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COURSE COMPONENTS OF ACADEMIC PROGRAMME

UNDERGRADUATE PROGRAMME

B.Tech. (Mechanical Engineering with minor in Aerospace Engineering)

Batch 2020-24

Minimum Duration: 8 Semesters (4 years)

Maximum Duration: 12 Semesters (6 years)

Total number of credits: 189+22 = 211 credits

Course Components		**Credits**
1. Compulsory courses		
i.	Foundation course	45
ii.	Core course	106
iii.	Aerospace minor	22
2. Elective courses		
i.	Departmental electives	10
3. Discipline-Centric Additional Courses		
i.	Project	5
ii.	Career Skill	4
4. General course		
i.	Disaster Management	1
ii.	Seminar & General Proficiency	8
iii.	Internship	11

Abbreviations:

L : Lecture, T : Tutorials, P : Practicals MT : Midterm Examinations
Att. : Attendance Asmt. : Teachers Assessment as Assignments, Seminar
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SEMESTER III

S.No.	SUB CODE	SUBJECT	L	T	P	TC	MT	Asmt./ LR/Att.	ESE	Total
	Theory									
1.	TMA303	Engineering Mathematics III	3	0	0	3	25	25	50	100
2.	TME 302	Material Science and Metallurgy	3	0	0	3	25	25	50	100
3.	TME304	Basic Thermodynamics	3	1	0	4	25	25	50	100
4.	TME305	Manufacturing Processes I	3	1	0	4	25	25	50	100
5.	TME306	Engineering Mechanics	3	1	0	4	25	25	50	100
6.	**TAS301**	**Introduction to Aerospace and Aerospace Materials**	**3**	**0**	**0**	**3**	**25**	**25**	**50**	**100**
	Labs									
7.	PME 311	Computer Aided Machine Drawing	0	0	4	2	25	25	50	100
8.	PME 312	Metallography & Material Testing Laboratory	0	0	3	1	25	25	50	100
9.	PME 313	Foundry & Forging Lab	0	0	3	1	25	25	50	100
10.	XCS 301	Career Skills-I	2	0	0	1	25	25	50	100
11.	GP301	Seminar & General Proficiency	-	-	-	1	-	-	100	100
12.		Internship I	To be held at the end of III semester							
Total			20	3	10	27	250	250	600	1100

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Internship will be of 2 to 4 weeks before the start of next semester. Evaluation will be done in the next semester.

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SEMESTER-IV

S.No.	SUB CODE	SUBJECT	L	T	P	TC	MT	Asmt./ LR/Att.	ESE	Total
	Theory									
1.	TME403	Manufacturing Processes II	3	1	0	4	25	25	50	100
2.	TME404	Mechanical Measurements & Metrology	3	0	0	3	25	25	50	100
3.	TME405	Kinematics of Machines	3	1	0	4	25	25	50	100
4.	TME406	Strength of Materials	3	1	0	4	25	25	50	100
5.	TME407	Fluid Mechanics	3	1	0	4	25	25	50	100
6.	**TAS 401**	**Aircraft designs**	**3**	**0**	**0**	**3**	**25**	**25**	**50**	**100**
	Labs									
7.	PME411	Machine Shop	0	0	3	1	25	25	50	100
8.	PME413	Measurements & Metrology Lab	0	0	3	1	25	25	50	100
9.	PME417	Fluid Mechanics Lab	0	0	3	1	25	25	50	100
10.	XCS401	Career Skills-II	2	0	0	1	25	25	50	100
11.	GP401	Seminar & General Proficiency	-	-	-	1	-	-	100	100
12.	MEI 401	Internship I*	-	-	-	3	-	-	100	100
13.		Internship II	To be held at the end of IV semester							
Total			20	4	9	30	250	250	700	1200

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***Internship After III Semester**

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SEMESTER-V

S.No.	SUB CODE	SUBJECT	L	T	P	TC	MT	Asmt./ LR/Att.	ESE	Total
	Theory									
1.	TME 501	Heat & Mass Transfer	3	1	0	4	25	25	50	100
2.	TME 502	Design of Machine Elements I	3	1	0	3	25	25	50	100
3.	TME503	Dynamics of Machines	3	1	0	4	25	25	50	100
4.	TME506	Fluid Machinery	3	1	0	4	25	25	50	100
5.	**TAS501**	**Aerodynamics**	**3**	**1**	**0**	**4**	**25**	**25**	**50**	**100**
6.	TME507	Industrial Engineering	3	0	0	3	25	25	50	100
	Labs									
7.	PME511	HMT Lab	0	0	3	1	25	25	50	100
8	PME512	DOM Lab	0	0	3	1	25	25	50	100
9.	PME516	Fluid Machinery Lab	0	0	3	1	25	25	50	100
10.	**PAS501**	**CFD lab for aerospace**	**0**	**0**	**3**	**1**	**25**	**25**	**50**	**100**
11.	XCS501	Career Skills-III	2	0	-	1	25	25	50	100
12.	GP501	Seminar & General Proficiency	-	-	-	1	-	-	100	100
13.	MEI 501	Internship II*	-	-	-	4	-	-	100	100
Total			20	5	12	32	275	275	750	1300

