Model Template for Scheme of Course Work

to be submitted by the Faculty of B.Tech/M.Tech/MCA I semester on or before 11.10.2013 to bhanucvk@gvpce.ac.in and yadavalliraghu@yahoo.com

SCHEME OF COURSE WORK

Course Details:

Course Title	**: Advanced Fluid Mechanics**		
Course Code	**: 13ME2301**	**L T P C**	**: 4 0 0 3**
Program:	**: M.Tech.**		
Specialization:	**: Thermal Engineering**		
Semester	**: I**		
Prerequisites	**: Basic Fluid Mechanics**		
Courses to which it is a prerequisite	**: ---**		

Course Outcomes (COs):
At the end of the course, the student will be able to

1	analyze and apply the concepts of potential flow and Navier-Stokes equations to solve the fluid flow problems
2	explain the concepts of boundary layer separation and turbulent flows
3	classify the compressible fluid flows and discuss stagnation properties
4	solve nozzle, diffuser, and shock wave problems of compressible fluids
5	apply Prandtl, Rankine-Hugniot equations to solve oblique shock waves and discuss the Fanno curves

Program Outcomes (POs):

1	exhibit in-depth knowledge in thermal engineering specialization
2	think critically and analyze complex engineering problems to make creative advances in theory and practice
3	solve problem, think originally and arrive at feasible and optimal solutions with due consideration to public health and safety of environment
4	use research methodologies, techniques and tools, and will contribute to the development of technological knowledge
5	apply appropriate techniques, modern engineering tools to perform modeling of complex engineering

	problems with knowing the limitations
6	understand group dynamics, contribute to collaborative multidisciplinary scientific research
7	demonstrate knowledge and understanding of engineering and management principles and apply the same with due consideration to economical and financial factors
8	communicate complex engineering problems with the engineering community and society, write and present technical reports effectively
9	engage in life-long learning with a high level of enthusiasm and commitment to improve knowledge and competence continuously
10	exhibit professional and intellectual integrity, ethics of research and scholarship and will realize the responsibility towards the community
11	examine critically the outcomes of actions and make corrective measures

Course Outcome versus **Program Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO-1	S		M								
CO-2		S	M								
CO-3	S	M									
CO-4		S	M								
CO-5	M	S									

S - Strongly correlated, *M - Moderately* correlated, *Blank - No correlation*

Teaching-Learning and Evaluation

Week	TOPIC / CONTENTS	Course Outcomes	Sample questions	TEACHING-LEARNING STRATEGY	Assessment Method & Schedule
1	Rotational and irrotational flows – velocity potential – circulation – relationship between stream function and potential function – basic solutions of stream and potential functions for uniform flow	CO-1	Explain basic solutions of stream and potential functions for uniform flow	▫ Lecture	
2	Source or sink, doublet and vortex flow – stationary circular cylinder - cylinder with circulation.	CO-1	Derive an expression for the lift on cylinder with circulation	▫ Lecture ▫ Discussion ▫ Problem solving	
3	Normal stresses – shear stresses -	CO-1	Explain order of	▫ Lecture	

	Navier-Stokes equations – flow through a parallel channel – very low Reynolds number flow, order of magnitude analysis, and approximation of N-S equations – boundary layer equations		magnitude analysis applied to N-S equations of boundary layer .	▫ Discussion	
4	Momentum integral equations – flow over a flat plate – displacement thickness – momentum thickness	CO-2	Discuss formation of boundary layer over a flat plate	▫ Lecture ▫ Discussion Problem solving	
5	boundary layer separation – drag – bluff bodies – aerofoils.	CO-2	Explain about the methods used toControl boundary layer separation	▫ Lecture ▫ Discussion Problem solving	Assignment (Week 5 - 7)
6	Laminar–turbulent transition – time mean and time dependent description – conservation of mass – momentum equations and Reynolds stresses – boundary layer equations	CO-2	Explain about Reynolds stresses in turbulent fluid flow	▫ Lecture ▫ Discussion	
7	Shear stress models, eddy viscosity, Prandtl's mixing length – laminar sub layer –turbulent boundary layer on a flat plate.	CO-2	Explain about the Prandtl's mixing length theory	▫ Lecture ▫ Discussion	
8	Wave propagation in an elastic solid medium – propagation of sound waves – Mach number – Mach angle – equation of sound wave. Energy equation – energy equation for non-flow and flow processes	CO-3	Derive an expression for the equation of velocity of sound wave in compressible fluid flow.	▫ Lecture ▫ Discussion Problem solving	Mid-Test 1 (Week 9)
9	**Mid-Test 1**				
10	adiabatic energy equation – stagnation enthalpy - stagnation temperature - stagnation pressure – stagnation velocity of sound – reference velocities – Bernoulli's equation – effect of Mach number on compressibility.	CO-3	Discuss the effect of Mach number on compressibility	▫ Lecture ▫ Problem solving	
11	Comparison of isentropic and	CO-4	Explain about the	▫ Lecture	

	adiabatic processes – Mach Number variation - expansion in nozzles – compression in diffusers		expansion and compression in nozzles and diffusers	▫ Discussion Problem solving	
12	Stagnation and critical states – area ratio as a function of Mach number, impulse function - mass flow rate, flow through nozzles - convergent nozzles	CO-4	Discuss about the Stagnation and critical states	▫ Lecture ▫ Discussion Problem solving	
13	Convergent-divergent nozzles – flow through diffusers.	CO4	Discuss about flow through the convergent-divergent nozzles	▫ Lecture Problem solving	
14	Development of a shock wave – rarefaction wave – governing equations, Fanno line, Rayleigh line -Prandtl-Meyer relation – Mach number downstream of the shock wave	CO-4	Explain about the development of a shock wave	▫ Lecture ▫ Discussion Problem solving	
15	static pressure ratio across the shock - temperature ratio across the shock – density ratio across the shock - stagnation pressure ratio across the shock.	CO-4	Derive the expressions for static pressure ratio and temperature ratio across the shock	▫ Lecture Problem solving	Assignment (Week 15 - 17)
16	Nature of flow through oblique shock waves – fundamental relations - Prandtl's equation – Rankine-Hugoniot equation.	CO-5	Derive an expression for the Rankine-Hugoniot equation.	▫ Lecture Problem solving	
17	The Fanno curves – Fanno flow equations – variation of flow parameters.	CO-5	Explain about the Fanno curves	▫ Lecture ▫ Discussion Problem solving	Mid-Test 2 (Week 18)
18	**Mid-Test 2**				
19/20	**END EXAM**				