar with them. Details can be found in the "Code of Practice for Assessment" available on e-Bridge in the 'Student Academic Services' section under the heading 'Policies and Regulations'.

- **Late Submission of Assessed Coursework**

  The University attaches penalties to the late submission of assessed coursework. You need to be familiar with the University's rules. Details can be found in the "Code of Practice for Assessment" available on e-Bridge in the 'Student Academic Services' section under the heading 'Policies and Regulations'.

- **Mitigating Circumstances**

  The University is able to take into account mitigating circumstances, such as illness or personal circumstances which may have adversely affected student performance on a module. It is the student's responsibility to keep their Academic Advisor, Programme Director, or Dean of School informed of illness and other factors affecting their progress during the year and especially during the examination period. Students who believe that their performance on an examination or assessed coursework may have been impaired by illness, or other exceptional circumstances should follow the procedures set out in the "Mitigating Circumstances Policy", which can be found on e-Bridge in the 'Student Academic Services' section under the heading 'Policies and Regulations'.

- **Learning Mall Online**

  Copies of lecture notes and other materials are available electronically through Learning Mall Online, the University's virtual learning environment at: Learning Mall @ XJTLU.