***Internship After IV Semester**

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ESE : End Semester Examination
SEMESTER-VI

S.No.	SUB CODE	SUBJECT	L	T	P	TC	MT	Asmt./ LR/Att.	ESE	Total
	Theory									
1.	TME601	Refrigeration & Air conditioning	3	1	0	4	25	25	50	100
2.	TME602	Design of machine elements II	3	1	0	4	25	25	50	100
3.	TME603	I.C. Engines	3	1	0	4	25	25	50	100
4.	TME606	CAD/CAM	3	0	0	3	25	25	50	100
5.		Elective I	3	1	0	4	25	25	50	100
6.	**TAS605**	**Aircraft Propulsion**	**3**	**1**	**0**	**4**	**25**	**25**	**50**	**100**
	Labs									
7.	PME611	Refrigeration & Air Conditioning Lab.	0	0	3	1	25	25	50	100
8.	PME614	Modeling and analysis lab(CFD + FEM)	0	0	3	1	25	25	50	100
9.	PME616	Automation & CNC Lab.	0	0	3	1	25	25	50	100
10.	**PAS605**	**Internet-of-Things lab for avionics**	**0**	**0**	**2**	**1**	**25**	**25**	**50**	**100**
11.	XCS601	Career Skills-IV	2	0	0	1	25	25	50	100
12.	GP601	General Proficiency	-	-	-	1	-	-	100	100
13.		Industrial Internship	To be held at the end of VI semester							
Total			20	5	11	29	275	275	650	1200

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Elective I

Code	**Elective name**
TME 614	Finite Element Method
TME 615	Computational Fluid Dynamics
TME 616	Numerical Methods Using MATLAB
TAS 617	**Boundary Layer Theory and Turbulence**

Industrial Internship will be of 4 to 6 weeks before the start of next semester. Evaluation will be done in the next semester.

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SEMESTER-VII

S.No.	SUB CODE	SUBJECT	L	T	P	TC	MT	Asmt./ LR/Att.	ESE	Total
	Theory									
1.	TME701	Mechanical Vibration	3	1	0	4	25	25	50	100
2.	TME704	Operation research & optimization technique	3	1	0	4	25	25	50	100
3.	TME706	Power plant Engineering	3	1	0	4	25	25	50	100
4.	TME707	Automobile Engineering	3	0	0	3	25	25	50	100
5.		Elective-II	3	0	0	3	25	25	50	100
6.	UCE701	Disaster Management	1	0	0	1	25	25	50	100
7.	**TAS 708**	**Flight Dynamics**	**3**	**0**	**0**	**3**	**25**	**25**	**50**	**100**
	Labs									
8.	PME717	Automobile Engineering Lab	0	0	3	1	25	25	50	100
9.	MEP701	Project work Phase I	-	-	-	1	--	--	100	100
10.	GP701	General Proficiency	-	-	-	1	-	-	100	100
11.	MEI 701	Industrial Internship*	-	-	-	4	-	-	100	100
Total			19	3	3	29	200	200	700	1100

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Electives-II

Code	**Elective name**
TME714	Total Quality Management
TME715	Quality Control
TME716	Computer Integrated Manufacturing
TAS717	**Plates and Shells**

***Industrial Internship after VI Semester**

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SEMESTER VIII

S.No.	SUB CODE	SUBJECT	L	T	P	TC	MT	Asmt./ LR/Att.	ESE	Total
	Theory									
1.		**Elective-III**	3	-	-	3	25	25	50	100
2.	**TAS801**	**Airport and Airline Management**	**3**	**0**	**0**	**3**	**25**	**25**	**50**	**100**
3.	MEP801	Project work Phase II	-	-	-	4	-	100	150	250
4.	OLC801	Online Course	-	-	-	6	-	-	100	100
5.	GP801	General Proficiency	-	-	-	1	-	-	100	100
Total			6	-	-	17	50	150	450	650

Elective III

Code	Elective name
TME812	Non-Conventional Energy Resources
TME814	Advanced Welding Technology
TME815	Tribology
TAS 816	**Management Information System**

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1. Subject Code: **TAS 301**

2. Course Title: **INTRODUCTION TO AEROSPACE AND AEROSPACE MATERIALS**

3. Contact Hours: **L: 3** **T: 0** **P: 0**

4. Examination Duration (Hrs.): **Mid: 1.5 hrs** **End: 3 hrs**

5. Relative Weightage**: MSE 50%** **ESE 25%** **TSM 50%**

6. Credits**: 3** **7.** Semester**: III** **8.** Subject Area**: Core Course**

9. Pre-requisite**: none**

10. Course Outcomes:

Course Outcome 1: To understand components of aircrafts, basic aerodynamics, lift and drag
Course Outcome 2: To understand stability of flight vehicles and gain basic knowledge of flight propulsion system
Course Outcome 3: To gain knowledge of aircraft materials and their properties
Course Outcome 4: To understand composite materials and their use in aircrafts

