

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination, May 2016
B. Tech in Mechanical Engineering, Semester IV

Roll No.....

ME 409: I.C. Engines & Gas Turbines

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.
4. Scientific Calculator without programming of any type is allowed.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark) 10

- i. The efficiency of the simple ideal cycle gas turbine is a function of (a) only the γ of the working fluid (b) only the pressure ratio (c) both pressure ratio and γ (d) inlet temperature of the turbine.
- ii. Increasing the compression ratio in SI engines the knocking tendency ; (a) decreases (b) increases (c) not affected (d) none of the above
- iii. In CI engines knocking tendency increases with; (a) increase in compression ratio (b) increasing inlet temperature of air (c) decrease in compression ratio (d) increasing coolant water temperature
- iv. Volumetric efficiency is a measure of; (a) speed of the engine (b) power of the engine (c) breathing capacity of the engine (d) pressure rise in the cylinder
- v. During starting petrol engines require; (a) Stoichiometric mixture (b) lean mixture (c) rich mixture (d) any air-fuel ratio is alright
- vi. Radiator is provided to; (a) cool the jacket water (b) pressurize the cooling water (c) provide additional water flow (d) none of the above
- vii. The lubricating system incorporated in two stroke petrol engine is; (a) wet sump lubrication system (b) Splash system for a single cylinder engine (c) Mist lubrication (d) Dry sump lubrication system
- viii. One of the major exhaust emissions from CI engines compared to SI engine is; (a) oxides of nitrogen (b) unburnt hydrocarbons (c) particulates (d) CO and CO₂
- ix. Mean effective pressure of Otto cycle is; (a) inversely proportional to pressure ratio (b) directly proportional to pressure ratio (c) does not depend on pressure ratio (d) proportional to square root of pressure ratio
- x. The lubricants commonly used in the automobiles are; (a) animals oils (b) vegetable oils (c) mineral oils (d) cooking oils

Q.2 Short answer type questions (4 questions @ 2.5 marks) 10

- i. What is meant by TDC and BDC? In a suitable sketch mark the two dead centers.
- ii. What is the function of a radiator?
- iii. Compare the relative advantages and disadvantages of four-stroke and two stroke engines.



- iv What is meant by Carburetion? 05
- Q.3A What is meant by delay period? It is usually divided into two parts. Name and describe them. 05
- Q.3B Briefly explain with a neat sketch the operation of a simple float type carburetor. 05
- Q.4A Explain the stages of combustion in a Compression Ignition engine. 05
- Q.4B Derive an expression for the air-standard efficiency of the Diesel cycle. 05
- Q.5A Why a very rich mixture is required for idling? 05
- Q.5B Describe the working of a Roots blower with the help of a neat sketch. 05
- Q.6A Explain the phenomenon of diesel knock. 05
- Q.6B Explain with a sketch the non-exhaust emission from a vehicle. 05
- OR
- Q.6B Give a brief account of air pollution due to engines. 05
- Q.7 Enlist and discuss the important properties of a lubricant which affect engine performance. 10
- OR
- Q.7 Derive the expressions for efficiency and specific work output for a simple gas turbine cycle in terms of pressure ratio. 10
- Q.8 Derive an expression for the mean effective pressure of the Otto cycles. 10
- Q.9 A test on a single cylinder, four stroke oil engine having bore 18 cm and stroke 36 cm yielded the following results; speed 285 rev/min; brake torque, 393 Nm; indicated m.e.p., 7.2 bar; fuel consumption, 3.5 kg/hr; cooling water flow, 4.5 kg/min; cooling water temperature rise 36°C ; air-fuel ratio by mass, 25; exhaust gas temperature, 415°C ; barometric pressure, 1.013 bar, room temperature 21°C . The fuel has a calorific value of 45200 kJ/kg and contains 15% by mass of hydrogen. Determine (a) indicated thermal efficiency, (b) volumetric efficiency based on atmospheric conditions. Draw up a heat balance in terms of kJ/min explaining clearly the content of such term. Take $R = 0.287 \text{ kJ/kg K}$, C_v for dry exhaust gases = 1.005 kJ/kg K and for superheated steam $C_p = 2.05 \text{ kJ/kg K}$. 10
- Q.10 An air standard diesel cycle has a compression ratio of 14. The pressure at the beginning of the compression stroke is 1 bar and the temperature is 27°C . The maximum temperature is 2500°C . Determine the thermal efficiency and the mean effective pressure. 10
- OR
- Q.10 A closed-cycle regenerative gas turbine operating with air as the working medium. Assume the following data: $p_1 = 1.4 \text{ bar}$, $T_1 = 310 \text{ K}$, $p_2/p_1 = 5$, $T_{\text{max}} = 1050 \text{ K}$, effectiveness of the regenerator is 100%, net output = 3000 kW. Assuming the compression and expansion to be isentropic, calculate:
1. thermal efficiency, and 2. mass flow rate of air per minute. 10

-----ALL THE BEST-----

