Module title:	Advanced mathematics 2
Module code:	24-14-704-01
Module credit:	3
Module objectives:	This course is presented for PhD students in mechanical engineering. This Advanced Mathematics course completes our suite of upper-secondary maths courses. It begins by teaching you important tips and common mistakes that students make when answering questions in math exams. You will study differential equations, kinematics, vector calculus, and dynamics. This course will also cover Perturbation's method, Monte Carlo's method, variations method for solving differential equations, and more. This course will also cover Newton's laws of motion, Lattice Boltzmann method for solving motion and energy equations.
Term:	Fall-September
Text:	S. J. Farlow, partial differential equations for scientists and engineers, new York, Wiley, 1982. A. H. Nayfeh, Perturbation Methods, 2004 WILEY-VCH Verlag GmbH & CO. KGaA, Weinheim. A. A. Mohamad, Lattice Boltzmann Method Fundamentals and Engineering Applications with Computer Codes, First Edition, Springer London Dordrecht Heidelberg New York,2011.

Instructor information:

Name: Dr. Samira Payan
Academic rank: Associate professor
Email address: s_payan_usb@eng.usb.ac.ir

Assessments: The students learning will be evaluated according to the below table:

Homework (paper report and Fortran codes report):	20%
Project (oral presentation):	20%
Final-term exam:	60%

References

[1] S. J. Farlow, *Partial Differential Equations for Scientists and Engineers*, new York, Wiley, 1982
[2] A. H. Nayfeh, *Perturbation Methods*, 2004 WILEY-VCH Verlag GmbH & CO. KGaA, Weinheim
[3] A. A. Mohamad, *Lattice Boltzmann Method Fundamentals and Engineering Applications with Computer Codes*, First Edition, Springer London Dordrecht Heidelberg New York,2011
[4] R. B. Bird, W. E. Stewart, E. N. Lightfoot,Transport Phenomena, Second Edition, 2001
[5] T. Kruger, H. Kusumaatmaja, R. A. Kuzmin, O. Shardt, G. Silva, E. M. Viggen, *The Lattice Boltzmann Method Principles and Practice*, Springer International Publishing Switzerland, 2017

Module subjects:

1st week: Diffusion type problems- boundary conditions for diffusion-type problems
2st week: Derivation of the heat equation
3st week: Separation of variables
4th week :Transforming nonhomogeneous BCs into homogeneous ones
5st week :Solving more complicated problems by separation of variables
6st week: Transforming hard equations to easier ones
7st week: Solving non-homogeneous PDEs
8st week: Integral Transforms (Sine and Cosine Transforms)
9stweek :The Fourier Transform and its application to PDEs
10st week: The Laplace Transform
11st week: Duhamel Principle
12st week: The convection term u_x in diffusion problems
13st week: Monte Carlo Methods(an Introduction)- Monte Carlo solutions of partial differential equations
14st week: Calculus variations- vibrational methods for solving PDEs(method of Ritz)
15st week: Perturbation methods for solution of PDEs
16st week: Lattice Boltzmann Method

Final-term exam