ENGINEERING & MANAGEMENT EXAMINATIONS, DECEMBER - 2007

IC ENGINE AND STEAM TURBINE

SEMESTER - 5

- 3 Hours] [Full Marks : 70

Steam Table and Mollier Chart are provided at the end of the booklet.

[Use of Steam table and Mollier chart is permitted]

GROUP - A

(Multiple Choice Type Questions)

Choose the correct alternatives for the following : $10 \times 1 = 10$

The self-ignition temperature of diesel compared to petrol

a) is higher b) is lower

c) is same d) depends on the quality of fuel.

The mixture requirements of an S.I. engine under normal running on road is

a) a stoichiometric mixture b) a rich mixture

c) a lean mixture d) none of these.

On which factor, out of the following, does volumetric efficiency not depend ?

a) Speed of the engine b) Compression ratio

c) Clearance volume d) Cylinder dimensions.

Cetane number is the measure of

a) viscosity of fuel b) auto-ignition temperature

c) ignition quality d) calorific value of fuel.

Supercharging of C.I. engines leads to

a) lower s.f.c. b) higher s.f.c.

c) more exhaust pollution d) rough engine run.

For petrol engines, the method of governing employed is

a) quantity governing b) quality governing

c) hit and miss governing d) both (a) and (b).

vii) The action of steam in a steam turbine is

a) static b) dynamic

c) static and dynamic both d) neither static nor dynamic.

viii) The maximum efficiency of a De-Laval Turbine is

a) $\sin^2 \alpha$ b) $\cos^2 \alpha$

c) $\tan^2 \alpha$ d) $\cot^2 \alpha$

e) none of these.

ix) The Parson's reaction turbine has

a) only moving blades

b) only fixed blades

c) identical fixed and moving blades

d) fixed and moving blades of different shapes.

x) The purpose of governing in steam turbine is to

a) reduce relative heat drop

b) reheat the steam and improve its quality

c) completely balance against end thrust

d) maintain the speed of the turbine.

GROUP – B

(Short Answer Type Questions)

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

2. Explain, with the help of suitable diagrams, the effect of variation of specific heat in an Otto cycle.

3. Explain why rich mixture is required in an engine for

i) idling

ii) maximum power

iii) sudden acceleration.

4. What is petrol injection ? Discuss the advantages and disadvantages of petrol injection system with conventional carburettor system.

hat the maximum discharge of steam through a nozzle takes place when the steam pressure at the throat to the inlet pressure is $\frac{p_2}{p_1} = \left(\frac{2}{n+1}\right)^{\frac{n}{n-1}}$ where the index of expansion.

ce show that the maximum discharge per unit area is

$$= \sqrt{n \frac{p_1}{v_1} \left(\frac{2}{n+1}\right)^{\frac{n+1}{n-1}}}$$

a Parson's turbine, derive an expression for the maximum theoretical stage and le efficiencies.

GROUP – C

(Long Answer Type Questions)

Answer any *three* questions. 3 × 15 = 45

A four-stroke, four-cylinder automotive engine develops 150 Nm brake torque at 3000 rpm. Find brake power, displacement volume, stroke and bore of the engine. Assume, mean brake effective pressure and mean piston speed are 1 bar and 10 m/s. 1.29 ☺ unsolved question. 7

Explain the phenomenon of dissociation. Show with the help of p-v diagram effect of dissociation in Otto cycle. 4

Discuss the important qualities of S. I. Engine fuels. 4

A 4-stroke, 4-cylinder S.I. engine having a bore of 100 mm and stroke 120 mm and running at 3000 rpm has a carburettor venturi with a 35 mm throat diameter. The volumetric efficiency of the engine at this speed is 80%. The co-efficient of discharge of air flow is 0·82. The ambient pressure and temperature are 1·013 bar and 25°C respectively. Air-fuel ratio is 15. The top jet is 5 mm above the petrol level in the float chamber. The co-efficient of discharge for fuel flow is 0·7. Determine the depression (pressure drop) at the throat and the diameter of the fuel jet of the simple carburettor. The specific gravity of the petrol is 0·75. 9

Explain briefly the stages of combustion in a C.I. engine 3

What are the advantages and limitations of supercharging in an IC engine ? 3

9. a) Explain the working of a magneto ignition system with the help of neat sketch. 4

b) What do you understand by ignition timing ? Discuss the various factors which affect ignition timing requirements. 4

c) What is angle of advance ? Why is it necessary with the ignition system ? 3

d) What do you understand by 'Scavenging' effect ? Explain with a suitable sketch any one of the scavenging processes. 4

10. a) What are the reasons for erosion and corrosion of turbine blades ? How is it prevented ? 3

b) Find the condition of maximum blade efficiency in a single stage impulse turbine. 4

c) The exit velocity of steam from the nozzle of single wheel impulse turbine is 600 m/s, the nozzle angle is 20% to the plane of wheel. The speed is 3000 rpm and mean blade radius is 59 cm. The axial velocity of the steam at exit from the blades is 164 m/s and the blades are symmetrical. Calculate

i) blade angles

ii) diagram work

iii) diagram efficiency. 8

11. a) Steam enters a 50% reaction turbine at 14 bar and 315°C and is expanded to a pressure of 0·14 bar. The turbine has a stage efficiency of 75% for each stage and the reheat factor is 1·04. The turbine has 20 successive stages and the total power output is 12,000 kW.

At a certain place in the turbine the steam has a pressure of 1 bar and dry saturated. The exit angle of the blade is 20° and the blade speed ratio is 0·7. The blade height is $\frac{1}{12}$ of the mean blade diameter. Estimate the :

i) steam flow rate, assuming all stages develop equal work.

ii) mean diameter of the annulus at this point of the turbine.

iii) rotor speed. 8

b) Explain why pure reaction turbine is not used in practice. 2

c) Define 'reheat factor' and show that the reheat factor is always greater than unity. 3

d) Explain the term 'State point locus'. 2

END