EO M232.03 – EXPLAIN THE CYCLES OF A FOUR-STROKE PISTON-POWERED ENGINE

1. **Performance**: Explain the Cycles of a Four-stroke Piston-powered Engine

2. **Conditions**:

   a. Given:

      (1) Supervision; and

      (2) Assistance as required.

   b. Denied: N/A.

   c. Environmental: Suitable classroom facilities or training area large enough to accommodate the entire group.

3. **Standard**: In accordance with specified references, the cadet shall explain the cycles of a four-stroke piston-powered engine, to include:

   a. the purpose of each stroke;

   b. the intake/exhaust valve operations; and

   c. the ignition spark timing methods.

4. **Teaching Points**:

TP	Description	Method	Time	Refs
TP1	Explain the purposes of the strokes of a four-stroke piston, to include: a. the intake (induction) stroke is responsible for drawing fuel and air into the combustion chamber; b. the compression stroke forces the fuel and air into the combustion chamber; c. the power (combustion) stroke transmits the energy of the exploding fuel to the crankshaft; and d. the exhaust stroke cleans the cylinder of exhaust fumes and prepares it for the next intake stroke.	Interactive Lecture	15 min	C3-116 (p. 43) C3-086
TP2	Identify and explain the operation of: a. valves; and b. cam shafts.	Interactive Lecture	5 min	C3-116 (p. 43) C3-086
TP3	Explain the timing of electrical ignition spark distribution, to include: a. the time required for the complete combustion; b. a unique time for each cylinder's detonation; and c. the mechanical arrangements providing timing.	Interactive Lecture	10 min	C3-116 (p. 43) C3-086

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TP	Description	Method	Time	Refs
TP4	Explain that all the engine operations must proceed precisely in order and list those operations in order, with emphasis on the simultaneous events, to include: a. fuel and air mixture; b. intake stroke; c. intake valve operation; d. compression stroke; e. electrical points operation; f. power stroke; g. exhaust stroke; h. exhaust valve operation; and i. camshaft operation.	Interactive Lecture	10 min	C3-116 (p. 43) C3-086
TP5	Enact the performance of the four-stroke engine operation in teams of six.	In-Class Activity	15 min	C3-086

5. **Time**:

a.	Introduction / Conclusion:	5 min
b.	Interactive Lecture:	40 min
c.	In-Class Activity:	15 min
d.	Total:	60 min

6. **Substantiation**:

   a. An interactive lecture was chosen for TP1 to TP4 to introduce the cycles of a four-stroke piston-powered engine and give an overview of them.

   b. An in-class activity was chosen for TP5 as it is an interactive way to provoke thought and stimulate interest among the cadets.

7. **References**:

   a. C3-086 NASA Glenn Research Center. *Engines 101.* Retrieved 21 February 2007, from http://www.grc.nasa.gov/WWW/K-12/airplane/icengine.html.

   b. C3-087 NASA Glenn Research Center. *Propulsion Index.* Retrieved 21 February 2007, from http://www.grc.nasa.gov/WWW/K-12/airplane/shortp.html.

   c. C3-116 A-CR-CCP-263/PT-001 (ISBN 0-9680390-5-7) MacDonald, A. F. and Peppler, I. L. (2000). *From the Ground Up: Millennium Edition.* Ottawa, ON: Aviation Publishers Co. Limited.

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8. **Training Aids**: Presentation aids (e.g. whiteboard/flipchart/OHP) appropriate for the classroom/training area.

9. **Learning Aids**: N/A.

10. **Test Details**: N/A.

11. **Remarks**:

    a. It is recommended that the two periods required for this EO be scheduled consecutively.

    b. If a computer and projector are available, software to demonstrate engine operation can be found at the Websites listed under reference para 7.b.

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