INDIAN INSTITUTE OF INFORMATION TECHNOLOGY
DESIGN AND MANUFACTURING (IIITDM) KANCHEEPURAM

INTRODUCTION OF NEW COURSE

<table>
<tr><td>Course Title</td><td>Computational Mathematics in Engineering</td><td>Course No</td><td colspan="4">MAT6XXX</td></tr>
<tr><td>Specialization</td><td></td><td>Structure (LTPC)</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>To be offered for</td><td>PG / Ph.D</td><td>Status</td><td colspan="2">Core ☐</td><td colspan="2">Elective ■</td></tr>
<tr><td>Faculty Proposing the course</td><td>Dr. Nachiketa Mishra</td><td>Type</td><td colspan="2">New ■</td><td colspan="2">Modification ☐</td></tr>
<tr><td rowspan="2">Date of DAC</td><td rowspan="2">12-08-2018</td><td>Members Present in DAC</td><td colspan="4">All Faculty Members of the Dept.</td></tr>
<tr><td>External Member:</td><td colspan="4">Prof. Soumyendu Raha, Scientific Computing Lab., IISc Bangalore</td></tr>
<tr><td>Pre-requisite</td><td>None</td><td>Submitted for approval</td><td colspan="4">39th Senate</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• Introduce students to DFT based spectral method, Sobolev spaces, weak formulation, different FEMs, finite element spaces with convergence, stability and error analysis.
• To gain a broad overview of different PDE based models appears in engineering.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Getting familiarized with computational challenges in spectral methods
• How to formulate the FEMs, verify their convergence & estimate the error bounds.
• Understanding of methods for evolution equations and stability issues.
• Identify best suitable FE method for PDE-based model in physics and engineering.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours)</td><td colspan="6"><u>Spectral method (14-hrs)</u>

Differentiation Matrices, Unbounded Grids The Semi-Discrete Fourier Transform, Periodic Grids the DFT and FFT, Chebyshev Differentiation Matrices, BVPs, Chebyshev Series and the FFT, Eigenvalues & Pseudospectra, Time-Stepping and Stability Regions.

<u>Finite Element Methods</u>

Elliptic problems:(20-hrs): Poisson equation and weak formulation, Galerkin FEM, Implementation Aspect, Convection-Diffusion equation, Streamline diffusion method, The Stokes Equations, Mixed FEM, Theory of errors.

Evolution problems(8-hrs): Parabolic model, Time discretization, Stability analysis, Error analysis.</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Lloyd N. Trefethen, Spectral Methods in MATLAB, SIAM, 2000
2. H. C. Elman, D. J. Silvester, and A. J. Wathen, Finite Elements and Fast Iterative Solvers: with Applications in incompressible Fluid Dynamics, 2nd Edition, Oxford University</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Mark S. Gockenbach, Understanding and implementing the FEM, SIAM, 2006
2. The set of lecture notes(freely available) "Finite Element Methods for Partial Differential Equations" by Endre Süli, Oxford University.</td></tr>
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