11. Details of Course:

Unit No.	Contents	Contact Hours
1.	Nomenclature of aircraft components, standard atmosphere tables and equations, speeds and pressures in a flow using Bernoulli's equation, airfoils, and Lift generation, lift and drag coefficient.	**05**
2.	concept of static stability of flight vehicles, basic components of an airplane and explain their contributions to static stability, basic knowledge of propulsive devices, spacecraft, space systems and space missions, key milestones in the history of aeronautics and astronautics	**07**
3.	Aircraft Steels and its alloys, Nickel alloys, copper alloys, aluminum alloys, magnesium alloys, Titanium alloys, Ni-Cr alloys. Alloying elements and functions, Heat treatment, of Aluminum alloys- annealing, solution treatment, precipitation hardening,	**08**
4.	Introduction to Composite Materials, properties and manufacturing processes, autoclave curing, out of autoclave curing, resin transfer moulding, Design and manufacturing of polymer matrix, metal matrix, ceramic matrix composites, carbon composites etc. Various forms and type of reinforcements, fillers, additives; Composites for structural, wear resistance and high temperature applications.	**09**

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5.	Rubber hoses pipes, seals "O"rings, adhesives and sealants, tubes and tyres, collapsible fibres for fuel tanks, plastics and neoprenes in aircraft industry, paints and varnishes for aircraft industry. Honeycomb, poly vinyl films, moltoprene filler blocks. Materials for electric aggregate bodies and attachments.	**06**
	Total	**35**

12.Suggested Books:

S. No.	**Name of Authors /Books /Publisher**
1.	John D. Anderson**,** Introduction to Flight**,** 8th Edition, McGraw-Hill Education, New York, 2015
2.	Fundamentals of aerospace engineering: An introductory course to aeronautical engineering, Manuel Soler Ist edition
3.	Fundamentals of Aerospace Engineering: (Beginner's Guide), Ali Baghchehsara

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NAME OF DEPARTMENT: Department of Mechanical Engineering with minor in Aerospace Engineering

1. Subject Code: **TAS 401**
2. Course Title: **Aircraft Designs**
3. Contact Hours: **L:3** **T: 0** **P: 0**
4. Examination Duration(Hrs.): **Mid: 1:30 hrs** **End: 3:00 hrs**
5. Relative Weightage**: MSE -25%** **ESE -50%** **TSM -25%**
6. Credits**: 3** **7.**Semester**: IV** **8.** Subject Area**: Core Course**

9. Pre-requisite**: Engineering Mechanics, Strength of Material, Aircraft Material**

10. Course Outcomes:

After learning the course the students should be able to

1. Understand parameters of Aircraft Design
2. Calculate the flight loading conditions and understand the Velocity - Load factor diagram
3. Calculate weight-estimation based on mission requirements and iterative approach
4. Design the wings considering the stalling, take off and landing conditions
5. Structural Design of Cockpit and aircraft passenger cabin layout for different categories

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11. Details of Course:

Unit No.	Contents	Contact Hours
1.	**Introduction:** Aircraft Design Requirements, specifications, role of users, Aerodynamic and Structural Consideration, Importance of weight, Airworthiness requirements and standards, Classifications of airplanes, Special features of modern airplane.	**08**
2.	**Air Loads in Flight:** Symmetrical measuring loads in flight, Basic flight loading conditions, Load factor, Velocity - Load factor diagram, salient features of the V-n diagram, gust load and its estimation, Structural limits.	**10**
3.	**Airplane Weight Estimation:** Weight estimation based on type of airplane, trends in wing loading, weight-estimation based on mission requirements, iterative approach	**08**
4.	**Wing Design:** Selection of airfoil selection, influencing factors. Span wise load distribution and plan-form shapes of airplane wing. Stalling, take off and landing considerations. Wing - drag estimation. High lift devices.	**09**
5.	**Structural Design**: Cockpit and aircraft passenger cabin layout for different categories, types of associated structure, features of light airplanes using advanced composite materials.	**07**
	Total	**44**

12. Suggested Books:

S. No.	Name of Authors /Books /Publisher
1.	Daniel P Raymer, Aircraft Design: A conceptual approach, AIAA Series, 1992
2.	D. Stinton, The Design of Airplane, GRANADA, UK 1983
3.	John D Anderson (Jr.), Airplane Performance and Design, McGraw Hill 1999
4.	E. Torenbeek, Synthesis of Airplane Design
5.	L. M. Nicholai, Fundamentals of airplane Design, Univ. of Dayton DHIO, 1975

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NAME OF DEPARTMENT: Department of Mechanical Engineering with minor in Aerospace Engineering

1. Subject Code: **TAS 501**
2. Course Title: **Aerodynamics**
3. Contact Hours: **L:3** **T: 1** **P: 0**
4. Examination Duration(Hrs.): **Mid: 1:30 hrs** **End: 3:00 hrs**
5. Relative Weightage**: MSE -25%** **ESE -50%** **TSM -25%**
6. Credits**: 4** **7.**Semester**: V** **8.** Subject Area**: Core Course**

9. Pre-requisite**: Fluid Mechanics**

10. Course Outcomes:

After learning the course the students should be able to

1. Understand the development of the aerodynamics.
2. Understand the potential flow over airfoil.
3. Comprehend the concept of flow over finite wings.
4. Understand the principles of subsonic compressible flow over airfoil.
5. Understand the concept of supercritical airfoil.
6. Understand the features of linearized supersonic flow over airfoil.

