Enrolment No:	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, July 2020

Course: Combustion & Reactive Flows **Semester: II**
Program: M.Tech CFD **Time 03 hrs.**
Course Code: ASEG7027 **Max. Marks: 100**

Instructions:

1. **Read the Instruction carefully before attempting**
2. **For Theory based : Type the Answers in word file**
3. **For Figures if any : Draw a free hand sketch and insert the same word file**
4. **For Numerical : Solve it in a paper and insert in the same word file**
5. **Upload as a single word file for all the Question in Blackboard.**

Note : Please upload the word document only, Do not upload PDF and or other format. The answer scripts will be considered for evaluation only through Blackboard. No other mode of submission is acceptable.

SECTION A [Case Based Study] 60 Marks

S. No.		Marks	CO
Q 1	Apply Chapman-Jouguet condition to illustrate DDT model in gas turbines. Analyze the Zeldovich-Von Neumann-Doring (ZND) theory of detonation.	**25**	**CO5**
Q 2	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?	**15**	**CO5**
Q 3	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**	**CO5**
SECTION B [Numerical and Short Answers] 40 Marks			
Q 4	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.	**10**	**CO4**
Q5	Derive Ficks law of diffusion from the basic principle. What are the commonalities among three transport laws?	**5**	**CO4**

NOTE : The submission time of the Question Paper Answer Sheet is 24 Hhrs from the scheduled time (*exceptional provision due to extraordinary circumstance due to COVID-19 and due to internet connectivity issues in the far-flung areas*).
No Submission will be entertained after 24 Hrs

Q 6	Explain the phenomena of flashback and blow-off? How can this be related to the burning velocity?	**5**	**CO2**
Q 7	Why is the gaseous fuel being preferred over solid or liquid fuel in recent times? Explain with few examples.	**5**	**CO1**
Q 8	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.	**5**	**CO3**
Q 9	Illustrate D^2 law? What is its significance as far as combustion of droplet is concerned? Is it valid for solid fuel combustion?	**5**	**CO3**
Q 10	Methane is burnt in a combustor with air-fuel ratio of 20. Determine the equivalence ratio. If the air is replaced with 20% of N_2, estimate the equivalence ratio and fuel-oxygen ratio.	**5**	**CO1**

NOTE : The submission time of the Question Paper Answer Sheet is 24 Hhrs from the scheduled time (*exceptional provision due to extraordinary circumstance due to COVID-19 and due to internet connectivity issues in the far-flung areas*).

No Submission will be entertained after 24 Hrs