Question Paper For Internal Assessment Examination (Theory) - Credit 4 / 45 /

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 2	**Date of Submission**	24/07/2021
Name of Faculty	Mr. Maris Brightson	**Date of Examination**	27/07/2021
Course	B.Tech (Aeronautical Engineering)	**Semester**	SEMESTER : 4
Batch	Combined Batches 18, 19, SF 2	**Subject**	4 AN4 - 04 Aerodynamics-I (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	CO3: Demonstrate Airfoil theory and its practical applications. CO4: Analyze the Thin Airfoil theory with its practical implementation.		
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.			3
Question : 1	Define Kelvin circulation theorem.		
15	Potential flow Theory	Fundamentals of Aerodynamics - J D Anderson	
Question : 2	Define Karman vortex street.		
16	Potential flow Theory	Fundamentals of Aerodynamics - J D Anderson	
Question : 3	Define Cauchy–Riemann equations.		
17	Airfoil Theory	Aerodynamics - L J Clancy	
Question : 4	Define conformal mapping.		

18	Airfoil Theory	Aerodynamics - L J Clancy	
Question : 5	Define complex potential function.		
19	Airfoil Theory	Aerodynamics - L J Clancy	
2. CHOOSE COURSE OUTCOME (CO) NUMBER ACCORDING TO THE TYPE OF MIDTERM, AS PER INSTRUCTIONS ABOVE.			4
Question : 6	Define vortex filament.		
23	Thin Airfoil Theory	Fundamentals of Aerodynamics - J D Anderson	
Question : 7	Define vortex sheet.		
23	Thin Airfoil Theory	Fundamentals of Aerodynamics - J D Anderson	
Question : 8	Define zero-lift angle of attack.		
27	Thin Airfoil Theory	Fundamentals of Aerodynamics - J D Anderson	
Question : 9	Define aerodynamic center.		
28	Thin Airfoil Theory	Fundamentals of Aerodynamics - J D Anderson	
Question : 10	Define lift-slope.		
24	Thin Airfoil Theory	Fundamentals of Aerodynamics - J D Anderson	

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.		3
Question : 1	Explain the following (a) Kutta condition (b) Magnus effect	

16	Potential flow Theory	Fundamentals of Aerodynamics - J D Anderson	
Question : 2	Consider the lifting flow over a circular cylinder with a diameter of 0.5 m. The freestream velocity is 25 m/s, and the maximum velocity on the surface of the cylinder is 75 m/s. The freestream conditions are those for a standard altitude of 3 km. Calculate the lift per unit span on the cylinder		
17	Potential flow Theory	Fundamentals of Aerodynamics - J D Anderson	
Question : 3	Explain Karman-Trefftz profiles.		
22	Airfoil Theory	Aerodynamics - L J Clancy	
4. CHOOSE COURSE OUTCOME (CO) NUMBER ACCORDING TO THE TYPE OF MIDTERM, AS PER INSTRUCTIONS ABOVE.			4
Question : 4	Derive the fundamental equation of thin airfoil theory.		
23	Thin Airfoil Theory	Fundamentals of Aerodynamics - J D Anderson	
Question : 5	Discuss the flow over a circular cylinder at various Reynolds numbers.		
20	Potential flow Theory	Fundamentals of Aerodynamics - J D Anderson	
Question : 6	Prove that "Vortex flow is irrotational everywhere except at the point r = 0, where the vorticity is infinite".		
18	Potential flow Theory	Fundamentals of Aerodynamics - J D Anderson	
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.	3

Question : 1	Transform circle into an ellipse by Joukowski transformation.		
20	Airfoil Theory	Aerodynamics - L J Clancy	
Question : 2	Transform circle into thin symmetrical airfoil by Joukowski transformation.		
21	Airfoil Theory	Aerodynamics - L J Clancy	
Question : 3	Derive the expression for lift per unit span for a flow over a flat plate at some angle of incidence.		
22	Airfoil Theory	Aerodynamics - L J Clancy	
6. CHOOSE COURSE OUTCOME (CO) NUMBER ACCORDING TO THE TYPE OF MIDTERM, AS PER INSTRUCTIONS ABOVE.			4
Question : 4	Consider a thin, symmetric airfoil at a 1.5◦ angle of attack. From the results of thin airfoil theory, calculate (a) lift coefficient, (b) moment coefficient about the leading edge, (c) moment coefficient about the quarter-chord point, and (d) moment coefficient about the trailing edge.		
24	Thin Airfoil Theory	Fundamentals of Aerodynamics - J D Anderson	
Question : 5	For the NACA 2412 airfoil, the lift coefficient and moment coefficient about the quarter-chord at -6◦ angle of attack are -0.39 and -0.045, respectively. At 4◦ angle of attack, these coefficients are 0.65 and -0.037 respectively. Calculate the location of the aerodynamic center.		
27	Thin Airfoil Theory	Fundamentals of Aerodynamics - J D Anderson	
Question : 6	Refer Attachment		
26	Thin Airfoil Theory	Fundamentals of Aerodynamics - J D Anderson	
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)*		https://form.123formbuilder.com/upload_dld.php?fileid=92a0ced11cc34a4bd10f481fc3a7e273	
I have scrutinized the question paper. There is no spelling mistake or any type of irrelevant question.			

PART – C

Question: 6

The NACA 4412 airfoil has a mean camber line given by

$$\frac{z}{c} = \begin{cases} 0.25\left[0.8\frac{x}{c} - \left(\frac{x}{c}\right)^2\right] & \text{for } 0 \le \frac{x}{c} \le 0.4 \\ 0.111\left[0.2 + 0.8\frac{x}{c} - \left(\frac{x}{c}\right)^2\right] & \text{for } 0.4 \le \frac{x}{c} \le 1 \end{cases}$$

Using thin airfoil theory, calculate
(*a*) $\alpha_{L=0}$ (*b*) c_l when $\alpha = 3°$