Charles Darwin University

Final Examination

Family Name						
Given Name/s						
Student Number						
Teaching Period	Semester 2, 2018					

ENG482 – Engines and Turbomachinery	DURATION	
	Reading Time:	10 minutes
	Writing Time:	180 minutes

INSTRUCTIONS TO CANDIDATES

Read the Exam question paper carefully.
Answer All Questions.
Questions are NOT of equal value
Marks are shown at each question.

EXAM CONDITIONS

<u>You may begin writing from the commencement of the examination session.</u> The reading time indicated above is provided as a guide only.

This is a CLOSED BOOK examination

Any non-programmable calculator is permitted

No handwritten notes are permitted

No dictionaries are permitted

ADDITIONAL AUTHORISED MATERIALS	EXAMINATION MATERIALS TO BE SUPPLIED
No additional printed material is permitted	2 x 20 Page Book 2 x Scrap Paper Formula Sheet/s

THIS EXAMINATION IS PRINTED DOUBLE-SIDED.

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Question 1 : 25%

You are the only Mechanical Engineer at a very small remote mine site in Australia. You are required to specify an IC engine to drive the generator which provides the primary electrical power for the site. What aspects of this task do you need to know to make an optimum choice of machine? You should consider a demand range and specify a solution accordingly. You should allow for the possibility of considerable growth in demand and discuss how your choice of engine would possibly vary. Growth rates at a similar site has seen demand go from an initial 10 kVA to 100 kVA and then to 1000 kVA and beyond. (1 kVA = 1 kW)
Under what conditions would you specify a gas turbine and what type would be most appropriate?
Under what conditions would you specify a CI engine and why?
Under what conditions would you specify an SI engine and why?
In each case you need to justify your preferred choice against possible alternatives.

Question 2 : 10%

Isooctane is burned with air in an engine at an equivalence ratio of 0.8333. Assuming complete combustion, write the balanced chemical reaction equation.

Calculate

1. Air fuel ratio.
2. How much excess air is used (%).
3. AKI and FS of this fuel.

Question 3 : 15%

A large twelve cylinder, 460 litre, two stroke cycle engine operates using dual fuel. 92% of the intake air is used for stoichiometric combustion of methanol, while 8% is used for stoichiometric combustion of light diesel fuel for ignition. The engine operates at 195 RPM with a volumetric efficiency of 93%. The methanol is input during the intake stroke, while diesel fuel is injected into each cylinder by a single injector from 15^0 bTDC to 6^0 aTDC.

Calculate;

1. Mass flow of air into the engine (kg/sec).
2. Mass flow rate of methanol into the engine (kg/sec).
3. Mas flow rate of diesel through one injector (kg/sec).

Question 4 : 10%

A two litre, four cylinder, open chamber SI engine operates at 3500 RPM using stoichiometric gasoline. At this speed, volumetric efficiency is 93% , combustion efficiency is 98%, indicated thermal efficiency is 47%, and mechanical efficiency is 86%

Calculate :

1. Brake power in kW
2. bmep in kPa
3. Amount of unburned fuel exhausted from the engine in kg/hr.
4. bsfc in gm/kwhr.

Question 5 : 10%

A large CI engine operating at 310 RPM has open combustion chambers and direct injection, with 260mm bores, a 730mm stroke and a compression ratio of 16.5:1. Fuel injection in each cylinder starts at 21^0 bTDC and lasts for 0.019 sec. ID is 0.0065 sec.

Calculate :

1. ID in degrees of engine rotation.
2. Crank angle position when combustion starts.
3. Crank angle position when injection stops.

Question 6 : 10%

A flat 6 SI engine has a capacity of 1500cc, 4 valves per cylinder, single overhead camshaft per bank and a compression ratio of 9:1. The engine currently uses 95RON gasoline which is directly injected into each cylinder on a four stroke cycle. If all other conditions are kept the same this engine is proposed to be fitted with twin spark plugs per cylinder. If all other engine parameters are kept the same, list and discuss three advantages and three disadvantages, this change gives for modern engines.

Question 7 : 5%

A five cylinder SI engine with bore B= 85.6mm and stroke S=0.92B, operates at 2800 RPM on an air-standard Otto cycle. During the compression stroke, the air in each cylinder is rotating at an angular velocity of 250 revs per second, using the paddlewheel model. At TDC, the gas mixture into a clearance volume that can be approximated as a 50mm diameter cylindrical bowl in the face of the piston.

