

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (I.C. ENGINE & AUTOMOBILE ENGINEERING) (11)

I.C.ENGINE MODELING AND SIMULATION

SUBJECT CODE: 2731101

M.E. SEM-III

Type of course: Advanced/ Application

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	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2#	2	5	70	30	20	10	10	10	150

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.

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:

1. Conversant with Basic Concept of Modeling
2. To develop modeling of IC engines.
3. To develop of Laminar Flow modeling
4. Understands Simulation of IC Engines and its new concepts.

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

Design based Problems (DP)/Open Ended Problem:

To prepare a computer code to study heat transfer of any parts (e.g. Piston or Puppert Valve etc.) of any low heat rejection engine.

Note: Computer program shall be made by theoretical modeling using any software like Matlab or open source software like Scilab. Simulation program can also study using any CFD or Finite Element simulation software.

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.