Name: **Enrolment No:**	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2023

Course: Fluid Structure Interaction **Semester: II**
Program: M.Tech CFD **Time 03 hrs.**
Course Code: ASEG 7048P **Max. Marks: 100**

SECTION A

S. No.		Marks	CO
Q 1	Justify the need of FSI for simulating wing flutter of an aircraft.	**4**	**CO1**
Q 2	Define reduced velocity and identify its role in FSI simulation.	**4**	**CO2**
Q 3	Discuss about radiation damping.	**4**	**CO2**
Q 4	Identify the physical significance of compressibility number.	**4**	**CO3**
Q 5	Derive the mathematical expression required to satisfy the condition of existence.	**4**	**CO4**
	SECTION B		
Q 6	Apply dimensional analysis to show that mass no. and reduced velocity are critical non-dimensional parameters to be considered while solving a FSI problem.	**10**	**CO1**
Q 7	Consider a FSI problem where a solid cylinder is placed in a potential flow at rest. The equation of motion of the solid are as follows: $$m\ddot{u} + ku = 0$$ Show that for such problem expression for added mass will be: $$M_a = \frac{-\rho\pi R^2}{m}\left(\frac{\alpha^2+1}{\alpha^2-1}\right)$$ Where R is the radius of cylinder, α is the ratio of the radius of the fluid domain to the radius of the cylinder, m is the mass of the solid and ρ is the density of the fluid. **OR** Discuss about viscous damping and hence find out the expression for viscosity number.	**10**	**CO2**
Q 8	Derive governing equation for determining the deformation of solid under external load. Discuss the boundary conditions required to solve the governing equation.	**10**	**CO3**
Q 9	Derive the generalized form of Navier Stokes equation and explain various terms involved in it.	**10**	**CO4**

SECTION-C			
Q 10	Derive the mathematical term for added mass matrix and thus depict its role in FSI computations. **OR** Consider a FSI problem where flow can be assumed to be potential flow and thus the FSI coupling could be reduced to inertial coupling. Derive various governing equations required to be solved for such FSI problems.	**20**	**CO3**
Q 11	Formulate the governing equations for Vibro- Acoustic modeling in fluid structure interaction.	**20**	**CO4**