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11. Details of Course:

Unit No.	Contents	Contact Hours
1.	Introduction to Aerodynamics: Importance of Aerodynamics: Historical Examples, Aerodynamics: Classification and Practical Objectives, Some Fundamental Aerodynamic Variables, Aerodynamic Forces and Moments, Center of Pressure, Dimensional Analysis: The Buckingham Pi Theorem, Flow Similarity, Fluid Statics: Buoyancy Force, Viscous Flow: Introduction to Boundary Layers, Applied Aerodynamics: The Aerodynamic Coefficients—Their Magnitudes and Variations	**10**
2.	Incompressible Flow over Airfoils, Airfoil Nomenclature, Airfoil Characteristics, Theoretical Solutions for Low-Speed Flow over Airfoils: The Vortex Sheet, The Kutta Condition, Kelvin's Circulation Theorem and the Starting Vortex, Classical Thin Airfoil Theory: The Symmetric Airfoil, The Cambered Airfoil, The Aerodynamic Center: Additional Considerations, Viscous Flow: Airfoil Drag	**10**
3.	Incompressible Flow over Finite Wings: Introduction: Downwash and Induced Drag, The Vortex Filament, the Biot-Savart Law, and Helmholtz's Theorems, Prandtl's Classical Lifting-Line Theory, Applied Aerodynamics: The Delta Wing, Applied Aerodynamics: Airplane Lift and Drag	**08**
4.	Subsonic Compressible Flow over Airfoils: Linear Theory: The Velocity Potential Equation, The Linearized Velocity Potential Equation, Prandtl-Glauert Compressibility Correction, Improved Compressibility Corrections, Critical Mach Number, Drag-Divergence Mach Number: The Sound Barrier, The Area Rule, The Supercritical Airfoil, Applied Aerodynamics: The Blended Wing Body	**09**
5.	Linearized Supersonic Flow, Derivation of the Linearized Supersonic Pressure Coefficient Formula, Application to Supersonic Airfoils, Viscous Flow: Supersonic Airfoil Drag, Sonic boom and rotary wing aerodynamics	**07**
	Total	**44**

12. Suggested Books:

S. No.	Name of Authors /Books /Publisher
1.	Fundamentals of Aerodynamics – John D Anderson Jr., McGRAW-HILL, 5th edition
2.	Aerodynamics for Engineering Students – E.L. Houghton and P. W. Carpenter, Butterworth-Heinemann, Year: 2003
3.	Aerodynamics of Wings and Bodies, Holt Ashley, Marten Landhahl, Dover Publications, Year: 1985

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NAME OF DEPARTMENT: Department of Mechanical Engineering with minor in Aerospace Engineering

1. Subject Code: **PAS 501**
2. Course Title: **CFD lab for Aerospace**
3. Contact Hours: **L: 0** **T: 0** **P: 2**
4. Examination Duration(Hrs.):**Mid: 1:30 hrs** **End: 3:00 hrs**
5. Relative Weightage**: MSE -25%** **ESE -50%** **TSM -25%**
6. Credits**: 1** **7.**Semester**: V** **8.** Subject Area**: Core Course**

9. Pre-requisite**: Fluid Mechanics and CFD**

10. Course Outcome:

After completion of the CFD lab the students should be able to

1. Grasp the ERCOFTAC guideline for the use of commercial CFD code.
2. To generate the grid over airfoil.
3. To use the adequate turbulence model for the CFD
4. To employ the adequate numerical methods for CFD

List of Experiments

1. Generated the flow inside a 2D pipe with diameter 1 meter and length 10 meter at least three different grid.
2. Calculate the flow inside a 2D pipe with diameter 1 meter and length 10 meter (Exp.1) using k-ω SST/ k-ε with enhanced wall treatment model. Compare the boundary layer profile and velocity profile with analytical solution. Take the Reynolds number of the flow 10000, 20000 and 40000.
3. Generation of grid for the flow over 2D rectangle (2cmX4cm) -at least three different grid.
4. Calculation of lift and drag for the flow over 2D rectangle (2cmX4cm) (Exp.3) using k-ω SST/ k-ε with enhanced wall treatment model for MACH-0.1.
5. Generate the grid for the flow over 2D backward facing step (***Fig. 1***)

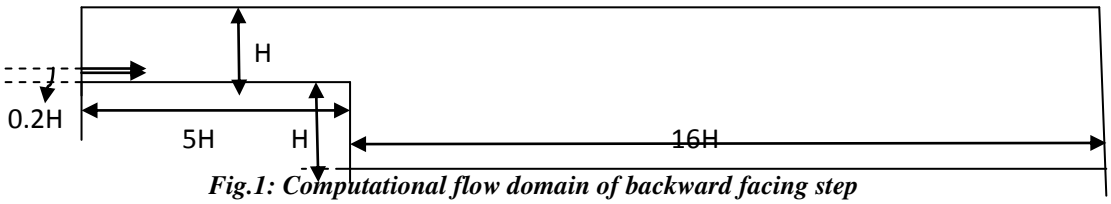

Fig.1: Computational flow domain of backward facing step

6. Calculate the flow over backward facing step (Exp 5.) using k-ω SST/ k-ε with enhanced wall treatment model. Analyze the boundary layer profile and reattachment length.

