# School of Aeronautics (Neemrana)

**I-04, RIICO Industrial Area, Neemrana, Dist. Alwar, Rajasthan**

Approved by Director General of Civil Aviation, Govt. of India, All India Council for Technical Education
Ministry of HRD, Govt of India & Affiliated to Rajasthan Technical University, Kota & BTU, Bikaner Rajasthan

Question Paper For Internal Assessment Examination (Theory) - Credit 3 / 30 /

**Instructions For Students / FacultyMid Term I (Total 60 Marks, 2 HRS. Syllabus From Beginning Of Session)**
• Part A: Total number of questions to be given are five, each carrying 3 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 15 marks.
• Part B: Total number of questions to be given are six, out of which student has to answer any four. They are long answer type (**Not More Than 50 Words For Question)**, each carrying 6 marks. Total 24 marks.
• Part C: Total number of questions to be given are four, out of which student has to answer any three. They are numerical answer type / fully elaborative type (**Not More Than 70 Words For Question)***, each carrying 7 marks. Total 21 marks.
**Mid Term II & III (Total 90 Marks, 2.5 HRS. Syllabus From Beginning Of Session)**
• Part A: Total number of questions to be given are ten, 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 seven, out of which student has to answer any five. They are long answer type (**Not More Than 50 Words For Question)**, each carrying 6 marks. Total 30 marks.
• Part C: Total number of questions to be given are five, out of which student has to answer any four. They are numerical answer type / fully elaborative type (**Not More Than 70 Words For Question)***, each carrying 10 marks. Total 40 marks.

*** LIST OF ELABORATIVE THEORY QUESTION SUBJECTS**: 3 MH4 - 07 Manufacturing Process, 4 AN4 - 06 Aircraft Materials and Processes (Cr 3), 5 AN4 - 05 Aircraft System (Cr 3), 6 AN4 - 05 Avionics-I (Cr 3), 6 MH4 - 03 Applied Hydraulics & Pneumatics (Cr 3), 6 MH5 - 11 Principles of Management (Cr 3), 6 MH5 - 13 Aircraft Electronics System (Cr 3), 7 AN5 - 12 Maintenance of Airframe and System (Cr 3), 7 AN5 - 13 Helicopter Theory (Cr 3), 7 AG6 - 60.1 Human Engineering and Safety (Cr 3), 7 ST - 01 Avionics II (Special Theory Subject) (Cr 3), 7 MH5 - 11 Design of Mechatronics Systems (Cr 3), 7 MH5 - 12 Robotics and Machine Vision System (Cr 3), 7 MH6 - 13 Medical Electronics (Cr 3), 7 AN6 - 60.1 Aircraft Avionic System (Cr 3), 8 AN5 - 12 Maintenance of Power Plant and System (Cr 3), 8 AN5 - 13 Unmanned Aerial Vehicles & Systems (UAV) (Cr 3), 8 MH5 - 13 Product Development & Launching (Cr 3), 8 EC6 - 60.2 Robotics and control (Cr 3)

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

**Question Paper & Student Details**

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| **Mid Term** | Mid Term 2 | **Date of Submission** | 21/08/2020 |
| **Name of Faculty** | Mr. Bipin Kumar Dwivedi | **Date of Examination** | 24/08/2020 |
| **Course** | B.Tech (Aeronautical Engineering) | **Semester** | SEMESTER : 5 |
| **Batch** | Combined Batches 15, 16, 17, SF 1 | **Subject** | 5 AN4 - 02 Aerodynamics-II (Cr 3) |

**COURSE OUTCOMES FOR REFERENCE TO FRAME QUESTION PAPER**
***(Faculties are required to mention relevant Course Outcome number against the respective question in QP)***

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| **Course Outcome** | COURSE OUTCOME<br>Upon completion of the course, Students will be able to<br>CO1: Interpret the basic concepts & fundamentals of aerodynamics.<br>CO2: Apply the fundamental concepts of mass, momentum, energy conservation equations for aerodynamic applications.<br>CO3: Illustrate the characteristics and impact of Normal Shocks.<br>CO4: Explain the Oblique Shocks characteristics and its impact on Aerodynamic properties.<br>CO5: Analyze the Expansion Waves characteristics.<br>CO6: Solve the problems related to the concepts of vorticity, irrotational and circulation.<br>CO7: Gain insights into thin airfoil theory.<br>CO8: Analyze and determine velocity profiles in the laminar and turbulent boundary layer. |

