Engine Mapping for Performance (Spark Ignition)

The course is divided into a teaching portion of 12 hours and a practical portion of 2 hours. The teaching portion will be conducted in 6 sessions of two hours each. The practical portion will be one meeting of two hours duration. The teaching portion will be conducted for all the students together. The practical portion will be performed on an individual basis or a maximum of three students at a time. The students themselves should decide how big their group is. The practical portion needs to be performed in small groups due to the fact that only one engine and dynamometer setup can be used.
Registration fee for the taught portion only €150

Students may opt not to take the practical portion. Registration for the practical portion will be started only after the 3rd class meeting. The fee for the practical portion will depend on the choice of the students to be in a group of
One : € 180 Two : € 110 Three: € 80

Due to the fact that during the practical portion many things will be new to the student and experiments are quite demanding, it is highly suggested that students register for the practical portion individually. If groups are registered, the grouped students should be well acquainted between them so that they are aware of each others knowledge and capabilities.

Target audience
Engine enthusiasts and mechanics for performance engines

Some knowledge of electronics, voltage, current resistance is necessary. Knowledge of operation of Spark Ignition engine is also necessary. Appreciation of Spark timing, fuel quantity, torque, brake horse power are also required for a successful participation in the course.

The course will be using The Reata Engineering ECU as a reference ECU. The Reata ECU was developed by Mario Farrugia (the lecturer of the course) and Michael Farrugia.

Course is conducted in Maltese language but using technical English words. If 10 or more students prefer the course in English, another course in English will be organized.

Course content
Taught portion
ECU principles, need for sensing and control
Sensors: Crank and Cam signals, TPS, MAP, IAT, Lambda
Sensor connection
Sensor testing and calibration
Engine mapping, starting from a blank sheet
Spark map, MBT timing
Fuel Mapping, exhaust lambda
Different engine cam and crank topologies

Practical portion
Testing and mapping of naturally aspirated spark ignition engine on dynamometer. Mapping of fuel quantity through exhaust Lambda sensing (four wire and/or five wire). Mapping of ignition through torque sensing, spark hooks.

Dr Ing Mario Farrugia,
mario.a.farrugia@um.edu.mt 79497809

Short CV

Current experience

Dr Mario Farrugia is currently a lecturer in the Mechanical Engineering Department of the University of Malta. His specialization is in Thermodynamics and Heat Transfer. His areas of interest are Power Generation Plants, Internal Combustion Engines, Electronic Engine Controls, Mechatronics, Control and Engine Simulation.

Past experience

Dr Farrugia has previously worked with Enemalta Corporation. He worked at Delimara Power Station as a mechanical maintenance engineer and later as project engineer. His later involvement was in the tender specification, adjudication and commissioning of the Phase 2A and 2B plants at Delimara, with direct involvement in the gas turbines and fuel delivery.

Education

Undergraduate degree in general mechanical engineering from the University of Malta, Malta, from 1988 to 1992.
Masters degree in Mechatronics from the Electronics and Controls Department, University of Hull, England 1995/1996.
Doctoral study at Oakland University Rochester Michigan USA from 2001 to 2005.

Electronic Engine Controls

Mario Farrugia together with brother Michael (Reata Engineering) have been involved in electronic engine controls ECU since 1998. The ECU built then was a microprocessor based unit that controlled the spark timing of a spark ignition engine. The ECU's continued to evolve in both computational power and wider functionality. Fuel injection control, launch control and closed loop (self learning) capabilities are now implemented. The ECU also has the ability to be software set for different cam/crank topologies and different engine sensors. The development of the ECU's was supported by the electronics knowledge of Michael together with the theoretical and practical engine testing that Mario obtained at Oakland University Michigan. The ECU was used for the Formula SAE cars at Oakland starting in 2004 and also used for the University of Malta Formula SAE car.

Formula SAE Project

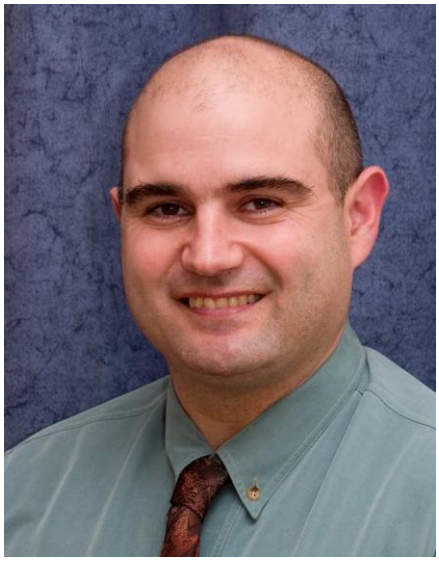
Faculty advisor for the University of Malta Formula SAE team. Having been extremely active in the Formula SAE student chapter at Oakland University, was delighted to appreciate that there was enthusiasm for this even in Malta. Work here started by making the students and other lecturers aware that we can actually built this and compete in an international competition. During summer 2007 a huge effort from the student group throughout mornings, afternoons evenings and weekends culminated in the students finishing the car and taking it to competition in the Ferrari race track at Fiorano Italy. The University of Malta Formula SAE team was given the Best Endeavour Award as a recognition of the tremendous effort shown in building and competing with our car.