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7. Generation of grid for the flow over symmetric NACA-0012 airfoil-at least three different grid.
8. Calculation of lift and drag of symmetric airfoil (NACA-0012) at 10° angle of attack using Spalart-Allmaras turbulence model for MACH-0.2.
9. Calculation of lift and drag of symmetric airfoil (NACA-0012) at 12° , 14°, 16° angle of attack using Spalart-Allmaras turbulence model for MACH-0.2.Analyse the boundary layer separation.
10. Calculation of lift and drag of symmetric airfoil (NACA-0012) at 12° , 14°, 16° angle of attack using k- ω (Standard and SST) turbulence model for MACH-0.2.Analyse the boundary layer separation.
11. Generation of grid for the symmetric NACA-2415 airfoil-at least three different grid.
12. Calculation of lift and drag of symmetric airfoil (NACA-2415) at 10° angle of attack using Spalart-Allmaras turbulence model for MACH-0.2.
13. Calculation of lift and drag of symmetric airfoil (NACA-2415) at 12° , 14°, 16° angle of attack using Spalart-Allmaras turbulence model for MACH-0.2.Analyse the boundary layer separation.
14. Calculation of lift and drag of symmetric airfoil (NACA-2415) at 10° angle of attack using Spalart-Allmaras turbulence model for MACH-0.5.

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GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

NAME OF DEPARTMENT: Department of Mechanical Engineering with minor Aerospace Engineering

1. Subject Code: **TAS 605**

2. Course Title: **Aircraft Propulsion**

3. Contact Hours: **L:3** **T: 1** **P: 0**

4. Examination Duration(Hrs.):**Mid: 1:30 hrs** **End: 3:00 hrs**

5. Relative Weightage**: MSE -25%** **ESE -50%** **TSM -25%**

6. Credits**: 4** **7.**Semester**: VI** **8.** Subject Area**: Core Course**

9. Pre-requisite**: Applied Thermodynamics**

10. Course Outcome:

After learning the course, the students should be able to

1. Understand basics of jet engines and rocket engines.
2. Understand the need of components of jet engines.
3. Comprehend the concept of fluid flow.
4. Understand the principles of gas dynamics as applicable to diffusers
5. Understand the types and features of gas turbine combustion chambers
6. Understand the features of compressible isentropic flows and irreversibility like shocks.

11. Details of Course:

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Unit No.	Contents	Contact Hours
1.	**Fundamentals of Gas Turbine Engines for Aircraft Power Plant:** Introduction and Basic review of thermodynamic concepts and Gas turbine cycle with regeneration, reheating and inter-cooling, air breathing and non-air breathing propulsion system, Various method to improve efficiency and work output of gas turbine, Fundamentals of gas turbine engine use as aircraft power plant, Fundamental thrust equation, Factors affecting the thrust, Effect of pressure temperature and velocity on thrust, Thrust augmentation techniques, Different types of aircraft power plant i.e. turbojet, turbofan, turbo prop and turbo shaft engine, Performance characteristics of turbojet engine, Performance comparison, advantages, disadvantages , limitation of turbojet, turbofan and turboprop engine, Efficiency and specific fuel consumption computations, Numerical	**10**
2.	**Diffusers / Inlets:** Introduction to inlets, subsonic and supersonic inlets Inlet Types internal compression inlet, external compression inlet and mixed compression inlet, design of HP and LP compressors including blades, Subsonic inlets design variables, inlet total pressure ratio, inlet sizing, inlet flow distortion, Nacelle and interference drag. Boundary layer separation and features of external flow near a subsonic inlet, internal flows and stalling in subsonic inlets, relation between minimum area ratio and internal deceleration ratio, Supersonic Inlets , design construction and working, Numerical	**07**
3.	**Gas Turbine Combustion Chamber/Burner:** Introduction and types of burners – Can burner, Annular burner, Cannular burner, Relative advantages and disadvantages of different types of burners, zones of combustion chamber, requirements of combustion chamber, design criteria of combustion chamber, pressure losses, combustion intensity and combustion efficiency, flame stabilization and flame holder, Fuel injection, sensors and transducers in a gas turbine engine, Flame out in engines, Critical Design parameters of combustion chamber Materials for combustion chamber	**07**
4.	**Nozzle Theory:** Basic review of thermodynamics and one dimensional isentropic flow, Area –Mach relation and types of nozzle, Exhaust velocity of nozzle, Mass flow rate through nozzle and choking of nozzle, Area ratio of nozzle, Effect of back pressure, Optimum expansion, under expansion and over expansion nozzle, Various nozzle configurations, Different Types of Nozzle, Actual mass flow rate through nozzle and equilibrium conditions, Normal shock relations, oblique shock relations and shock tables	**08**
5.	**Ramjet Propulsion:** Introduction and operating principle, Advantages, disadvantages, limitations and comparison with jet engines, Subcritical, critical and super critical operation, Ramjet performance, Simple design calculation of ramjet engine, Introduction to scramjet and preliminary concepts in supersonic combustion, Numericals **Rocket Propulsion:** Introduction to rocket propulsion and operating principle, Classification of rocket propulsion system, Introduction to solid propellant rockets and liquid propellant rockets **Introduction to electric aircraft and green engines**	**09**
	Total	**42**

