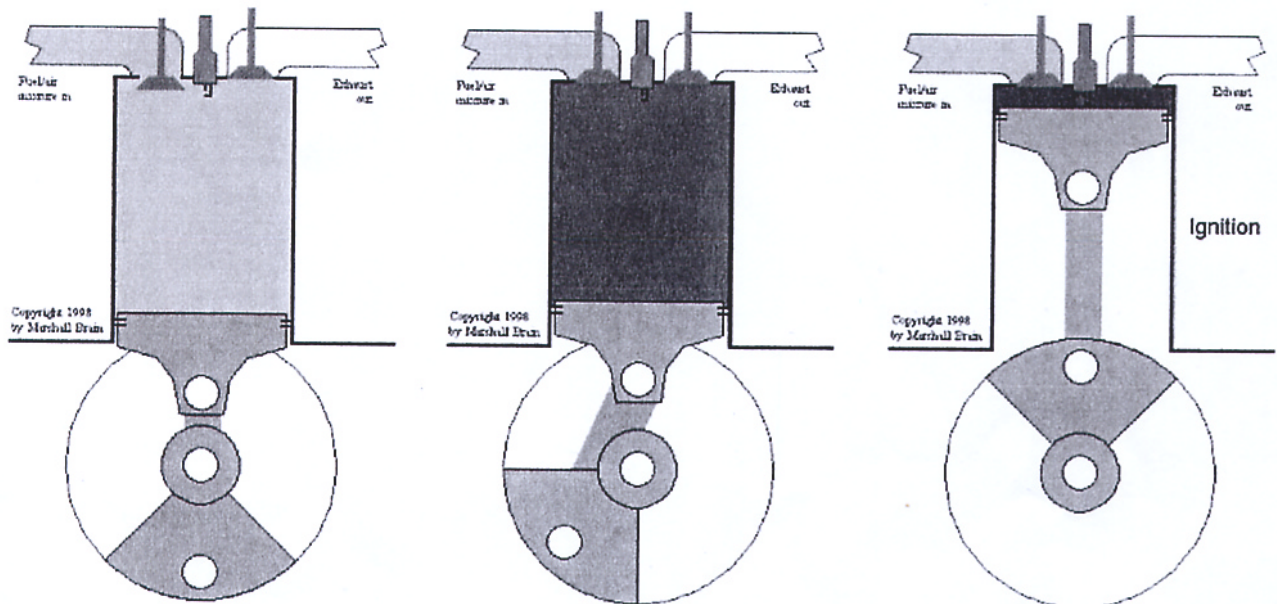


2005/10 Doctoral Qualification Exam: Manufacturing Processes

1. Given the following materials, please comment on their probable working environments (loading and temperature), mechanical and chemical properties.
(i) plastics, (ii) superalloy (iii) ceramics (10%)
2. Give a short statement about the non-traditional machining processes to distinguish from the traditional manufacturing processes. Also, describe the working algorithm, process characteristics, their applications and comment on their advantages and disadvantages, if any.
(i) ElectroChemical Machining (ii) wire EDM
(iii) Laser Beam Machining (iv) Ultra-sonic machining (20%)
3. What are the four major categories of traditional manufacturing processes, name three processes in each categories. (20%)

(1) What is the difference between the “strength” and “stiffness” of a structure? What will happen if the strength of a structure is not enough? What will happen if the stiffness of a structure is not enough? (5%) What material property represents the strength of the material? What material property represents the stiffness of the material? (5%)

(2) The following figure is the operation procedure of an engine. Please use a skeleton diagram to represent this mechanism.(2%) How many links are there in this mechanism? (1%) How many joints are there? (1%) What are the names of the joints? (2%) What is the name of this mechanism? (2%) Use an equation to calculate the total degree of freedom of this mechanism. (2%)



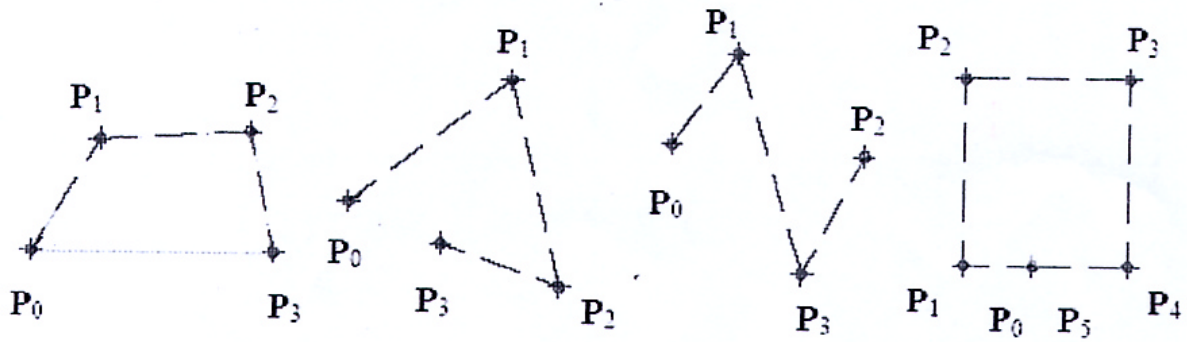
(3) When a spring is in compression or tension, the wire itself is twisted. Strain energy stored in the wire when the spring wire is twisted can be expressed as

$$U = \frac{1}{2} K_{\theta} \theta^2 = \frac{1}{2} \left(\frac{GJ}{L} \right) \theta^2 = \frac{1}{2} \left(\frac{GJ}{L} \right) \left(\frac{TL}{GJ} \right)^2 = \frac{T^2 L}{2GJ},$$

where $T = \frac{FD_m}{2}$, $J = \frac{\pi D_w^4}{32}$, and $L = \pi D_m N_a$.

From $F = k\delta$, strain energy is equal to $U = \frac{1}{2} k\delta^2 = \frac{F^2}{2k}$. Derive spring constant k (6%), and discuss how the parameters of a spring (G, D_w, D_m, N_a) influence k . (4%)

(4) Draw the Bezier curves defined by the control points below. (10%)



(5) Explain in “egg roll(蛋餅) manufacturing”, what are the manufacturing cost terms in the following figure.(10%)

