COURSE NUMBER: Vm432	**COURSE TITLE:** Combustion
CREDIT: 3	**PREREQUISITES:** Vm 235 and Vm320
TEXTBOOKS/REQUIRED MATERIAL:	**PREPARED BY:** Lipo Wang **DATE OF PREPARATION:** July. 10, 2012 **DATE OF UC APPROVAL:** Oct. 30, 2013
INSTRUCTOR(S): Kwee-Yan The, Lipo Wang, Thomas Hamade	**SCIENCE/DESIGN:** n/a
CATALOG DESCRIPTION: Introduction to combustion processes; combustion thermodynamics, reaction kinetics and combustion transport. Chain reactions, ignition, quenching, and flammability limits, detonations, deflagrations, and flame stability. Introduction to turbulent premixed combustion. Applications in IC engines, furnaces, gas turbines, and rocket engines	**COURSE TOPICS:** 1. Introduction to combustion processes; review of basic fluid mechanics: the derivation of mass, momentum and energy conservation equations based on the Reynolds transport theorem. 2. Chemical thermodynamics, mixture fraction, the adiabatic flame temperature (the Burke-Schumann solution), chemical equilibrium reaction kinetics: the Arrehenius rate expression, the order of reaction, chain reactions (initiating, branching, propagating, breaking). 3. Premixed combustion: Hugoniot relation (detonation, deflagration) the laminar flame structure, theoretical expression of the flame speed based on the Zeldovich theory, ignition, extinction and stability limits. 4. Nonpremixed combustion: Stefan flow, droplet burning (governing equations and theoretical solution: mass consumption rate and flame location), counterflow combustion, flamelet transform. 5. Combustion of nonvolatile fuels: coal combustion physics, carbon combustion at different limits, metal particle combustion, multi-component fuel combustion (miscible and immiscible cases), introduction of nitric oxides: formation mechanism of NOx and soot, engine combustion 6. Combustion stability: acoustics physics, acoustics instability, acoustic energy, flame front instability and theoretical analysis 7. Introduction to turbulent combustion
COURSE STRUCTURE/SCHEDULE: Lecture: twice per week, 90 minutes each.	

COURSE OBJECTIVES [Course Outcomes in brackets]	1. To teach the principal concepts of combustion [1-8] 2. To apply the relevant knowledge to analyze some basic combustion phenomena [1-8] 3. To teach combustion applications. [1-8]
COURSE OUTCOMES [Program Outcomes in brackets]	After completing Vm432, students should be able to: 1. Compute adiabatic flame temperatures of multicomponent gas mixtures with dissociation of the products [a] 2. Given the temperature, use tabulated Arrhenius reaction rates to determine which of a number of reactions is proceeding most rapidly [a] 3. Given one measured laminar flame speed, predict flame speeds at other conditions for the same primary reaction [a] 4. Given the initial mixture properties, estimate the speed and pressure of a detonation wave [a] 5. Know the main differences between laminar and turbulent combustion [a] 6. Know the main differences between premixed and diffusion flames [a] 7. Know the basic temperature performance emissions tradeoffs made in designing commercial combustion systems [a] 8. Given the heating load and fuel composition, size an appropriate combustion system [a]
ASSESSMENT TOOLS [Course Outcomes in brackets]	Course work: 20 % Written exam (only the final): 50 % Oral exam: 30 %