Awards

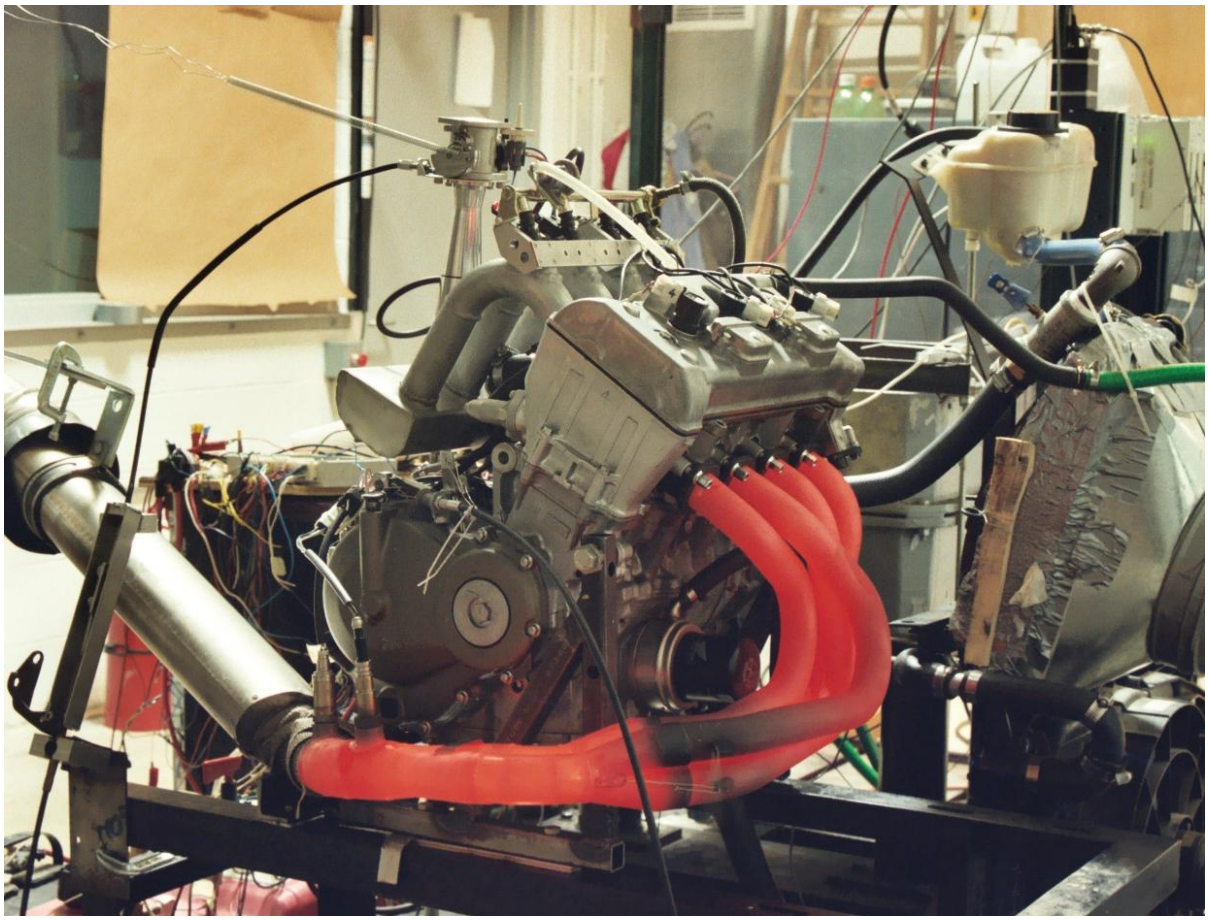
Malta Engineering Excellence Awards 2003: Received the Innovation Award, with others from the University of Malta, for the development of the Electric Car at the University of Malta.
Myers Award 2007: Received the SAE International's Myers Award for Outstanding Student Paper at the SAE 2007 World Congress in Detroit, April 16-19. The award, established in 1998, recognizes the best technical paper written by a student and presented at a major SAE meeting. The award honors Dr. Phil Myers, former SAE President and retired professor at the University of Wisconsin-Madison. The award was received as the

lead author for the paper, "Cycle- Averaged Heat Flux Measurements in a Straight-Pipe Extension of the Exhaust Port of an SI Engine" (SAE Paper #2006-01-1033).

Professional Membership
Warranted Engineer in Malta,
Charted Engineer in the UK,
Member Institute of Mechanical Engineers,
Member Institute of Engineering Technologists,
Member Society of Automotive Engineers,



Dr Ing Mario Farrugia
BEng(Hons), MSc, PhD,
CEng, MIMechE, MIET, SAE



Honda F4i with a restricted intake, being tested on waterbrake dynamometer, Wide Open Throttle WOT 12000rpm. Oakland University Formula SAE testing setup 2005.