Question Paper For Internal Assessment Examination (Theory) - Credit 4 / 46 /

Instructions for Students/FacultyMid Term I (Total 80 Marks, 2 HRS. Syllabus from Unit-1)

- Part A: Total number of questions to be given are ten (5 from CO1 and 5 from CO2), each carrying 2 marks and are compulsory to attend. There is no choice. They are short answer type questions (**Not More Than 25 Words For both Question & Answer)**, no objective type or fill in the blanks. Total 20 marks.
- Part B: Total number of questions to be given are six (3 from CO1 and 3 from CO2), out of which student must answer four (2 from CO1 and 2 from CO2). They are long answer type (**Not More Than 50 Words for Question)**, each carrying 5 marks. Total 20 marks.
- Part C: Total number of questions to be given are six (3 from CO1 and 3 from CO2), out of which student must answer four (2 from CO1 and 2 from CO2). They are numerical answer type / fully elaborative type (**Not More Than 70 Words for Question)** *, each carrying 10 marks. Total 40 marks.

Mid Term II (Total 120 Marks, 2.5 HRS., Syllabus from Unit-2)

- Part A: Total number of questions to be given are ten (5 from CO3 and 5 from CO4), each carrying 4 marks and are compulsory to attend. There is no choice. They are short answer type questions (**Not More Than 25 Words For both Question & Answer)**, no objective type or fill in the blanks. Total 40 marks.
- Part B: Total number of questions to be given are six (3 from CO3 and 3 from CO4), out of which student has to answer four (2 from CO3 and 2 from CO4). They are long answer type (**Not More Than 50 Words for Question)**, each carrying 7 marks. Total 28 marks.
- Part C: Total number of questions to be given are six (3 from CO3 and 3 from CO4), out of which student has to answer four (2 from CO3 and 2 from CO4). They are numerical answer type / fully elaborative type (**Not More Than 70 Words For Question)** *, each carrying 13 marks. Total 52 marks.

Mid Term III (Total 120 Marks, 2.5 HRS., Syllabus from Unit-3)

- Part A: Total number of questions to be given are ten (5 from CO5 and 5 from CO6), each carrying 4 marks and are compulsory to attend. There is no choice. They are short answer type questions (**Not More Than 25 Words For both Question & Answer)**, no objective type or fill in the blanks. Total 40 marks.
- Part B: Total number of questions to be given are six (3 from CO5 and 3 from CO6), out of which student must answer four (2 from CO5 and 2 from CO6). They are long answer type (**Not More Than 50 Words for Question)**, each carrying 7 marks. Total 28 marks.
- Part C: Total number of questions to be given are six (3 from CO5 and 3 from CO6), out of which student must answer four (2 from CO5 and 2 from CO6). They are numerical answer type / fully elaborative type (**Not More Than 70 Words for Question)** *, each carrying 13 marks. Total 52 marks.

*** LIST OF ELABORATIVE THEORY QUESTION SUBJECTS**: NO SUBJECT UNDER CREDIT FOUR

Instructions For Faculties:

There should be total 6 Course Outcomes (COs) for each subject.

- Mid Term Question Papers are to be submitted as per Course Outcomes (COs) which should be divided equally in Part A, Part B and Part C according to Mid Term Examination and Credit Point.
- In Mid Term-1, the questions are to be given from CO1 and CO2. In Mid Term-2, the questions are to be given from CO3 and CO4. Similarly, in Mid Term-3, the questions are to be given from CO5 and CO6.

- **FACULTY MEMBERS, PLEASE ENSURE EXCEPT ABOVE LISTED SUBJECTS, NO THEORITICAL ELABORATIVE QUESTION SHOULD BE GIVEN IN PART 'C' OF QUESTION PAPER**

INSTRUCTION FOR STUDENTS

- **STUDENT IS ALLOWED TO ENTER LATE NOT MORE THAN 15 MIN AFTER STARTING OF EXAM, AND MAY LEAVE THE EXAM HALL ON EXPIRY OF ATLEAST OF 1 Hr FROM THE STARTING TIME OF EXAMINATION.**

