Menoufiya University
Faculty of Engineering Shebin El-Kom
Mechanical Power Eng. Department
Post graduate Examination 2017-2018

جامعة المنوفية

Subject: Performance of ICE
Level: 600. Code: MPE618
Time Allowed: 3 hours
Total Marks :100 marks
Date of Exam : 30 /12/2017

Solve the Following Questions and assume any required data

(Question Number-1) :(25 Marks)

(a) Considering the time averaged heat flux from gas side to the coolant is as follows:

Gas side: $\dot{q} = \dot{q}_{conv} + \dot{q}_{rad} = h_{cg}(\bar{T}_g - \bar{T}_{wg}) + \sigma\varepsilon(\bar{T}_g^4 - \bar{T}_{wg}^4)$

Wall: $\dot{q} = \dot{q}_{cond} = k\frac{(\bar{T}_{wg} - \bar{T}_{wc})}{t_w}$

Coolant side: $\dot{q} = \dot{q}_{conv} = h_{cc}(\bar{T}_{wc} - \bar{T}_c)$

If the radiation in the combustion chamber is negligible, previous equations can be combined into the following overall equation approximating the time- averaged heat transfer from the engine.

$$\dot{q} = h_o(\bar{T}_g - \bar{T}_c)$$

Drive the expression for h_o (8 marks)

(b) Prove that rate heat flux is proportional to fuel burning rate as follows.

$\dot{q} \propto \frac{\dot{m}_f}{A}$

Where, A is the heat transfer area.

Use the previous relation to predict the amount of heat losses with respect to engine speed and its reflection on engine performance. (9 marks)

(c) Discuss briefly the effect of Engine load and equivalence ration on heat losses. (8 marks)

(Question Number-2) :(25 Marks)

(a) Compare between different methods used to evaluate friction losses inside reciprocating internal combustion engine. (5 marks)

(b) Discuss different factors governing friction losses and show how to use these concepts on reducing friction during the engine cycle. (5 marks)

(c) Explain how multi-grade oil performs inside engine at different operating conditions. (5 marks)

(d) Discuss the role of the following factors on power losses:
Throttling valve, compression ratio, stroke/connecting rod ratio (5 marks)

(e) Assign cylinder location at which the maximum friction between piston skirt and cylinder liner. Show also different design parameters affecting such location. (5 marks)

(Question Number-3) :(25 Marks)

(a) Compare between single zone and two zone combustion model when simulating thermal cycle of ICE. (6 marks)

(b) In case of Multi-zone combustion model, write the basic conservation equations in 2D, considering time dependent, compressible flow. Show the effect of grid size on final results. (6 marks)

(c) In single zone model, show how to obtain combustion duration and the rate of fuel burning. (7 marks)

(d) In diesel engine, assign the governing factors affecting atomization process and show how droplets size distribution can control combustion phases. (6 marks)

(Question Number-4) : (25 Marks)

(a) Prove that, engine torque is proportional directly to mean effective pressure. (6 marks)

(b) Interpret the reduction of sfc when opening throttle valve. (6 marks)

(c) Show the relation between spark timing and maximum output brake torque. Explain also why such timing varies with respect to engine rotational speed. Discuss also the role of fuel octane number on adopting such timing. (7 marks)

(d) Show how volumetric efficiency controls the performance of both SIE and CIE. Discuss in details factors that govern volumetric efficiency in both engines. (6 marks)