M.E Semester: 3 Mechanical Engineering (Automobile Engineering)
Subject Name: Computational modeling and simulation (Elective-III) ME303B

A. **Course Objective**

- To present a problem oriented in depth knowledge of Computational modelling and simulation
- To address the underlying concepts and methods behind Computational modelling and simulation

B. **Teaching / Examination Scheme**

SUBJECT		Teaching Scheme				Total Credit	Evaluation Scheme					Total Marks
		L	T	P	Total		THEORY		IE	CIA	PRACT.	
CODE	NAME	Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	
MEA303B	Computational modeling and simulation	3	0	0	3	3	3	70	30	20	0	120

C. **Detailed Syllabus / Lesson Planning**

1. INTRODUCTION: Basic concepts of fluid flow-derivation of the governing equations, conservation of mass, momentum and energy. Mathematical classification of flow - hyperbolic, parabolic, elliptic and mixed flow types.
2. DISCRETISATION: Finite difference method - forward, backward and central difference schemes, explicit and implicit methods. Properties of numerical solution methods - stability analysis, error estimation, difference between the FDM and FVM methods.
3. INTRODUCTION TO GRID GENERATION: Choice of grid, grid oriented velocity components, cartesian velocity components, staggered and collocated arrangements, adaptive grids.
4. CFD TECHNIQUES: Lax - Wendroff technique - MacCormack's technique, relaxation technique. Artificial viscosity, ADI technique, Pressure correction technique, SIMPLE algorithm. Upwind schemes - flux vector splitting.
5. TURBULENCE MODELING: Turbulence energy equation- one-equation model, the k-_ model, the k- _ model. Practical problem solving using CFD packages.

D. **Lesson Planning**

SR.NO	DATE/WEEK	UNIT NO	%WEITAGE	TOPIC NO
1	1^{ST} , 2^{ND} , 3^{RD}	1	20	1
2	4^{TH} ,5^{TH} , 6^{TH}	2	20	2
3	7^{TH} ,8^{TH} , 9^{TH}	3	20	3
4	10^{TH} ,11^{TH} , 12^{TH}	4	20	4
5	13^{TH} ,14^{TH} , 15^{TH}	5	20	5

E. **Instructional Method & Pedagogy**

- At the start of course, the course delivery pattern , prerequisite of the subject will be discussed
- Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while teaching and conduction of all examinations.
- Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.
- One/Two internal exams may be conducted and total/average/best of the same may be converted to equivalent of 30 marks as a part of internal theory evaluation.
- Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.
- Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.

F. **Students Learning Outcomes**

- The student can identify different areas of Computational modelling and simulation
- Can find the applications of all the areas in day to day life.

G. **Recommended Study Materials**

- **Text & Reference Books:**

1. Muralidhar K and Sundararajan T, “Computational Fluid Flow and Heat Transfer”, Narosa Publications, New Delhi, 2003.
2. Chung T J, “Computational Fluid Dynamics”, Cambridge University Press, London, 2002.

3. Versteeg H K and Malalasekara W, “An Introduction to Computational Fluid Dynamics - The Finite Volume Method', Longman, 1995.
4. John D Anderson, “ Computational Fluid Dynamics – The Basics with Applications”, McGraw Hill, , New York, 1995.
5. David C Wilcox, “Turbulence Modeling for CFD”, DCW Industries, Inc., 1993.