



GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code: 3731101

Semester – III

Subject Name: I.C.Engine modeling and Simulation

Type of course: Program Elective - V

Prerequisite: Fundamentals of IC Engine, Automobile Systems & Aerodynamics

Rationale: 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 C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Course Content:

Sr. No.	Course Content	Total Hrs	% Weightage
1	Introduction to modeling; importance of modeling; Spray equation model; Thin and thick spray model; Droplet turbulence interactions; Droplet impingement on walls.	6	13
2	Modeling of IC Engines; 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	16	35
3	Laminar flow modeling; K-e model, probability density functions; effective viscosity; vortex structures; Compression generated turbulence.	8	17
4	Simulation of IC Engines SI & CI engine simulation – air standard cycle, fuel-air cycle, progressive combustion cycle and actual cycle simulation – part throttle, full throttle and supercharged conditions.	10	22
5	Simulation of New Engine Concepts Dual fuel engine, low heat rejection engine, lean burn engine, variable compression ratio engine, homogeneously charged compression ignition engine, controlled auto ignition engine.	6	13

Reference Books:

1. J.I Ramos – Internal Combustion Engine Modeling- Hemisphere Publishing Corporation, 1989.



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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

Course Outcome:

Sr. No.	CO statement	Marks % weightage
CO-1	Basic understanding engine modeling;	18
CO-2	Understating and evaluation of different flow models and combustion models of engines	24
CO-3	Understanding Laminar flow modeling;	20
CO-4	Demonstrate and analyze air standard cycle, fuel-air cycle, progressive combustion cycle and actual cycle simulation	18
CO-5	Knowledge of Simulation of New Engine Concepts	20

List of Experiments:

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