Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech(ME)/SEM-5/ME-501/2009-10

2009

IC ENGINE & STEAM TURBINE

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 Ty e Questions)

1. Choose the correct alternatives of the following : 10 × 1 = 10

i) Commonly used injection system in automobile is

a) air injection

b) solid injection

c) combination of (a) and (b)

d) none of these.

ii) Supercharging increases the power output of the engine by

a) increasing the charge temperature

b) increasing the charge pressure

c) increasing the speed of the engine

d) none of these.

iii) The most perfect method of scavenging is

a) cross scavenging

b) uniflow scavenging

c) loop scavenging

d) reverse flow scavenging.

iv) The air fuel ratio of the petrol engine is controlled by

a) carburetor b) injector

c) g vernor d) none of these.

v) For Mach number > 1

a) covergent passage will act as the diffuser

b) divergent passage will act as the diffuser

c) divergent passage will act as nozzle for incompressible flow only

d) both (b) and (c).

vi) Detonation in SI engine occurs due to

a) pre-ignition of the charge before the spark

b) sudden ignition of the charge before the spark

c) auto ignition of the charge after the spark

d) none of these.

vii) During starting, petrol engine requires

a) stoichiometric mixture

b) lean mixture

c) rich mixture

d) any A/F ration is sufficient.

viii) Ignition quality of dies l engine is indicated by its

a) octane number b) cetane number

c) flash point d) fire point.

ix) Pure reaction turbine is

a) feasible b) not feasible

c) partially feasible d) none of these.

x) The speed of the steam turbine is controlled by

a) governor b) fly wheel

c) centrifugal pump d) none of these.

GROUP – B
(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. A spray type de-super heater is supplied with water at 60°C. It is connected in a steam line carrying 200 t/h of steam at 35 bar. Calculate the amount of water that must be sprayed per hour to maintain steam at 400°C when the boiler load causes steam to leave at 450°C.

   The enthalpies at 35 bar 450°C, 60°C and 35 bar 400°C are 3337·2 kJ/kg, 252 kJ/kg and 3222·3 kJ/kg respectively.

3. a) What is the difference between S I. and C.I. engines knocking ? 2

   b) What do you mean by IGNITION QUALITY of a fuel ? 1

   c) Explain how the ignition lag is an important parameter for causing knock ng in a C.I. engine ? 2

4. a) State the main performance parameters of a I.C. engine.3

   b) A diesel engine has a brake thermal efficiency of 30%. If the calorific value of the fuel is 42,000 kJ/kg. Find the brake specific fuel consumption. 2

5. What are the needs of compounding in case of impulse turbine ? With neat sketch show the variation of steam pressure and velocity across the velocity compounded impulse stages. 2 + 3

6. What are the advantages of using 50% reaction stage ? Explain with suitable velocity diagram.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) What is dissociation ? How does it affect power developed by the engine ? Explain with the help of a p-V diagram the loss due to variation of specific heats in an Otto cycle. 1 + 3 + 3

   b) Combustion in a diesel engine is assumed to begin at inner dead centre and to be at constant pressure. The A/F ratio is 27 : 1, the calorific value of he fuel is 43000 kJ/kg and the specific heat of the products of combustion is given by

   $c_v = 0{\cdot}71 + 20 \infty 10^{-5} T$; R for the products = 0·287 kJ/kg-K.

   If the compression ratio is 15 : 1 and the temperature at the end of the compression 870 K, find at what percentage of the stroke combustion is completed. 8

8. a) Briefly explain the f llowing :

   i) Time l ss factor

   ii) Heat loss factor

   iii) Exhaust blow down factor. 2 × 3

   b) A simple jet carburetor is required to supply 5 kg of air and 0·5 kg fuel per minute. The fuel specific gravity is 0·75. The air is initially at 1 bar and 300 K. Calculate the throat diameter of the choke for a flow velocity of 100 m/s. Velocity coefficient is 0·8. If the pressure drop across the fuel metering orifice is 0·80 of that of the choke, calculate the orifice diameter assuming $C_{df} = 0{\cdot}60$ and $\gamma = 1{\cdot}4$. 9

9. The following details were noted in a test on a four cylinder four stroke engine, diameter = 100, stroke = 120 mm, speed of the engine = 1600 rpm, fuel consumption = 0·2 kg/min, calorific value of fuel is 44000 kJ / kg, difference in tension on either side of the brake pulley = 40 kg, brake circumference = 300 cm. If the mechanical efficiency is 80%, calculate :

   a) brake thermal efficiency

   b) indicated thermal efficiency

   c) indicated mean effective pressure

   d) brake specific fuel consumption.

10. a) Show that for symme rical blading, unit blade friction factor and axial d scharge of Curtis stage with two rows of moving blade the ratio of work output at first rows of moving blade t that of second rows of moving blade is 3 : 1 7

   b) Steam enters the moving rows of a impulse turbine at a velocity of 450 m/s. If nozzle angle is 20°, the blade exit angle is 5° less than the inlet angle, friction factor is 0·9 and blade velocity is that required for maximum work output determine inlet and outlet blade angle, diagram efficiency, axial and tangential thrust for steam flow rate 1 kg/s. 8

11. a) Prove that the mass of steam flowing through a nozzle under a pressure drop from P_1 to P_2

$$m = A_2 \sqrt{\left(2 \frac{n}{n-1} \frac{P_2}{v_1} \left[\left(\frac{P_2}{P_1} \right)^{2/n} - \left(\frac{P_2}{P_1} \right)^{\frac{n+1}{n}} \right] \right)}$$

b) Steam is expanded in a set of nozzles from 10 bar, 300°C to 2 bar. Are the nozzles convergent or convergent-divergent ? Neglecting the initial velocity, find the minimum area of the nozzles to flow 1 kg/s of steam. Assume isentropic expansion. The enthalpies of steam at 10 bar, 300°C and at throat are 3052·2 kJ/kg and 2905·3 kJ/kg respectively. If the entropy at 10 bar, 300°C is greater than the entropy at the throat, what will be the stat of steam at the throat ?