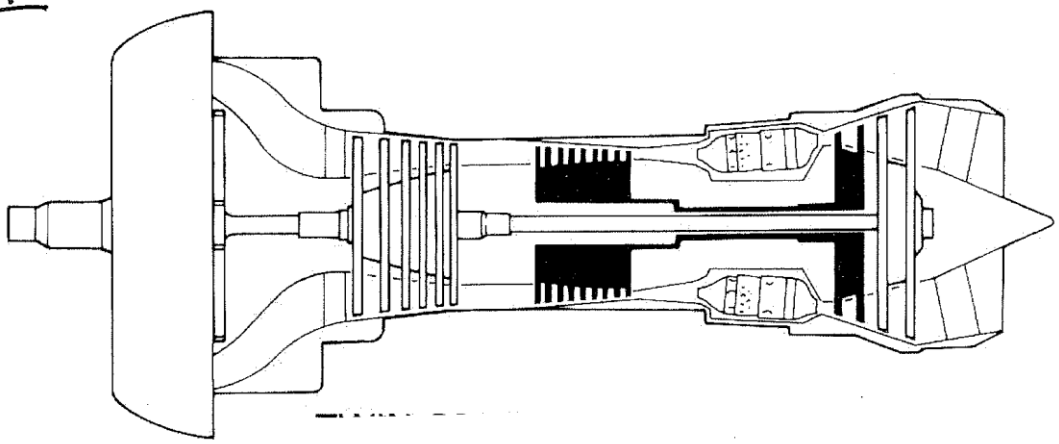
Calculate

1. The swirl ratio during the compression stroke using two different equations
2. The angular velocity in the bowl at TDC, assuming angular momentum is conserved.

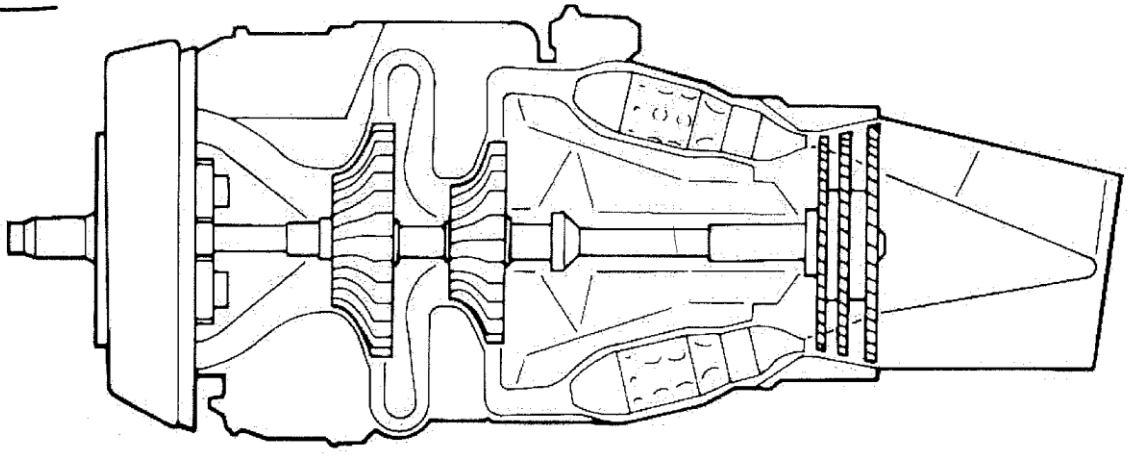
Question 8 : 15%

With reference to the following images of gas turbines A,B,C and D, describe at least 5 attributes in any 3 (eg in terms of compressor type, stages in compressor/turbine, shafts etc.)

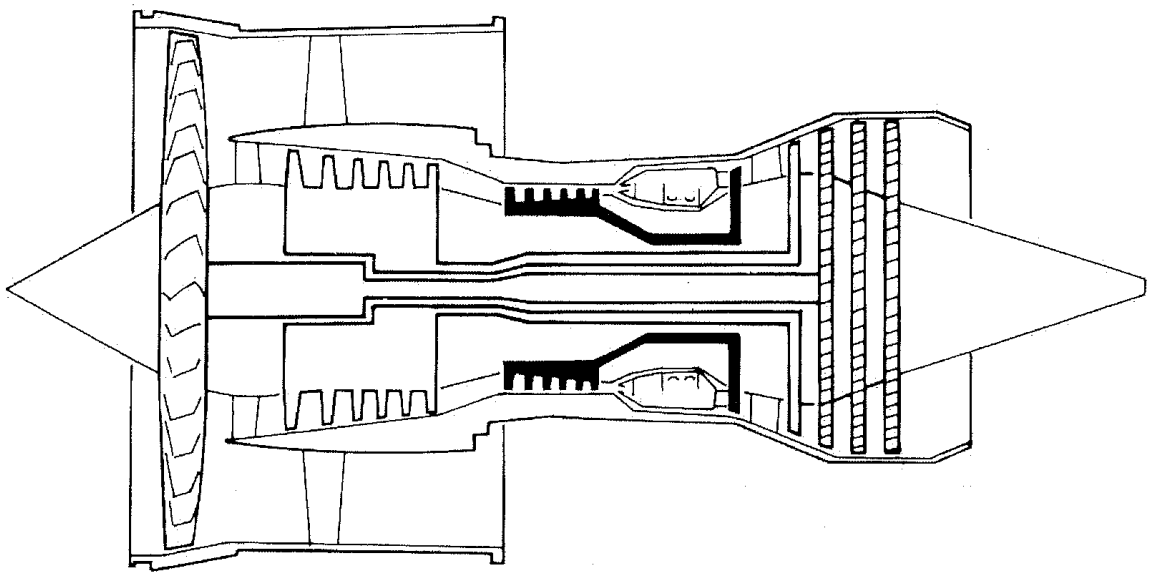
A



B



C



D