Calculating Necessary Engine Size

Orientation:
In this activity you will use given engine specs and then make assumptions using typical performance parameters about mean piston speed and brake mean effective pressure. This will enable you to calculate expected output torque and power. You will validate your assumed bmep value against one derived from process efficiencies expected for different engine applications. Using equations to mathematically predict engine performance is much more cost effective than a design/test approach. Making assumptions, explaining them, and documenting them for future reference is necessary in all engine modeling.

Learning Objectives:
1. Use two different versions of modeling equations to predict engine power.
2. Understand how to make assumptions about BMEP, MPS, η_m, η_i, η_c, and η_v that reflect peculiarities of different engine types and geometries.

Targeted Skills:
Identifying assumptions – examining preconceptions/biases
Validating – using alternative methods to test results
Reasoning with theory – explaining data with accepted knowledge

The instructor will assign each group a pair of engines to examine.

Simple Modeling using BMEP assumption
1) For the engines given, discuss as a group what Brake Mean Effective Pressure (BMEP) seems reasonable for the given applications. Also, discuss what Mean Piston Speed (MPS) you would expect in each application at peak power. Record the values chosen, and justify *why* they were chosen.

	BMEP (peak power)	**MPS (peak power)**
Engine 1		
Engine 2		

2) Calculate Max RPM, and Power Output [hp] and [kW] for the engines using BMEP assumption from above.

	Max RPM	**Power**
Engine 1		
Engine 2		

More detailed modeling using larger equation

3) As a group, discuss what values should be used for Mechanical Efficiency, Volumetric Efficiency, and Combustion Efficiency when calculating peak power and peak torque. Justify *why* you chose these values. Calculate the Indicated Thermal Efficiency using compression ratio (and load ratio for CI engines).

	η_m	η_i	η_c	η_v
Engine 1 (power)				
Engine 2 (power)				

4) Use the recently developed model from class with given engine parameters and above assumptions to predict Power output [kW] of the given engines.

Engine 1 (power)

Engine 2 (power)

ENGINE PAIR 1

Engine 1	**Saito 5-cylinder radial**		**Engine 2**	**Yamaha WR250F (2005)**	
Specs:		Units	Specs:		Units
Bore	24.8	mm	Bore	77	mm
Stroke	22	mm	Stroke	53.6	mm
# cylinders	5		# cylinders	1	
Compression ratio	8		Compression ratio	12.5	
Heating value	-15	MJ/kg	Heating value	-42	MJ/kg
Air fuel ratio	4		Air fuel ratio	15	
alpha	cr/4				

ENGINE PAIR 2

Engine 3	**Yamaha YZ250F**		**Engine 4**	**GM 5.7L LS6**	
Specs:		Units	Specs:		Units
Bore	77	mm	Bore	3.9	in
Stroke	53.6	mm	Stroke	3.62	in
# cylinders	1		# cylinders	8	
Compression ratio	12.5		Compression ratio	10.5	
Heating value	-42	MJ/kg	Heating value	-42	MJ/kg
Air fuel ratio	15		Air fuel ratio	15	

ENGINE PAIR 3

Engine 5	**Honda B18C1**		**Engine 6**	**Yamaha R6 (2006-2007)**	
Specs:		Units	Specs:		Units
Bore	81	mm	Bore	67	mm
Stroke	87	mm	Stroke	42.5	mm
# cylinders	4		# cylinders	4	
Compression ratio	10.6		Compression ratio	12.8	
Heating value	-42	MJ/kg	Heating value	-42	MJ/kg
Air fuel ratio	15		Air fuel ratio	13	

ENGINE PAIR 4

Engine 7	**Cummins Turbo Diesel**		**Engine 8**	**Polaris 600HO (2-stroke)**	
Specs:		Units	Specs:		Units
Bore	4.02	in	Bore	77.24	mm
Stroke	4.72	in	Stroke	64	mm
# cylinders	6		# cylinders	2	
Compression ratio	16.3		Compression ratio	7	
Heating value	-40	MJ/kg	Heating value	-40	MJ/kg
Air fuel ratio	20		Air fuel ratio	12	