Paper Code: MME 173 **Roll No.** | | | | | | | | | | |

M.Tech
(SEM I) THEORY EXAMINATION, 2015-16
Internal Combustion Engines

Time: 3 Hours **Max. Marks: 100**

Note: ***1. Attempt any five questions. Marks are indicated against each question.***
2. Assume any missing data suitably.

Q1) Answer the following 10x2=20

(i) Draw valve timing diagram of 4-stroke high speed and low speed SI engine. A four stroke diesel engine is operating at 2400 rpm. Fuel injection starts at 20° before TDC and ends at 5° after TDC. If the quantity of fuel injected in a cycle is 40 mg. Find the fuel injection rate in kg/s.

(ii) List the various losses considered in the analysis of the actual cycle. Discuss the losses due to the variation of specific heats on the otto cycle with the help of PV diagram.

Q2) Answer the following 10x2=20

(i) Compare 2- stroke and 4-stroke engine on the basis of volumetric, mechanical and thermal efficiency. A three litre four stroke SI V6 square engine is connected to a dynamometer which gives a brake output torque of 205 N-m at 3600 rpm. Air at 20 C and 1 bar enters the engine at a rate 5.4 kg/min find the volumetric efficiency of the engine.

(ii) Derive the expression of thermal efficiency of diesel cycle in terms of compression and cutoff ratio. A diesel engine intakes atmospheric air at 1 bar & 27 C. heat supplied during the cycle is 1000kJ/kg. If the maximum pressure is 5 MP, find (i) cut off ratio (ii) thermal efficiency (iii) power output for an air flow of 0.1 kg/s.

Q3) Answer the following 10x2=20

(i) Define octane No. An old car has a engine with a carburetor adjusted to supply stoichiometric air-fuel supply at normal condition using gasoline (C_8H_{15}) as fuel. Calculate the actual equivalence ratio the carburetor is supplying to the engine when it is supplied with the M20 (20% blend of methanol in petrol fuel).

(ii) Describe with suitable sketch the combustion phenomenon in SI engine. Discuss the effect of F/A ratio, compression ratio, engine load and engine speed on flame propagation.

Q4) Answer any four of the following 5x4=20

a) Define flame development and rapid burning angle in SI engine combustion
b) Discuss the effect of cetane no. and engine speed on delay period.
c) Show instantaneous heat release Vs crank angle for direct injection CI engine.

d) Discuss the effect of spark timing, turbulence and engine size on knocking in SI engine.
e) Discuss common rail injection system with neat sketch.

Q5) 20x1=20

Name the different regulated and unregulated emission coming out of engine. Discuss the major causes for the formation of HC emissions in SI engine. Also discuss design and operating variable which may reduce the formation of HC in SI engine.

Q6) Answer the following 10x2=20

(i) Describe the working principle of NDIR gas analyzer with the help of schematic diagram for measuring CO concentration in exhaust gases.

(ii) A hydrocarbon fuel has the following composition of dry products of combustion by volume: CO2 = 12%, CO=0.5%, O2= 4%, and the rest N2 . Determine the A/f ratio, equivalence ratio and percentage composition of fuel on mass basis.

Q7) Answer the following 10x2=20

(i) A six cylinder square four stroke 5 litre engine is tested at 2500 rpm on dynamometer which has 50 cm arm. The dynamometer scale reading was 500 N. The air consumption is measured by Air box method. The following readings were observed,
Ambient pressure and temperature = 1 bar and 27 ºC
Orifice dia = 30 mm, pressure drop across orifice = 14 cm of Hg, C_d of orifice = 0.6
For fuel, C/H ratio by mass = 83/17, density = 780 kg/m3,
time taken for 100 ml fuel consumption = 18 s,
Find bore of the engine, bsfc, equivalence ratio, volumetric efficiency and bmep.

(ii) Discuss the use of hydrogen as a fuel in internal combustion engines.