

Name: \_\_\_\_\_ Entry No. \_\_\_\_\_

**CENTRE FOR ENERGY STUDIES**  
**Alternative Fuels for Transportation (ESL 875)**

**December 2, 2006**

**Venue: IV-LT-2**

**Time: 10:30AM-12:30PM**

**Total Marks: 60**

*Note: Write the name and entry number in the question paper.*

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**1. Indicate if the following statements are True (T) or False (F)**

**(20 marks)**

- i. Diesel-fuelled engines emit higher levels of  $\text{NO}_x$  as compared to petro-diesel ones (.....)
- ii. Biodiesel possesses better lubricity than conventional diesel (.....)
- iii. In hydrogen engine  $\text{NO}_x$  emissions tend to be higher than manifold injection configuration because of higher combustion temperature (.....)
- iv. Biodiesel vehicles have lesser cold start problems relative to petro-diesel (.....)
- v. DME engine can have the same  $\text{NO}_x$  emission level as the Otto engine with 3-way catalytic converter (.....)
- vi. DME has a lower heating value than diesel
- vii. DME has a higher viscosity than diesel and hence does not necessitate a lubricant for engine applications. .
- viii. Timed manifold injection for hydrogen fuel utilization in S.I. engine is considered superior than carburetion version in terms of combustion and emission characteristics.
- ix. Hydrogen because of its low minimum ignition energy makes it sometimes very unsafe and needs special safety device to be used for engine applications.
- x. LPG has got a lower octane rating compared to premium petrol(     )
- xi. Addition of methane to LPG increases its Octane number (     )
- xii. Amongst ULS Diesel, Petrol and LPG, ultra-low sulphur Diesel has the lowest tailpipe  $\text{NO}_x$  emissions. (     )
- xiii. As compared with Petrol, LPG combustion enhances the deposits of soot on combustion chamber walls (     )
- xiv. Use of GTL in existing vehicles gives significant emission benefit in terms of PM,  $\text{NO}_x$ , HC and CO (     )
- xv. It is essential to have a cetane improver for using DME in engines. (     )
- xvi. LNG must be maintained cold (at least below 117 K) to remain liquid, independent of pressure
- xvii. As liquid, LNG is not explosive, but LNG vapor is explosive within the flammability range when mixed with air.
- xviii. LNG combustion reduces  $\text{NO}_x$  and VOC, but increases methane emissions
- xix. LPG combustion ensures high  $\text{NO}_x$  and particulate matter emissions
- xx. DME engine can have the same  $\text{NO}_x$  emission level as the Otto engine with 3-way catalytic converter.

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**2. Fill in the blanks with appropriate words**

**(10 marks)**

- i. Flammability limits of hydrogen are in the range of .....% to .....% by volume whereas those of iso-octane are between .....% to .....% by volume.
- ii. Biodiesel has a cetane number in the range of .....
- iii. A neat biodiesel engine ensures approximately ..... % reduction in sulphate emissions compared to conventional diesel.
- iv. Premixed hydrogen produces about ..... % less power than iso-octane when both fuels are used in stoichiometric proportions and at atmospheric manifold pressure.
- v. Cetane number of DME is of the order of .....
- vi. The only pollutant of major concerns in hydrogen operated S.I. engine is .....
- vii. .... is the process by which vegetable oils can be made suitable for diesel engine applications.
- viii. Soot emissions from DME operated engines are generally ..... than a similar diesel operated engine.
- ix. When vaporized LNG burns only in concentrations of \_\_\_\_\_% to \_\_\_\_\_% when mixed with air.
- x. Stoichiometric A/F ratio of DME is about \_\_\_\_\_
- xi. LPG is predominantly a mixture of ----- and ----- in different proportions.
- xii. Octane rating of LPG is about ----- as compared to ----- for premium petrol
- xiii. Soot emissions from DME operated engines are generally ----- than a similar diesel operated engine.
- xiv. Premixed hydrogen produces about -----% less power than iso-octane when both fuels are used in stoichiometric proportions and at atmospheric manifold pressure.

**3. List out**

**(18 marks)**

- a. Two transportation fuels derived from Natural gas by physical operation:

(i)

(ii)

- b. Two transportation fuels derived from Natural gas by chemical conversion:

(i)

(ii)

- c. Two operating methods of lowering the NO<sub>x</sub> emission level in a hydrogen engine:

(i)

(ii)

d. Two properties of DME which makes it superior than diesel for engine application.

(i)

(ii)

e. Two commonly used methods through which hydrogen is being produced all over the world.

(i)

(ii)

f. List out five significant measures adopted in India for control of vehicular emission.

(i)

(ii)

(iii)

(iv)

(v)

g. List three significant features of LPG-Hydrogen combustion in automotive engines

(i)

(ii)

(iii)

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**4. Explain**

**(6 marks)**

(i) "Regasification" in the context of LNG

(ii) Two methods to lower NOx emissions from hydrogen engine

(iii) Why it is possible to achieve ultra-lean hydrogen SI engine operation

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**5. Comment on the following**

**(6 marks)**

- a. Explain why no significant emission of PAH takes place with DME operation
- b. Explain the phenomena of “Auto-refrigeration “ and “Rapid Phase Transition” in respect of LNG
- c. Discuss some GTL production technology indicating the key steps. Explain the advantages of GTL process from environment point of view.