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12. Suggested Books:

S. No.	Name of Authors /Books /Publisher
1.	Ahmed F. El-Sayed, "Aircraft Propulsion and Gas Turbine Engines", CRC Press, 2008.
2.	H.S. Mukunda, "Understanding Aerospace Chemical Propulsion", Interline Publishing, 2004.
3.	Hill P. and Peterson C., "Mechanics & Thermodynamics of Propulsion", Addison Wesley, 1992.
4.	Zucrow N. J., "Aircraft and Missile Propulsion", Vol. I& II, John Wiley, 1975.
5.	Sutton G.P., "Rocket Propulsion Elements", John Wiley, New York, 1986.

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GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

NAME OF DEPARTMENT: Department of Mechanical Engineering with minor Aerospace Engineering

1. Subject Code: **TAS 617**

2. Course Title: **Boundary layer theory and turbulence**

3. Contact Hours: **L:3** **T: 0** **P: 0**

4. Examination Duration(Hrs.):**Mid: 1:30 hrs** **End: 3:00 hrs**

5. Relative Weightage**:** **MSE -25%** **ESE -50%** **TSM -25%**

6. Credits**: 3** **7.**Semester**: VI** **8.** Subject Area**: Elective**

9. Pre-requisite**: Fluid Mechanics**

10. Course Outcome:

After learning the course, the students should be able to

1. Understand basics of viscous flow
2. Understanding the development of the momentum and thermal boundary layer.
3. Understanding the phenomena of the boundary layer separation.
4. Solve the Navier-stokes equations on some basic flows.
5. Understand the basic nature of turbulence
6. Understand the need for turbulence modelling.

11. Details of Course:

Unit No.	Contents	Contact Hours
1.	Features of Viscous Flows: Real and Ideal Fluids, Viscosity, Reynolds Experiment, Asymptotic Behaviour at Large Reynolds Numbers, Boundary-Layer Concept, Laminar Boundary Layer on a Flat Plate at Zero Incidence, Turbulent Boundary Layer on a Flat Plate at Zero Incidence, Fully Developed Turbulent Flow in a Pipe, Boundary Layer on an Airfoil, Separation of the Boundary Layer	**08**

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2.	Exact Solutions of the Navier-Stokes Equations: Couette-Poiseuille Flows,Steady Axisymmetric Flows: Circular Pipe Flow (Hagen-Poiseuille Flow), Flow Between Two Concentric Rotating Cylinders, Axisymmetric Stagnation-Point Flow	**06**
3.	Thermal Boundary Layers Without Coupling of the Velocity Field to the Temperature Field, Effect of the Prandtl Number, Similar Solutions of the Thermal Boundary Layer, Integral Methods for Computing the Heat Transfer, Boundary layer instability and transition to turbulence	**08**
4.	The origins and nature of turbulence, from non-linearity to chaos, energy cascading in turbulent flow, Kolmogorov's scale and Taylor micro-scale. Discussion on complexity of Navier-Stokes equation with respect to DNS and concept of LES.	**07**
5.	Reynolds Averaging techniques for N-S equations, Prandtl's mixing length model, two-equation model (K-ε, and k-ω model), v2-f model, Reynolds Stress model.	**06**
	Total	**35**

12. Suggested Books:

S. No.	Name of Authors /Books /Publisher
1.	Herrmann Schlicting, Boudary layer theory, McGraw Hill
2.	P.A. Davidson, Turbulence-An introduction for Scientists and Engineers
3.	H. Tennekes, J.L. Lumley, A first course in turbulence

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GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

NAME OF DEPARTMENT: Department of Mechanical Engineering with minor Aerospace Engineering

1. Subject Code: **TAS 708**
2. Course Title: **FLIGHT DYNAMICS-TAS708**
3. Contact Hours: **L:3** **T: 1** **P: 0**
4. Examination Duration (Hrs.): **Mid: 1:30 hrs** **End: 3:00 hrs**
5. Relative Weightage: **MSE -25%** **ESE -50%** **TSM -25%**
6. Credits: **4** 7.Semester: **VII** 8. Subject Area: **Core Course**

9. Pre-requisite**: Engineering Mechanics, linear algebra, linear differential equations, gravitation**

10. Course Outcomes:

Course Outcome 1: Students should be able to understand different forces acting on a fixed wing aircraft.
Course Outcome 2: Student should be able to understand different parameters of flight performance
Course Outcome 3: Student should be able to understand aircraft stability and identify aircraft controls.
Course Outcome 4: Student should be able to understand the motion of satellites and interplanetary vehicles

