Engine Design

FLYWHEELS

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ENERGY METHOD

- Are generally called Lagrangian methods.
- Are quick and easy to use.
- But give limited information compared to Newtonian methods.
- Lagrangian methods give no information on internal forces.
- Can calculate for the input torque.

ENERGY METHOD

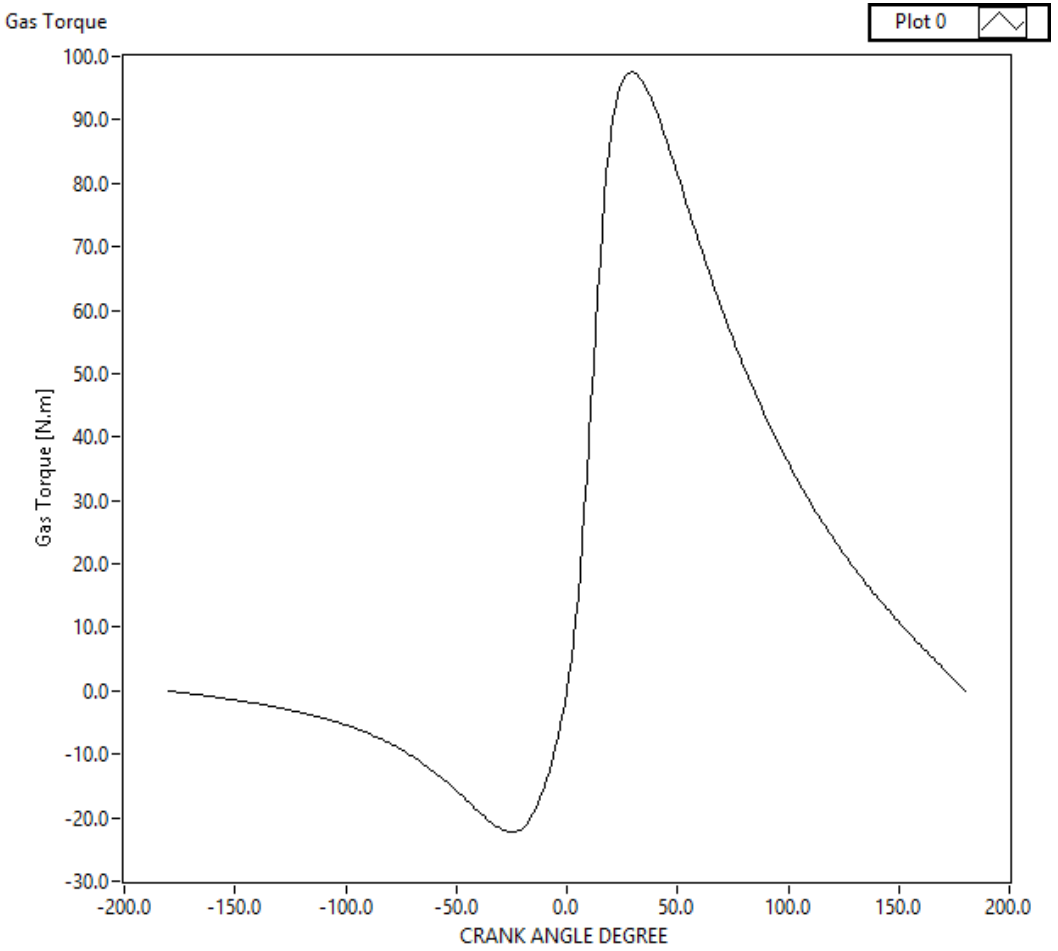
- Is an energy (work) method from its name.
- But is misnamed as actually uses a power equation.
- Work, $W = F \cdot R$ [N.m] or [J], Can be positive, negative or zero.
- Power, $P = \frac{dW}{dt}$, [N.m.s^{-1}] or [W], rate of work done.

KINETIC ENERGY

- Energy of a moving mass, *m* at speed *v*
- $K.E. = \frac{m \cdot v^2}{2}$ [J],
- Power, $P = \frac{d\left(\frac{m \cdot v^2}{2}\right)}{dt} = F \cdot v$, [W], for linear motion.
- $P = \frac{d\left(\frac{I \cdot \omega^2}{2}\right)}{dt} = T \cdot \omega$, [W], for angular motion.

- Torque typically varies widely over the cycle
- Motors must change speed to change torque
- We usually want constant speed
- So – a dilemma: How maintain constant speed in the face of a time-varying torque?

Typical Gas Torque



Past year Final Exam Question

A single cylinder, four-stroke petrol engine develop 1 kW at 3000 RPM. The work done by the gases during expansion stroke is 2.3 times the work done on the gases during compression stroke and the work done during intake and exhaust stroke is negligible. These is represented by torque of the engine as shown in **Figure Q2**. The speed is to be maintained within ±1 %.

Estimate the moment of inertia of the required flywheel.

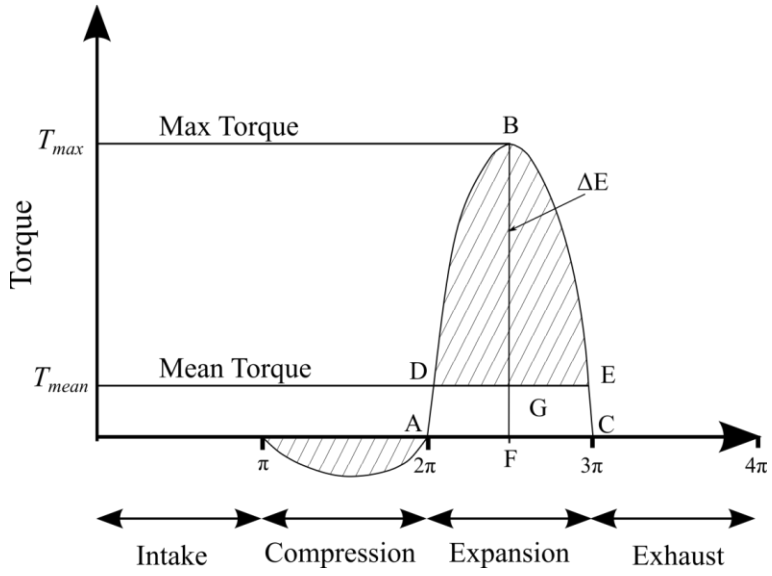


Figure Q2

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