Name: **Enrolment No:**	UPES University of Tomorrow

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

Course: Combustion & Reactive Flows **Semester: II**
Program: M.Tech (CFD) **Time 03 hrs.**
Course Code: ASEG7027 **Max. Marks: 100**
Instructions: All questions are compulsory. Assume data if missing.

SECTION A

S. No.		Marks	CO
Q 1	What do you mean by combustion? Why is it important today?	**04**	**CO1**
Q 2	Why is the gaseous fuel being preferred over solid or liquid fuel in recent times? Explain with few examples.	**04**	**CO1**
Q 3	Define activation energy. Why is it so important?	**04**	**CO3**
Q 4	How does the burning velocity vary with pressure for methane-air premixed flame?	**04**	**CO4**
Q 5	What is the mechanism of soot formation in a diffusion flame? Describe it briefly.	**04**	**CO4**

SECTION B

Q 6	Determine the air-fuel ratio of ATF fuel (C_8H_{18}) for an equivalence ratio of 0.5. The higher heating value for the aviation turbine fuel (ATF) is 48,000 kJ/ Kg at 298K. The heat of vaporization of this liquid fuel is 375 kJ/kg. Calculate the heat of reaction at 298 K for the ATF vapour.	**10**	**CO3**
Q 7	Derive Ficks law of diffusion from the basic principle. What are the commonalities among three transport laws?	**10**	**CO2**
Q 8	Explain the phenomena of flashback and blow-off? How can this be related to the burning velocity?	**10**	**CO4**
Q 9	A liquid fuel combustor is to be designed, considering the flow to be one-dimensional with mono-dispersed spray of initial droplet diameter of 200 µm. The initial air velocity is 2.0 m/s at 600K and 0.1 MPa. The fuel/air ratio by mass is estimated to be 0.06 with adiabatic flame temperature of 2100K. Assume burning rate constant to be 0.9 mm^2/s. The density of liquid fuel is 800 kg/m^3. Determine the initial droplet number density the length of the reaction zone and the combustion intensity. Take C_p= 1.2 kJ/kg K. **OR** Illustrate D^2 law? What is its significance as far as combustion of droplet is concerned? Is it valid for solid fuel combustion?	**10**	**CO5**

SECTION-C			
Q 10	a). What are the advantages of using a computational approach for simulating the flow over a micronozzle compared to experimental methods? b). Analyse the challenges associated with simulating the flow over a micronozzle using a computational approach? How do you validate the numerical results obtained from the simulations?	**10+10 = 20**	**CO5**
Q 11	Analyze the methods available for SO_x and CO_x emission control with relevant schematic diagrams. Which method is preferred most? Why is it so? **OR** In a laboratory, combustor methane fuel is burnt at fuel lean condition and 200 ppm of CO concentration (dry) is measured by Non-Dispersive Infra-Red (NDIR) gas analyzer at 7.5% of oxygen level. Calculate the CO level at 15% oxygen level?	**20**	**CO4**