



# SILVER OAK UNIVERSITY

## Engineering and Technology (M. Tech.) Mechanical (I.C. Engine & Automobile Engineering)

Subject Name: I.C. Engine Modeling & Simulation

Subject Code:

Semester: III

**Prerequisite:** Fundamentals of IC Engine, Automobile Systems & Aerodynamics

**Objective:** To know about modeling, different types of modeling and its application in Automobile engineering, to gain the knowledge in simulation of various systems and components of IC Engines with various new engine concepts.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits	Evaluation Scheme				Total Marks
L	T	P	C	Internal		External		
				Th	Pr	Th	Pr	
3	0	2	4	40	20	60	30	150

**Content:**

Unit No.	Course Contents	Teaching Hours	Weightage %
1	<b>Introduction to modeling;</b> importance of modeling; Spray equation model; Thin and thick spray model; Droplet turbulence interactions; Droplet impingement on walls.	6	14
2	<b>Modeling of IC Engines:</b> Classifications; zero dimensional modeling; quasi dimensional modeling, Comparison of different combustion systems; Combustion efficiency. Heat of reaction - adiabatic, constant volume combustion, constant pressure combustion, temperature drop due to fuel vaporization, adiabatic flame temperature, mean effective pressure, torque and thermal efficiency at full throttle, part throttle and supercharged conditions., flow models and combustion models.	14	34
3	<b>Laminar flow modeling;</b> K-e model, probability density functions; effective viscosity; vortex structures; Compression generated turbulence.	7	16

4	<b>Simulation of IC Engines</b> SI & CI engine simulation – air standard cycle, fuel-air cycle, progressive combustion cycle and actual cycle simulation – part throttle, full throttle and supercharged conditions.	9	22
5	<b>Simulation of New Engine Concepts</b> Dual fuel engine, low heat rejection engine, lean burn engine, variable compression ratio engine, homogeneously charged compression ignition engine, controlled auto ignition engine.	6	14

### Course Outcome:

Sr. No.	CO statement	Unit No
<b>CO-1</b>	Basic understanding engine modeling;	1
<b>CO-2</b>	Understating and evaluation of different flow models and combustion models of engines	2
<b>CO-3</b>	Understanding Laminar flow modeling;	3
<b>CO-4</b>	Demonstrate and analyze air standard cycle, fuel-air cycle, progressive combustion cycle and actual cycle simulation	4
<b>CO-5</b>	Knowledge of Simulation of New Engine Concepts	5

### List of Experiments/Tutorials:

1. To study Weibe's combustion model.
2. To study Single zone and Multi zone combustion models for SI engine.
3. To study Premixed-Diffusive models for CI engine.
4. To study characterizing of spray using thin and thick spray combustion model.
5. To study different turbulence combustion models.
6. To study droplet breakup, collision and wall interaction model.
7. Prepare a computer code (Using any software like Matlab or open source software like Scilab) to simulate any stroke (i.e. Suction, Compression, Power or Exhaust) of Auto cycle

### **Books Recommended:-**

1. J.I Ramos – Internal Combustion Engine Modeling- Hemisphere Publishing Corporation,1989.
2. James N Mattavi and Charles A Amann – Combustion Modeling in Reciprocating Engines – Plenum Press-1980.
3. Pkandylas G C Koltsakis and A M Stamatelos – Mathematical modeling of Precious metals catalytic converters for diesel Nox reduction – Proc. Institution of Mechanical Engineers.
4. Ganesan V, “Computer Simulation of spark ignition engine process“, Universities Press (I) Ltd, Hyderabad, 2001
5. Heywood J B, “Internal Combustion Engine Fundamentals” McGraw Hill Book Co., USA – 2001.
6. Ramoss A L, "Modeling of Internal Combustion Engines Processes", McGraw Hill Publishing Co., 1992.
7. Ashley Campbel, "Thermodynamic analysis of combustion engines", John Wiley & Sons, New York, 1986. 8. Benson R S, whitehouse. N.D, "Internal Combustion Engines", Paragon Press, oxford, 1979