| | | | | | |
|---|---|---|---|---|---|
| Course Title | Differential Equations | | | | |
| Course Code | MAT210 | | | | |
| Course Type | Compulsory | | | | |
| Level | Bachelor (1st cycle ) | | | | |
| Year / Semester | 2nd Year / 4th Semester | | | | |
| Teacher's Name | TBA | | | | |
| ECTS | 6 | Lectures / week | 3 hours / 14 weeks | Laboratories / week | N/A |
| Course Purpose and Objectives | The purpose of the course is to provide the student the skills and working knowledge on differential equations. The student will appreciate the role of differential equations as tools for modeling and studying phenomena in fields like science, engineering, economics. The student will also develop the skills for solving a variety of linear and non-linear ordinary differential equations. | | | | |
| Learning Outcomes | Upon successful completion of this course students should be able to:<br>• Define what ordinary differential equations are and classify them.<br>• Solve a large variety of ordinary differential equations including linear differential equations (emphasis on first- and second-order linear), separable, homogeneous as well as differential equations reducible to the previous forms.<br>• Appraise the power of differential equations as tools for modelling and solving problems from the fields of Natural Sciences, Engineering as well as Economics.<br>• Identify the concept of a Laplace transform and use it to solve linear differential equations as well as systems of linear differential equations.<br>• Identify the concept of a Power Series and use it in solving Differential Equations.<br>• Define what partial differential equations are and solve them using characteristic lines or separation of variables. | | | | |
| Prerequisites | MAT200 | Co-requisites | None | | |
| Course Content | Introduction:<br>Definition of key terms: ordinary differential equations, order of a differential equation, explicit solution and implicit solution over an open interval, initial conditions, initial-value problem, linear differential equation, non-linear differential equation. | | | | |

| | |
|---|---|
| | First-Order Linear Differential Equations:<br>Solution using the method of integrating factors. Solution of differential equations reducible to first order linear ones by means of an appropriate substitution: Bernoulli's equation, Ricatti's equation, Higher-Order linear differential equations. Applications of First-Order Linear Differential Equations: Radio-carbon dating technique, population growth model, charging/discharging of a capacitor, logistic equation.<br><br>Separable Differential equations:<br>Solution and applications of separable differential equations: Speed of a chemical reaction, motion of a particle under a resistive force.<br><br>Homogeneous Differential equations:<br>Solution of homogeneous and equations reducible to homogeneous equations.<br><br>Second-Order Linear Differential Equations:<br>Basic theorems. Solution of homogeneous second-order linear differential equations with constant coefficients using the auxiliary equation. Applications: Simple Harmonic Motion (free, underdamped, critically damped, overdamped),<br><br>Current in an LCR circuit.<br><br>Solution of non-homogeneous second-order linear differential equations with constant coefficients with RHS being a polynomial, an exponential, of the form asinkx + bcoskx and a linear combination or product of the previous forms. Applications: Forced oscillations with emphasis on resonance.<br><br>Solution of homogeneous second order linear differential equations by the method of reduction of order when one solution is known. Solution of nonhomogeneous second order linear differential equations with constant coefficients by the method of variation of parameters.<br><br>Laplace Transforms:<br>Definition of the Laplace Transform and calculation in simple cases. Elementary Properties and Theorems of the Laplace Transform. Inverse Laplace Transforms and calculations of these using standard tables. Solution of Linear Differential Equations and simple systems of Linear Differential Equations using Laplace Transforms.<br><br>Series Solutions of Differential Equations: |

| | |
|---|---|
| | Power Series. Radius and interval of convergence. Taylor Series. Series solutions of linear differential equations about ordinary points and about regular singular points.<br><br>Partial Differential Equations:<br>First Order PDE in two variables. Solutions by using characteristic lines and by a change of variables. |
| Teaching Methodology | Face- to- face |
| Bibliography | Zill D., A FIRST COURSE IN DIFFERENTIAL EQUATIONS WITH MODELING APPLICATIONS, Brooks/Cole Cengage Learning<br><br>Nagle, K., Saff E., Snider A., FUNDAMENTALS OF DIFFERENTIAL EQUATIONS, Pearson<br><br>Simmons G., DIFFERENTIAL EQUATIONS WITH APPLICATIONS AND HISTORICAL NOTES, Chapman and Hall/CRC<br><br>Boyce W., DiPrima R., Meade D., ELEMENTARY DIFFERENTIAL EQUATIONS AND BOUNDARY VALUE PROBLEMS, Wiley<br><br>Butcher J., NUMERICAL METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS, Wiley |
| Assessment | Examinations 90%<br>Class Participation and Attendance 10%<br>100% |
| Language | English |