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| **Course Code: MAT1001** | | **Course Title: Calculus for Engineers** | **TPC** | 3 | 2 | 4 |
| **Version No.** | | **1.0** | | | | |
| **Course Pre-requisites/ Co-requisites** | | None | | | | |
| **Anti-requisites (if any).** | | MAT1008 | | | | |
| **Objectives:** | | 1. to enable students to use fundamental tools of mathematics in theoretical studies as well as in applied thematic exercises and in project based learning. 2. to apply modern computer software to enhance and support project based learning. 3. to develop essential analytical skills required for solving engineering problems. 4. to provide knowledge and appreciation of calculus, differential equations and Laplace transforms and optimize their use as tools in solving technical and applied physical problems in stream specific domains. 5. to use modern computer software effectively for simulation and mathematical modelling. | | | | |
| **Expected Outcome:** | | At the end of this course the students will be able   1. to evaluate multiple integrals in Cartesian, Cylindrical and Spherical geometries 2. to use Chain rules for partial differentiation, methods for finding maxima and minima and techniques of linearization 3. to apply Vector calculus in various subjects like Fluid Dynamics and Electromagnetic fields. 4. to solve ordinary differential equations relevant to engineering and physics 5. to construct mathematical modeling, analyze graphical visualization and interpret results through MATLAB. | | | | |
| **Module No. 1** | | **Differential Calculus** | **9 Hours** | | | |
| Introduction to single variable differential calculus.  Multivariable differential calculus:  Functions of two or more variables, Level curves; limits and continuity-partial derivatives-Chain Rules–Total differential; Jacobian, Taylor’s expansion for two variables-Linear Approximation and Increment estimation; Maxima, minima and saddle points, Constrained maxima and minima-Lagrange’s multiplier method, Differentiation of integrals containing a parameter-Leibnitz's rule. | | | | | | |
| **Module No. 2** | | **Integral Calculus** | **9 Hours** | | | |
| Introduction to single variable integral calculus.  Multivariable integral calculus:  Evaluation of double integrals–change of order of integration– change of variables between Cartesian and polar co-ordinates- evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical polar co-ordinates; beta and gamma functions–interrelation-evaluation of integrals using gamma and beta functions; error function-properties. | | | | | | |
| **Module No. 3** | **Vector Calculus** | | **9 Hours** | | | |
| Scalar and vector point functions - Vector Differentiation- expressions for velocity and acceleration in cylindrical geometry. Gradient–physical interpretation-total derivative–directional derivative; Divergence and Curl - physical interpretations-Statement of vector identities - scalar and vector potentials-line, surface and volume integrals- Statement of Green’s, Stoke’s and Gauss divergence theorems - verification and evaluation of vector integrals using them. | | | | | | |
| **Module No. 4** | | **Ordinary Differential Equations & Applications** | **10 Hours** | | | |
| Introduction to first order ordinary differential equation, Linear higher order ordinary differential equation with constant coefficients– solutions of homogenous and non-homogenous equations- Method of undetermined coefficients-–method of variation of parameters – equations reducible to linear equations with constant coefficients. | | | | | | |
| **Module No. 5** | | **Laplace Transforms** | **8 Hours** | | | |
| Definition-Laplace transforms of functions-properties of Laplace transforms - initial and final values theorems - inverse transforms-transforms of periodic functions - convolution theorem - step functions, impulse functions - the solution of differential equations, concept of Transfer function. | | | | | | |
| **Text Book**   1. George B. Thomas, D.Weir and J.Hass (2013), Thomas’ Calculus, 13h edition, Pearson. | | | | | | |
| **References**   1. Gilbert Strang (2010), Calculus, 2nd Edition, Wellesley-Cambridge Press. 2. Dennis G Zill and Warren S Wright (2011), Multivariable Calculus, 4th Edition, Jones and Bartlett Publishers. 3. Erwin Kreyszig (2017), Advanced Engineering Mathematics, 10th Edition, John Wiley. 4. Glyn James (2016), Advanced Modern Engineering Mathematics, 4th Edition, Pearson. 5. B. S. Grewal (2017), Higher Engineering Mathematics by, 44th Edition, Khanna Publishers. 6. Rudra Pratap (2016), Getting started with MATLAB:A quick introduction for scientists and Engineers, 7th Edition, Oxford University Press. | | | | | | |
| **Related Applications** | | | | | | |
| 1. Distance, Velocity, Acceleration of moving object 2. Area under a curve 3. Arc length and area of Surface of revolution 4. Volume of surface of revolution 5. Maxima and minima 6. Area, surface, volume 7. Moment of inertia and center of mass 8. Work done 9. Flux and curl for velocity field 10. Newton's law of cooling 11. Radioactive Decay 12. Motion of a particle in a resisting medium 13. Mass - spring system 14. LCR circuits 15. Solution of differential equation using Laplace transform technique etc. | | | | | | |
| **Laboratory exercises using MATLAB** | | | | | | |
| Understanding of the concepts through mathematics lab - 10 experiments  1 Introduction to MATLAB through matrices   1. Plotting and visualizing functions, rates of change of functions / tangent line 2. Understanding integration as area under the curve 3. Evaluating extremum of a single variable function 4. Plotting of surfaces and visualizing tangent planes 5. Evaluating maxima and minima of function of several variables 6. Applying Lagrange Multiplier Method 7. Evaluating volume under surfaces 8. Evaluating triple integrals 9. Evaluating integrals using cylindrical and spherical coordinates and their visualization 10. Evaluating gradient, curl and divergence 11. Evaluating line integrals 12. Applying Green’s, Stoke’s and Gauss divergence 13. Evaluating Laplace transforms 14. Solution of differential equations etc. | | | | | | |
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| **Mode of Evaluation** | | Continuous Assessment (Quizzes, CATs, Assignments etc.).   |  |  |  | | --- | --- | --- | | CAT-1 | Weightage (in %) | 20 | | CAT-2 | Weightage (in %) | 20 | | CAT-3 | Weightage (in %) | 20 | | Lab | Weightage (in %) | 25 | | Assignment | Weightage (in %) | 5 | | Quiz-1 | Weightage (in %) | 5 | | Quiz-2 | Weightage (in %) | 5 | |  | **Total** | **100** | | | | | |
| **Recommended by the Board of Studies on** | | **06.01.2018** | | | | |
| **Date of Approval by the Academic Council** | | 1st Academic Council 24.01.2018 | | | | |