QUESTION PAPER AND STUDENTS DETAILS

Type of Exam	Mid Term 3	**Date of Submission**	25/07/2021
Name of Faculty	Mr. Maris Brightson	**Date of Examination**	26/07/2021
Course	B.Tech (Aeronautical Engineering)	**Semester**	SEMESTER : 6
Batch	Combined Batches 15, 16, 17, SF 1	**Subject**	6 AN4 - 02 Propulsion-II (Cr 4)

COURSE OUTCOMES FOR REFERENCE TO FRAME QUESTION PAPER

(Faculties are required to mention relevant Course Outcome number against the respective question in QP)

Course Outcome	CO 5. Solve the problems related to the concepts of Ramjet and Scram jet Propulsion system. CO 6. Analyze and determine Chemical Rocket Propulsion and Solid and Liquid Propellant Rockets.		
Email I'd	marisbrightson@soaneemrana.org	**Phone No.**	805-667-7643
Student Name		**Student Reg No.**	

Part A

All the questions are compulsory to attend.

1. CHOOSE COURSE OUTCOME (CO) NUMBER ACCORDING TO THE TYPE OF MIDTERM, AS PER INSTRUCTIONS ABOVE.			5
Question : 1	Define TSFC.		
25	Ramjet and Scramjet Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
Question : 2	List the demerits of ramjet engine.		
27	Ramjet and Scramjet Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
Question : 3	List the differences between ramjet and scramjet engines.		

29	Ramjet and Scramjet Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
Question : 4	Write the applications of ramjet and scramjet engines.		
29	Ramjet and Scramjet Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
Question : 5	Define isolator.		
30	Ramjet and Scramjet Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
2. CHOOSE COURSE OUTCOME (CO) NUMBER ACCORDING TO THE TYPE OF MIDTERM, AS PER INSTRUCTIONS ABOVE.			6
Question : 6	Define specific impulse.		
34	Rocket Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
Question : 7	Define propellant mass fraction.		
36	Rocket Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
Question : 8	Define burnout velocity.		
36	Rocket Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
Question : 9	Define cryogenic propellant.		
37	Rocket Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
Question : 10	Define burning rate.		
39	Rocket Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	

Part B

FOR MIDTERM 1 - Part B: Total number of questions to be given are six (3 from CO1 and 3 from CO2), out of which student must answer four (2 from CO1 and 2 from CO2).
FOR MIDTERM 2 - Part B: Total number of questions to be given are six (3 from CO3 and 3 from CO4), out of which student must answer four (2 from CO3 and 2 from CO4).
FOR MIDTERM 3 - Part B: Total number of questions to be given are six (3 from CO5 and 3 from CO6), out of which student has to answer four (2 from CO5 and 2 from CO6).

3. CHOOSE COURSE OUTCOME (CO) NUMBER ACCORDING TO THE TYPE OF MIDTERM, AS PER INSTRUCTIONS ABOVE.			5
Question : 1	Illustrate the neat sketch of the ramjet engine and scramjet engine.		
26	Ramjet and Scramjet Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
Question : 2	Explain the various types of scramjet combustors.		
29	Ramjet and Scramjet Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
Question : 3	Explain the fuel injection schemes in scramjet combustors.		
30	Ramjet and Scramjet Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
4. CHOOSE COURSE OUTCOME (CO) NUMBER ACCORDING TO THE TYPE OF MIDTERM, AS PER INSTRUCTIONS ABOVE.			6
Question : 4	Explain in detail about types of rocket testing.		
35	Rocket Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
Question : 5	Explain the composition/types of solid propellant.		
36	Rocket Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
Question : 6	Illustrate the following (a) Gas generator cycle (b) Staged combustion cycle (c) Expander cycle		

38	Rocket Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
Question : 7 (Old Pattern)			

Part C

FOR MIDTERM 1 - Part C: Total number of questions to be given are six (3 from CO1 and 3 from CO2), out of which student must answer four (2 from CO1 and 2 from CO2).
FOR MIDTERM 2 - Part C: Total number of questions to be given are six (3 from CO3 and 3 from CO4), out of which student must answer four (2 from CO3 and 2 from CO4).
FOR MIDTERM 3 - Part C: Total number of questions to be given are six (3 from CO5 and 3 from CO6), out of which student has to answer four (2 from CO5 and 2 from CO6).

