Spray Theory and Applications - Video course

COURSE OUTLINE

This course covers the theory necessary to understand spray formation and evolution, as well as a host of spray applications.

Topics include drop size distributions, breakup of liquid sheets and ligaments, drop formation and breakup, drop motion and the interaction between a spray and its surroundings, drop evaporation, nozzle internal fluid mechanics, external spray characteristics, nozzle performance, and experimental techniques relevant to these subjects.

Applications this semester will include

1. gas turbine engines
2. sprays for geo-engineering
3. internal combustion engine sprays and
4. use of non-traditional liquids in aero-propulsion and other systems.

COURSE DETAIL

Sl. No.	Module	Lectures
1	**Introduction** : Basic spray processes, Factors controlling spray formation.	2
2	**Drop size and velocity distribution functions** : Number distributions, Mass/volume distributions, Empirical distributions, Theoretical distributions.	5
3	**Sheet and ligament breakup** : Instability analyses for ligaments and sheets, Design models based on instability analyses.	7
4	**Drop formation** : Static and dynamic force balances, Continuity considerations, Secondary atomization, Collisions and coalescence.	3
5	**Drop motion and spray-surroundings interactions** : Steady trajectories (gas turbines, spray cooling, paint sprays), Entrainment.	5
6	**Drop evaporation** : Steady evaporation, Unsteady evaporation, Convective effects.	2
7	**Internal fluid mechanics** : Swirl atomizers, Impinging jet atomizers.	4
8	**External spray characteristics** : Cone angle, Radial and circumferential mass flux distributions.	3

NP-TEL

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http://nptel.iitm.ac.in

Mechanical Engineering

Pre-requisites:

1. Undergraduate fluid mechanics.
2. Undergraduate differential equations.

Additional Reading:

Journal:

1. Atomization and sprays and
2. International journal of spray and combustion dynamics.

Coordinators:

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9	**Atomizer performance** : Modern design models for pressure-swirl atomizers, impinging jet atomizers, transient pressure (Diesel) atomizers.	5
10	**Measurement techniques** : Drop sizing by Malvern and P/DPA, Drop velocity by P/DPA, Mass flux distribution via patternators and P/DPA.	4
	Total	30

References:

There is no required text for this course. Course material will come from available references (PowerPoint presentations) and technical papers. However, two books of interest are

1. *Atomization and Sprays*, by A.H. Lefebvre (Hemisphere: New York, 1989. ISBN 0-89116-603-3) and
2. *Liquid Atomization*, by L. Bayvel and Z. Orzechowski (Taylor and Francis: Washington DC, 1993. ISBN 0-89116-959-8).

Lefebvre's book is superior in providing experimentally based correlations for predicting nozzle performance and in coverage of combustion related, specifically gas turbine, sprays.

Bayvel and Orzechowski's book is superior in coverage of fundamental aspects of liquid breakup, coverage of transient sprays, such as those found in IC engines, and coverage of non-combustion sprays, such as agricultural applications and spray drying.