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| **Student Name** | | **Student Reg No.** | |

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| **Part A** | | | |
| **Question : 1** | What is temperature velocity? | | |
| 6 | Steady one-dimensional Isentropic flow | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 2 |

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|---|---|---|---|
| **Question : 2** | What is characteristic Mach number M∗? | | |
| 10 | Normal shock wave | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 3 |
| **Question : 3** | What is the relation of Mach numbers before and after the normal shock wave? | | |
| 12 | Normal shock wave | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 3 |
| **Question : 4** | What is the momentum equation for the normal shock wave? | | |
| 13 | Normal shock wave | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 3 |
| **Question : 5** | What is the difference between normal shock wave and oblique shock wave? | | |
| 15 | Oblique shock wave | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 4 |
| **Question : 6** | What is the difference between oblique shock wave and expansion wave? | | |
| 20 | Expansion wave | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 5 |
| **Question : 7** | What is shock polar diagram for oblique shock wave? | | |
| 17 | Oblique shock wave | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 4 |
| **Question : 8** | What is the relation between wedge angle, oblique shock angle and free stream Mach number? | | |
| 18 | Oblique shock wave | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 4 |
| **Question : 9** | What is Hugoniot equation? | | |
| 13 | Normal shock wave | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 3 |
| **Question : 10** | What is Mach angle? | | |
| 22 | Expansion wave | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 5 |
| **Part B** | | | |
| **Question : 1** | Derive the expression of critical pressure, critical temperature and critical density. | | |
| 8 | Steady one-dimensional Isentropic flow | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 2 |
| **Question : 2** | Derive and explain the Prandtl-Mayer relation for normal shock wave. | | |
| 10 | Normal shock wave | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 3 |
| **Question : 3** | Derive the Mach number relation before and after the oblique shock wave. | | |
| 18 | Oblique shock wave | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 4 |
| **Question : 4** | Draw and explain the shock polar diagram for different Mach numbers. | | |
| 19 | Oblique shock wave | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 4 |
| **Question : 5** | Derive the prandtl-Meyer function for the expansion wave. | | |
| 25 | Expansion wave | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 5 |
| **Question : 6** | Explain the following<br>(a) Attached shock wave (b) Detached shock wave | | |
| | Oblique shock wave | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 4 |
| **Question : 7** | Explain the following<br>(a) Weak oblique shock wave (b) Strong oblique shock wave | | |
| 19 | Oblique shock wave | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 4 |
| **Part C** | | | |

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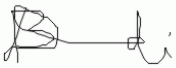
| **Question : 1** | A nozzle in a wind tunnel gives a test section Mach number of 2.0. Air enters The nozzle from a large reservoir at 0.69 bar and 310 K. the cross sectional Area of the throat is 1000 cm□. Determine the mass flow rate and area of Cross section of the test section. | | |
| 8 | Steady one-dimensional Isentropic flow | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 2 |
| **Question : 2** | The stagnation pressure and temperature of air at the entry of a nozzle are 5 bar and 500K respectively. The exit Mach number is 2.0 where a normal Shock occurs. Calculate the air velocities and Mach numbers before And after normal shock wave. | | |
| 11 | Normal shock wave | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 3 |
| **Question : 3** | Consider a supersonic flow with Mach number 2.0 has pressure 1atm and Temperature 288K. This flow is deflected at a compression corner through 20 degree. Determine the Mach number, pressure and temperature behind the oblique shock wave. | | |
| 18 | Oblique shock wave | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 4 |
| **Question : 4** | An oblique shock wave at an angle of 35 □ occurs at the leading edge of a Symmetrical wedge. Air has a Mach number of 2.0, and pressure and Temperature of 10 bar and 310 K respectively upstream of this wave. Determine the wedge angle. | | |
| 19 | Oblique shock wave | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 4 |
| **Question : 5** | A flat plate airfoil placed in Mach 3.0 flow at standard sea level condition at an angle of attack 10 degree. Calculate the lift coefficient and drag coefficient if chord length is 3m and plate width 2m. | | |
| 25 | Expansion wave | FUNDAMENTAL OF AERODYNAMICS BY JOHN D ANDERSON | 5 |
| **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.** |  | | |

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