5. CHOOSE COURSE OUTCOME (CO) NUMBER ACCORDING TO THE TYPE OF MIDTERM, AS PER INSTRUCTIONS ABOVE.			5
Question : 1	A rocket-powered by a liquid-propellant rocket motor has the following characteristics: The thrust of 500 kN at sea level Propellant consumption rate = 175 kg/s Gas exit static pressure = 60.0 kPa Exhaust area = 0.6 m2. Calculate the effective exhaust speeds and thrust force in the following cases: 1. Sea-level operation (Pa= 101 kPa) 2. Ambient pressure is (Pa= 60 kPa) 3. In-space operation (Pa= 0.0 kPa)		
30	Rocket Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
Question : 2	A rocket motor has a combustion chamber with temperature of 3300 K and pressure of 22 atmospheres. The throat area is 0.2 m2. The exit pressure is equal to atmospheric pressure at an altitude of 30 km. The specific heat ratio γ =1.23 and the specific heat at constant pressure Cp = 2520 J/kg/K. Calculate: 1. Exit velocity 2. Mass flow through the motor 3. Thrust force 4. Specific impulse		
31	Rocket Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
Question : 3	A spacecraft's dry mass is 75,000 kg and the effective exhaust gas velocity of its main engine is 3100 m/s. How much propellant must be carried if the propulsion system is to produce a total Δv of 700 m/s?		

31	Rocket Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
6. CHOOSE COURSE OUTCOME (CO) NUMBER ACCORDING TO THE TYPE OF MIDTERM, AS PER INSTRUCTIONS ABOVE.			6
Question : 4	Refer attachment		
36	Rocket Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
Question : 5	Refer attachment		
36	Rocket Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
Question : 6	Refer attachment		
42	Rocket Propulsion	Aircraft Propulsion and Gas Turbine Engines (2nd Edition)-Ahmed F. El-Sayed	
Upload Scanned Document In Case of Numerical or Diagram For Any of The Above Questions. *(Mention question number with relevant fig / numerical / equations. Max 150 KB)*			
I have scrutinized the question paper. There is no spelling mistake or any type of irrelevant question.			

PART – C

Question: 4

A certain rocket has the following data: thrust = 9000 N, propellant combustion rate = 3.9 kg/s, rocket speed $u = 420$ m/s, heat of combustion: $Q_R = 7.0$ MJ/kg, combustion efficiency: $\eta_c = 99\%$. Calculate

1. Effective exhaust velocity
2. Thermal (internal) efficiency
3. Propulsive (external) efficiency
4. Overall efficiency
5. Specific propellant consumption

Question: 5

Tests of a solid-propellant grain showed the following results:

Test Number	Chamber Pressure P_c (MPa)	Burn Rate $\dot{r}$ (mm/s)
1	18	23.8
2	8	12.5

Calculate

1. The combustion pressure if the burning rate is 20 mm/s
2. The propellant consumption rate per square meter of burning surface if the combustion pressure is 15 MPa, the density of propellant ρ_p is 1700 kg/m^3, and the grain diameter is 0.2 m

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Question: 6

A liquid oxygen–liquid hydrogen rocket engine has a mixture ratio of 3.51. The combustion chamber temperature and pressure are 3510 K and 22.1 atmospheres. The exit area is 3.225 m^2. The exit pressure is equal to the atmospheric pressure at an altitude of 20.2 km. The specific heat ratio $\gamma = 1.23$ and the specific heat at constant pressure $Cp = 2520$ J/kg/K. Other data are

$$P_{oe} = 2230 \text{ kPa}, \quad u_e = 3450.0 \text{ m/s}, \quad \rho_e = 0.0102 \text{ kg/m}^3,$$

$$\dot{m} = 113.5 \text{ kg/s}, \quad T = 392 \text{ kN}, \qquad I_{sp} = 352 \text{ s}$$

1. Calculate the oxygen and fuel mass flow rate.
   If the propellant mass flow rate is constant, examine the effects.
2. The nozzle efficiency (η_n), which varies from 93% to 99%.
3. The pressure drop in the combustion chamber (ΔP_c), which varies from 1% to 5% on the exhaust speed, thrust force, and specific impulse.
