

CS/B.TECH/ME/PE/EVEN/SEM-6/ME-601/2015-16



**MAULANA ABUL KALAM AZAD UNIVERSITY OF
TECHNOLOGY, WEST BENGAL**

Paper Code : ME-601

**INTERNAL COMBUSTION ENGINES
& GAS TURBINES**

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own
words as far as practicable.*

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following :

10 × 1 = 10

- i) The ratio of work done per cycle to the swept volume in case of IC engine is called
- compression index
 - compression ratio
 - compressor efficiency
 - mean effective pressure.

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- ii) A heat engine is supplied heat at the rate of 30000 J/s and gives an output of 9 kW. The thermal efficiency of engine will be
- 30%
 - 33%
 - 40%
 - none of these.
- iii) The term 'scavenging' is generally associated with
- 2-stroke cycle engine
 - 4-stroke cycle engine
 - aeroplane engine
 - high efficiency engines.
- iv) The fuel catane
- has zero cetane number
 - has 100 cetane number
 - helps detonation
 - is a straight chain paraffin
 - both (b) and (d).
- v) For same power and same speed, the flywheel of a 4-stroke engine as compared to 2-stroke engine will be
- smaller
 - bigger
 - same size
 - depend on other engine parameters.

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- vi) In a four-stroke IC engine cam shaft rotates at
- same speed as crankshaft
 - twice the speed of crankshaft
 - half the speed of crankshaft
 - none of these.
- vii) Engines used for ships are normally
- four-stroke SI engines of very high power
 - two-stroke SI engines of very high power
 - four-stroke CI engines of very high power
 - two-stroke CI engines of very high power.
- viii) The advancing of spark timing in S.I. engine will
- reduce knocking tendency
 - increase knocking tendency
 - not have any effect
 - none of these.
- ix) The thermal efficiency of closed cycle Gas turbine plant increases by
- reheating
 - inter-cooling
 - regenerator
 - all of these.
- x) Major application of gas turbines is for
- Aircraft
 - Locomotive
 - Automobiles
 - all of these.

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GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

- Define effectiveness of a regenerator.
 - What is the effect of irreversibilities in Turbine and Compressor ? 2 + 3
- Derive the expression of optimum pressure ratio for maximum work output in an ideal Brayton cycle. What is the corresponding cycle efficiency ?
- Define volumetric efficiency. Explain how it is important related to the performance of IC engines. Mention the factors that affect volumetric efficiency.
- What is supercharging ? What is objective of supercharging ? Draw the $p-v$ diagram of supercharged engine. 2 + 2 + 1
- Explain with sketches the working of a 2-stroke engine. What is scavenging ? 3 + 2

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GROUP - C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) The bore and stroke of a water cooled vertical single cylinder, four stroke diesel engine are 80 mm and 110 mm respectively and the torque developed is 23.5 Nm. Calculate the brake mean effective pressure.
- b) Air enters the compressor of a gas turbine plant operating on Brayton cycle at 1 bar pressure and 300 K temperature. The pressure ratio is 5 and the maximum cycle temperature is related to 1075 K. If the compressor and turbine efficiencies are 80% and 85% respectively calculate net work output, cycle efficiency and work ratio.
- c) Explain the various factors that influence the flame speed. $4 + 8 + 3$
8. a) A four-cylinder four-stroke engine having diameter and length of stroke as 100 mm and 120 mm respectively and is running at 1800 RPM. Its carburetor venturi has a 28 mm throat. Assuming co-efficient of air flow 0.8, the density of air is 1.2 kg/m^3 and volumetric efficiency as 0.75, determine the suction of the throat.

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- b) An unknown hydrocarbon fuel C_xH_y was allowed to react with air. An analysis was made of a representative sample of the product gases with the following result : CO_2 12.1%, O_2 3.8%, CO 0.9%. Determine —
 - i) the chemical equation for the actual reaction
 - ii) the composition of the fuel
 - iii) the air-fuel ratio during the test
 - iv) the excess or deficiency of air used. $7 + 8$
9. a) Briefly explain the stages of combustion in SI engine elaborating the flame front propagation. 5
- b) Write short notes on any *two* of the following : 2×5
 - i) Dissociation
 - ii) Fuel-air cycle
 - iii) Battery ignition system
 - iv) Magneto-ignition system.
10. a) Derive the efficiency of Brayton cycle.
- b) In a closed cycle gas turbine the following data apply :
 Working substance = Air, $C_p = 1 \text{ kJ/kg-K}$, Ambient temperature = 27°C , Top temperature = 823°C , Pressure at compressor inlet = 1 bar, Pressure ratio = 4, Compression ratio = 80%,

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Turbine efficiency = 85%, Heating value of fuel = 41800 kJ/kg. Heater loss = 10% of the heating value. Find the following :

- i) Compression work
- ii) Heat supplied
- iii) Turbine work
- iv) Thermal efficiency
- v) Air : Fuel ratio. 6 + 9

11. a) Describe D-MPFI and L-MPFI injection systems.
- b) Clearly explain the various wet sump lubrication system. 7 + 8

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