11. Details of Course:

Unit No.	Contents	Contact Hours
1.	FLIGHT ENVIRONMENT AND FLIGHT FORCES: Atmosphere as flight environment, international standard atmosphere, basic aerodynamics and propulsion properties, force and moments acting on an aircraft	**06**
2.	STEADY FLIGHT PERFORMANCE: straight and level flight, maximum speed, effect of altitude, climb and descent, absolute and service ceiling, gliding performance, range and endurance, take-off and landing performance, stall speed, coordinated turn, pull-up manoeuvre, Power requirement computation for various flight maneuvers,flight envelope determination.	**10**
3.	STABILITY AND CONTROL: notion of static and dynamic stability, longitudinal stability, lateral stability, roll stability, aircraft controls, Spin and stall in aircrafts, Introduction to primary and secondary aerodynamic surfaces.	**07**
4.	DYNAMIC STABILITY: equations of motion of an aircraft, small disturbance theory, phugoids and short period modes, lateral directional modes, spiral roll and dutch roll modes.	**11**

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5.	ASTRONAUTICS: upper atmosphere, projectiles and satellite, circular and elliptical orbits, orbital dynamics, atmospheric re-entry, sub-orbital flight.	**08**
	Total	**42**

12. Suggested Books:

S. No.	**Name of Authors /Books /Publisher**
1.	Flight Stability And Automatic Control – Robert Nelson
2.	Mechanics of Flight – A.C. Kermode
3.	Introduction to Flight – John D Anderson Jr.

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GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

NAME OF DEPARTMENT: Department of Mechanical Engineering with minor Aerospace Engineering

1. Subject Code: **TAS 717**
2. Course Title: **PLATES AND SHELLS**

3. Contact Hours: **L:3** **T: 1** **P: 0**

4. Examination Duration(Hrs.):**Mid: 1:30 hrs** **End: 3:00 hrs**

5. Relative Weightage**: MSE -25%** **ESE -50%** **TSM -25%**

6. Credits**:3** **7.**Semester**: VII** **8.** Subject Area**: Elective**

9. Pre-requisite**: Strength of Materials**

10. Course Outcomes:

Course Outcome 1: Students should be able to understand application of plate and shell structures in aircraft
Course Outcome 2: Student should be able to understand deformation of plates and shells under different loadings
Course Outcome 3: Student should be able to understand performance of laminates in making plates and shells

11. Details of Course:

Unit No.	Contents	Contact Hours
1.	Basic aircraft components and loads; axial, torsion and bending loads; normal and shear stress; failure criteria	**05**
2.	Basics of plate bending theory; circular plates; uniformly loaded circular plate; circular plate with concentrated load at its centre; Rectangular plates; simply supported rectangular plated under various loadings; thermal stresses in plates	**11**
3.	General behaviour of shells; load resistance action of a shell; shells of revolution; symmetrically and asymmetrically loaded shells of revolutions	**08**
4.	Exact methods of bending, buckling and vibration analysis of plate and shell structures; Classical solutions to plates and shells	**11**

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5.	Lamina and Laminate; Lamina theory and failure criteria for composites; Establishing the classical lamination theory; Development of the governing differential equations of equilibrium for composite beams and plates	**07**
	Total	**42**

12. Suggested Books:

S. No.	Name of Authors /Books /Publisher
1.	Stresses in Plates and Shells, A.C. Ugural, McGraw-Hill, New York, 1981. (3rd Edition, 2009).
2.	Theory of Plates and Shells, S.P. Timoshenko and S. Wienowsky-Kreiger, 2nd Edition, McGraw-Hill, New York, 1959.
3.	The Behaviour of Thin Walled Structures: Beams, Plates and Shells, J.R. Vinson, Kluwer Academic Publishers, 1989 (2nd Edition 2002).

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GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN
NAME OF DEPARTMENT: Department of Mechanical Engineering with minor Aerospace Engineering

1. Subject Code: **TAS 801**
2. Course Title: **Airport and Airline Management**
3. Contact Hours: **L:3** **T: 0** **P: 0**
4. Examination Duration(Hrs.):**Mid: 1:30 hrs** **End: 3:00 hrs**
5. Relative Weightage**:** **MSE -25%** **ESE -50%** **TSM -25%**
6. Credits**: 3** **7.**Semester**: VIII** **8.** Subject Area**: Elective**
9. Pre-requisite**:** **Management Information System, Operation Management.**

10. Course Outcomes:

Course Outcome 1: Students will be able to understand about airline working

Course Outcome 2: Students will be able to understand about airline communication process

Course Outcome 3: Students will be able to understand about airline transportation systems

Course Outcome 4: Students will be able to understand about airlines, airport, and aviation rules

Course Outcome 5: Students will be able to understand about management of passenger terminals.

Course Outcome 6: Students will be able understand about logistics and cargo management.

