B. E. Common to all Programmes
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES

<table>
<thead>
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<th>Course Code</th>
<th>18MAT31</th>
<th>CIE Marks</th>
<th>40</th>
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<td>Teaching Hours/Week (L: T:P)</td>
<td>(2:2:0)</td>
<td>SEE Marks</td>
<td>60</td>
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<tr>
<td>Credits</td>
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<td>Exam Hours</td>
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Course Learning Objectives:
- To have an insight into Fourier series, Fourier transforms, Laplace transforms, Difference equations and Z-transforms.
- To develop the proficiency in variational calculus and solving ODE’s arising in engineering applications, using numerical methods.

Module-1

**Laplace Transform:** Definition and Laplace transforms of elementary functions (statements only). Laplace transforms of Periodic functions (statement only) and unit-step function – problems.

**Inverse Laplace Transform:** Definition and problems, Convolution theorem to find the inverse Laplace transforms (without Proof) and problems. Solution of linear differential equations using Laplace transforms.

Module-2

**Fourier Series:** Periodic functions, Dirichlet’s condition. Fourier series of periodic functions period $\frac{2\pi}{2}$ and arbitrary period. Half range Fourier series. Practical harmonic analysis.

Module-3

**Fourier Transforms:** Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Problems.

**Difference Equations and Z-Transforms:** Difference equations, basic definition, z-transform-definition, Standard z-transforms, Damping and shifting rules, initial value and final value theorems (without proof) and problems, Inverse z-transform and applications to solve difference equations.

Module-4

**Numerical Solutions of Ordinary Differential Equations (ODE’s):**
Numerical solution of ODE’s of first order and first degree- Taylor’s series method, Modified Euler’s method. Runge-Kutta method of fourth order, Milne’s and Adam-Bash forth predictor and corrector method (No derivations of formulae)-Problems.

Module-5

**Numerical Solution of Second Order ODE’s:** Runge-Kutta method and Milne’s predictor and corrector method. (No derivations of formulae).

**Calculus of Variations:** Variation of function and functional, variational problems, Euler’s equation, Geodesics, hanging chain, problems.

Course outcomes: At the end of the course the student will be able to:
- CO1: Use Laplace transform and inverse Laplace transform in solving differential/integral equation arising in network analysis, control systems and other fields of engineering.
- CO2: Demonstrate Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.
- CO3: Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arising in wave and heat propagation, signals and systems.
- CO4: Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.
- CO5: Determine the externals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.

Question paper pattern:
- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Title of the Book</th>
<th>Name of the Author/s</th>
<th>Name of the Publisher</th>
<th>Edition and Year</th>
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<tr>
<td><strong>Textbooks</strong></td>
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<tr>
<td>5</td>
<td>Advanced Engineering Mathematics</td>
<td>Chandrika Prasad and Reena Garg</td>
<td>Khanna Publishing,</td>
<td>2018</td>
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**Web links and Video Lectures:**
2. http://www.class-central.com/subject/math(MOOCs)
4. VTU EDUSAT PROGRAMME - 20
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