Literature Review - Topic Proposal
Due: September 25, 2012
On Campus: Submit hardcopy
Distance Learning and On Campus: Canvas

Name: **Arjun Darbha**

Topic (1 or 2 sentences explaining with focus your proposed topic):

"Low temperature combustion (LTC) - in diesel engines". This work would study the benefits of LTC and different strategies employed in achieving LTC. Focus will also be directed towards reviewing the latest developments in this research field

Reason for selection of topic (how it relates to your degree and/or research goals):

Low temperature combustion, as the researchers at Sandia National Labs claim, is the comprehensive solution to increase efficiency and reduce emissions. This topic allows me to research upon a new technology in the field of IC-Engines which is generating a lot of interest in engine/auto manufacturers. This would also be a perfect addition to the Hybrid Electric Vehicle knowledge I gained over the past two semesters as entire world is talking about higher efficiency and lower emissions

Explain why this is a topical area of interest:

Research investigations made by combustion engineers and the amount of interest generated around low temperature combustion is truly amazing. This is a fairly new area of research in IC Engines so it is not complicated to understand this filed comprehensively and I believe this can be done over a period of time stipulated for literature review. Also, this topic allows me to gain insight into different control strategies employed in order to achieve LTC which I think will be a good learning experience, especially at a time when EPA standards are becoming stringent by the year with fuel costs eternally raising.

Literature Review – Primary References
Due: October 4, 2013
Submit with Page 2 with approved topic

Authors Names	**Authors Organization(s)**	**SAE Paper No** *or* **Journal, Vol, No**	**Date of Pub**	**Title**
Shuji Kimura, Osamu Aoki, Yasuhisa Kitahara, Eiji Aiyoshizawa	Nissan Motor Co.	2001-01-0200	2001-03-05	Ultra-Clean Combustion Technology Combining a Low-Temperature and Premixed Combustion Concept for Meeting Future Emission Standards
William de Ojeda, Phil Zoldak, Raul Espinosa, Raj Kumar	International truck and engine company	2008-01-0057	2008-04-14	Development of a Fuel Injection Strategy for Diesel LTC
Mark P.B. Musculus, Paul C. Miles, Lyle M. Pickett	Sandia National Laboratories	39 (2013) 246-283	April-June 2013	Conceptual models for partially premixed low-temperature diesel combustion

Abstract (1)
Experimental investigations were conducted with a direct-injection diesel engine to improve exhaust emission, especially nitrogen oxide (NOx) and particulate matter (PM), without increasing fuel consumption. As a result of this work, a new combustion concept, called Modulated Kinetics (MK) combustion, has been developed that reduces NOx and smoke simultaneously through low-temperature combustion and premixed combustion, respectively. The characteristics of a new combustion concept were investigated using a single cylinder DI diesel engine and combustion photographs. The low compression ratio, EGR cooling and high injection pressure was applied with a multi-cylinder test engine to accomplish premixed combustion at high load region. Combustion chamber specifications have been optimized to avoid the increase of cold-start HC emissions due to a low compression ratio. The results indicate the possibility of obtaining ultra-clean internal combustion engines capable of meeting Ultra Low Emission Vehicle (ULEV) regulations in the 21st century.

Abstract (2)
Nitrogen oxide (NOx) and particulate matter (PM) emissions of diesel vehicles are regarded as a source of air pollution, and there is a global trend to enforce more stringent regulations on these exhaust gas constituents in the early years of the 21st century. On the other hand, the excellent thermal efficiency of diesel engines is certainly a welcome attribute from the standpoints of conserving energy and curbing global warming. Recently, many research institutes around the world have been using high-efficiency direct-injection (DI) diesel engines to research emission control technologies. The authors have also been engaged in such research. As a result of this work, we have developed a new combustion concept, called Modulated

Kinetics (MK),that reduces NOx and smoke simultaneously due to low-temperature and premixed combustion characteristics, respectively, without increasing fuel consumption.

Abstract (3)

Based on recent research within optically accessible engines and combustion chambers, conceptual models for low-temperature combustion (LTC) diesel engines are proposed. To provide a reference to which the LTC conceptual models may be compared, an established conceptual model framework for conventional diesel combustion is first reviewed and updated. Then, based on multiple optical diagnostic observations and homogeneous reactor simulations using detailed chemical kinetic mechanisms, extensions to the existing conceptual model are proposed. The LTC conceptual models are not intended to describe all LTC strategies, but rather a common subset of low-load, single-injection, partially pre-mixed compression ignition conditions that are diluted by exhaust-gas recirculation to oxygen concentrations in the range of 10-15%. The models describe the spray formation, vaporization, mixing, ignition, and pollutant formation and destruction mechanisms that are consistent with experimental observations and modeling predictions for LTC diesel engines. Two separate subcategories are offered for either heavy-duty, large-bore or for light-duty, small-bore engines. Relative to the existing conventional diesel conceptual model, the features of the LTC conceptual models include longer liquid-fuel penetration, an extended ignition delay that allows more premixing of fuel, a more distinct and temporally extended two-stage ignition, more spatially uniform second-stage ignition, reduced and altered soot formation regions, and increased over-mixing leading to incomplete combustion.