Reg. No. | | | | | | | | | |

M.E. / M.TECH. DEGREE EXAMINATIONS, MAY/JUNE 2017

SECOND SEMESTER

INTERNAL COMBUSTION ENGINEERING

IC16006- SIMULATION OF I.C. ENGINE PROCESSES

(Regulation 2016)

Time: Three Hours **Q. Code: 204787** **Maximum : 100 Marks**

Answer **ALL** questions

(Use of approved data book and chart is permitted)

PART A - (10 X 2 = 20 marks)

1. In a combustor, propane gas is combusted with 10% excess air. If the combustion is assumed to be complete, write the chemical equation for the same.
2. Write the four important factors that makes the actual cycle deviate from the ideal cycle of an engine.
3. What is the error involved in estimating the final temperature of a system undergoing isentropic change of state and how it can be minimized?
4. Write the Wiebe function for determining the mass fraction burnt during SI engine combustion. Explain the terms involved in the function.
5. What is the fundamental difference between premixed combustion and diffusion combustion? Give example for each combustion.
6. State the disadvantages of the single zone heat release models used for engine simulation.
7. Draw a typical valve lift and intake valve open area as a function of camshaft angle.
8. List down four important factors that affect the residual gas fraction in an engine.
9. Write the primary equations used in extended Zeldovich Mechanism for the calculation of NOx.
10. Define the term flame stability.

PART B - (5 X16 = 80 marks)

11. (a) (i) A natural gas fired industrial boiler operates with an oxygen concentration of 3 mole percent in the flue gases. Determine the operating air-fuel ratio and the equivalence ratio. Treat the natural gas as methane. **(10)**

(ii) In detail explain the Annand's equation to predict the heat transfer coefficient in an engine. **(6)**

(OR)

(b) (i) Determine the upper and lower heating values at 298 K of gaseous n-decane, $C_{10}H_{22}$, per kilomole of fuel and per kilogram of fuel. **(12)**

(ii) If the enthalpy of vaporization of n-decane is 359 kJ/kg at 298 K, what are the upper and lower heating values of liquid n-decane? **(4)**

12. (a) (i) Derive an expression for the drop in temperature of air-fuel mixture in a carburettor. Explain the thermodynamics involved in it. **(10)**

(ii) Estimate the manifold temperature of C_8H_{18}- air mixture with an equivalence ratio of 0.9. The air and fuel are entering the carburettor at 298 K. **(6)**

(OR)

(b) (i) Derive an expression for the burning velocity of a fuel in terms mass fraction burnt. **(10)**

(ii) Calculate the burning time of fuel assuming the flame propagates in the combustion chamber in spherical shape. **(6)**

13. (a) Explain the Watson combustion model used for a direct injection diesel engine. Give proper equations. **(16)**

(OR)

(b) (i) Explain with proper equations, the Hardenberg and Hase's correlation that is used to determine the ignition delay period of a compressed ignited engines. **(12)**

(ii) List the major factors that affect the ignition delay period of a CI engine. **(4)**

14. (a) In detail explain the thermodynamics involved in the exhaust process. Derive an expression for the change in pressure during the exhaust process. **(16)**

(OR)

(b) Explain the various components of engine friction in engine. Write the proper equations that can be used to estimate the friction values of those components. **(16)**

15. (a) Describe in detail the various emission models used to predict the pollutant formation in gas turbine combustors. **(16)**

(OR)

(b) Explain how an ideal gas turbine combustor using Brayton cycle can be used to predict the pressure and temperature at salient points. Draw a flow chart to explain the simulation methodology. **(16)**