11. Details of Course:

Unit No.	Contents	Contact Hours
1.	**INTRODUCTION** History of Aviation- Development of Air transportation in India-Major players in Airline Industry-SWOT analysis in Airline Industry-Market potential of Indian Airline Industry— Current challenges in Airline Industry-Completion in Airline Industry-IATA & ICAO	**09**
2.	**AIRPORT MANAGEMENT:-** Airport planning-Operational area and Terminal planning, design, and operation-Airport operations-Airport functions-Organization structure of Airline and Airports sectors, Airport authorities-Global and Indian scenario of Airport management – DGCA –AAI.	**09**

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3.	**AIR TRANSPORT SERVICES:-** International trends-Emerging Indian scenario-PPP-Public Private Participation in Indian Airports-Environmental regulations-Private participation in International developments Environment regulations-Regulatory issues-Meteorological services for Aviation-Airport fees, rates, and charges,	**09**
4.	**AIRLINE OPERATIONS** Airline Terminal Management-Flight Information Counter/Reservation and Ticketing Check In/Issue of Boarding pass-Customs and Immigration formalities-Co-ordination, Air Traffic Control, Layout for Airport including Airside and Kerb-side design, Security Clearance-Baggage and -Handling of Unaccompanied minors and Disabled Passengers-Handling of Stretcher Passengers and Human Remains-Handling of CIP,VIP & VVIP-Co-ordination of Supporting Agencies /Departments.	**09**
5.	**LOGISTICS AND AIR CARGO MANAGEMENT** Concept of Logistics- Role of Ware Housing-trend in material handling-Global Supply Chain-Quality concept and Total Quality Management-improving Logistic performance Air Cargo Concept- Cargo Handling-Booking of Perishable Cargo and Live Animals Industry Relation-Type of Air Cargo-Air Cargo Tariff, ratios and Charges-Airway Bill, Function, Purpose, Validation. Ground Handling and support equipment, Aircraft turnaround, safety, security and hazardous activity management. Green airports	**09**
	Total	**45**

12. Suggested Books:

S. No.	Name of Authors /Books /Publisher
1.	Graham. A-Managing Airport an International Perspective –Butterworth Heinemann, Oxford-2001
2.	Wells. A-Airport Planning and Management, 4th Edition-McGraw-hill, London-2000.
3.	P. S. Senguttuvan –Fundamentals of Airport Transport Management – McGraw Hill 2003
4.	Paul R. Murphy,JR and Donal & F.Wood-Contemporary Logistics –Prentice Hall.9th Edn.2008.
5.	Richard De Neufville – Airport Systems: Planning, Design, and Management.- McGraw-Hill, London- 2007
6.	Alexander T. Well, Seth Young –Principles of Airport Management-McGraw Hill 2003

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GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN
NAME OF DEPARTMENT: Department of Mechanical Engineering with minor Aerospace Engineering

1. Subject Code: **TAS 816**
2. Course Title: **Management Information System**
3. Contact Hours: **L:3** **T: 0** **P: 0**
4. Examination Duration(Hrs.):**Mid: 1:30 hrs** **End: 3:00 hrs**
5. Relative Weightage**:** **MSE -25%** **ESE -50%** **TSM -25%**
6. Credits**: 3** **7.**Semester**: VIII** **8.** Subject Area**: Elective**
9. Pre-requisite**: Operation Management**

10. Course Outcomes:

1. Students will be able to understand about use MIS.
2. Students will be able to understand about Development of MIS within the organization.
3. Students will be able to understand Planning, Implementation and controlling of Management Information System.
4. Students will be able to understand about the fundamental of data processing.
5. Students will be able to understand about Managerial Decision Making.
6. Students will be able understand about Data management.

11. Details of Course:

Unit No.	Contents	Contact Hours
1.	INTRODUTION TO MIS:-The meaning and use MIS, System View of Business, Process of MIS, Development of MIS within the organization, Management Process, Information Needs, System Approach in Planning Organizing and Controlling MIS.	**07**
2.	Planning, Implementation and Controlling of Management Information System. SCM, CRAM and International Systems: Introduction, Supply Chain Management Systems, Customer Relationships Management Systems, Challenges of Enterprise Systems Implementations- Managing the implementation, International Information Systems-Outsourcing and off-shoring	**07**

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3.	Fundamentals of Data Processing, Computer Operation of Manual Information System, Components of Computer Systems, Flow Chart, Conversion of Manual to Computer Based Systems, Computer Systems Software, Application Software, Telecommunication Modem.	**07**
4.	Managerial Decision Making, characteristics and components of Decision Support System.	**07**
5.	System Design: System design consideration, input/output design, forms design, file organization and database, data management, file design, program design, control and security	**07**
	Total	**35**

12. Suggested Books:

S. No.	Name of Authors /Books /Publisher
1.	Management Information Systems: Managing the Digital FirmBook by Jane Laudon and Kenneth C. Laudon
2.	Database Systems: Design, Implementation, and Management by Peter Rob
3.	Management Information Systems by James A. O'Brien and George M. Marakas
4.	Management Information Systems by Effy Oz