Name: **Enrolment No:**	

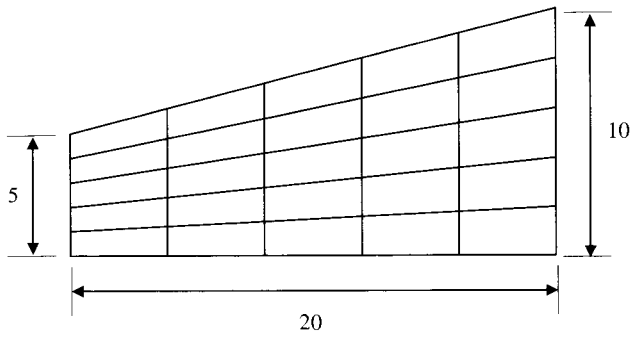
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2022

Course: Flow Visualization and Post Processing **Semester: II**
Program: M. Tech. CFD **Time : 03 hrs.**
Course Code: ASEG 7029 **Max. Marks: 100**

Instructions: Assume missing data, if any, appropriately. All the symbols used in the paper have their usual meanings.

SECTION A
(5Qx4M=20Marks)

S. No.		**Marks**	**CO**
Q 1	Discuss the "*colour mapping*" visualization of a scalar dataset with an appropriate example.	**04**	**CO4**
Q 2	Define slicing in context to data enrichment. Write down the interpolation functions to evaluate an off node value of a function over a 1D linear, and 2D triangular mesh element.	**04**	**CO4**
Q 3	Discuss the spot noise method for visualization of velocity fields.	**04**	**CO2**
Q 4	What are ellipsoid glyphs? Discuss how these glyphs can be used to visualize a symmetric tensor field.	**04**	**CO4**
Q 5	Give an account of Brodlie's taxonomy of visualization mappings for various classes of data. Discuss any two scalar visualization mappings.	**04**	**CO1**
	SECTION B **(4Qx10M= 40 Marks)**		
Q 6	Elucidate the various visualization mapping schemes for streamline generation through a velocity vector field. How can an adaptive time stepping method be used improve the accuracy of a first order Euler scheme?	**10**	**CO2**
Q 7	What is ray casting? For a ray cast during volume visualization, derive an expression for the colour intensity on the Image plane obtained by a *front-to-back* compositing of local and background colours.	**10**	**CO1**

Q 8	List down the importance of vortex extraction in fluid mechanics. Discuss the following algorithms for extracting vortex core from CFD data a) λ_2 method b) Eigenvector method	**10**	**CO3**
Q 9	Write a code to generate a 7 x 16 grid as shown in figure below and write to a file the grid data in a structured format (I, J, K) for the purpose of visualization using TECPLOT. 	**10**	**CO4**
SECTION-C **(2Qx20M=40 Marks)**			
Q 10	Draw all the distinct topological cases for the marching square algorithm and thus list the steps for generation of *isolines* using this algorithm. Also, explicate the methods to resolve the contouring ambiguities that might arise during the process.	**20**	**CO2**
Q 11	(a) What are the various critical points in a vector field? How can these critical points be classified? Illustrate with examples. (b)The topological behavior of a flow around an airfoil is shown below. The critical points are represented by open circles. Name all the critical points shown and explain the behavior of the fluid flow near these singularities.	**20**	**CO3**