TULSIRAMJI GAIKWAD-PATIL COLLEGE OF ENGINEERING & TECHNOLOGY
Wardha Road, Nagpur - 441108
Accredited with NAAC A+ Grade
Approved by AICTE, New Delhi, Govt. of Maharashtra
(An Autonomous Institution Affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur)

DEPARTMENT OF AERONAUTICAL ENGINEERING

Teaching Scheme & Syllabus (As per NEP_2020)

SCHEME OF INSTRUCTION & SYLLABI

Semester -Seventh

Programme: Aeronautical Engineering

From

Academic Year 2026-27

Institute Vision & Mission

Vision:

- To emerge as a learning Center of Excellence in the National Ethos in domains of Science, Technology and Management.

Mission:

- To strive for rearing standard and stature of the students by practicing high standards of professional ethics, transparency and accountability.
- To provide facilities and services to meet the challenges of Industry and Society.
- To facilitate socially responsive research, innovation and entrepreneurship.
- To ascertain holistic development of the students and staff members by inculcating knowledge and profession as work practices.

Program Outcomes (POs)

1. Engineering Knowledge
2. Problem Analysis
3. Design/development of solutions
4. Conduct investigations of complex problems
5. Modern tool usage
6. The engineer and society
7. Environment and sustainability
8. Ethics
9. Individual and team work
10. Communication
11. Project management and finance
12. Lifelong learning

Department Vision & Mission

Vision:

- To foster technically skilled Aeronautical Engineers of the utmost academic principles, to convene the needs of academia, industry and society.

Mission:

- Impart quality technical education and unique interdisciplinary experiences.
- Develop the analytical, computational and design capabilities to provide sustainable solutions.
- Expose the students to the current trends and opportunities in the Aerospace industry.
- Inculcate professional responsibility based on an innate ethical value system.

Program Educational Objectives (PEOs)

1. Undergraduate students will acquire knowledge to investigate and solve Aeronautical Engineering problems using basics of applied science and engineering.
2. Undergraduate students will utilize the modern technology and techniques to explore new skills and ideas to satisfy the need of society as well as industry.
3. Undergraduate students will get finest employment opportunities in the field of Aeronautical Engineering.
4. To develop the environment of societal and ethical values to concern with engineering issues.
5. Undergraduate students will contribute in the domain specific and interdisciplinary research through the project based learning.

Program Specific Outcomes (PSO)

- Develop profound working knowledge to solve combination of complex problems in aerodynamics, propulsion, structures, flight mechanics and allied courses.
- Be equipped to use CAE packages, simulation languages and advanced tools to solve practical design and analysis problems.
- Undergraduates will be able to utilize the extensive knowledge of design, manufacturing, testing or maintenance of systems and sub systems to pursue career in aeronautical engineering.

Department of Aeronautical Engineering

Scheme of Instructions: Fourth Year B. Tech. in Aeronautical Engineering (As Per NEP 2020)

Semester–VII

S N.	Sem	Type	BoS/ Dept	Sub Code	Subject	T/P	Contact Hours			Credits	% Weightage			ESE Duration	Total Marks
							L	P	Hrs		CT/IA	CA	ESE		
1	VII	PCC	AE	BAE34701	Flight Mechanics	T	3	-	3	3	30	10	60	3 Hrs	100
2	VII	PCC	AE	BAE34702	Aircraft Design	T	4	-	4	4	30	10	60	3 Hrs	100
3	VII	PCC	AE	BAE34703	Airport Planning and Management	T	3	-	3	3	30	10	60	3 Hrs	100
4	VII	PEC	AE	BAE34704--07	Program Elective-IV	T	3	-	3	3	30	10	60	3 Hrs	100
5	VII	MDM	ECE	BIT33616	Internet of Things	T	3	-	3	3	30	10	60	3 Hrs	100
6	VII	MDM	ECE	BIT33617	Internet of Things Lab	T	2	-	2	1		25	25	2Hrs	50
7	VII	PROJ	AE	BAE34708	Project Work	P	-	08	08	4	-	100	100	2 Hrs	200
8	VII	AEC	AE	BAE34709	Sustainable Development Goals	T	2	-	2	2	14	6	30	2 Hrs	50
Total							**20**	**8**	**28**	**23**	**164**	**181**	**455**	**21Hrs**	**800**

Course Category	HSSM (Humanities Social Science & Management)	BSC (Basic Science Course)	ESC (Engg. Science Course)	PCC (Programme Core Courses)	PEC (Program Elective Courses)	OEC (Open Elective Courses)	MDM (Multi-disciplinary Courses)	SEC (Skill Course)	ELC/FP/CEP (Experiential Learning Courses)	CC (Liberal Learning Courses)
Credits	--	--	--	10	03	--	04	02	4	--
Cumu. Sum	12	16	13	54	13	08	14	10	06	4

PROGRESSIVE TOTAL CREDITS:127+23=150

Chairperson	Director Academics/ Vice Principal	Director Administration	Principal	March, 2026 Date of Release	1.00 Version	Applicable For AY2023-24 Onwards

Head
Aeronautical Engineering
TGPCET, Nagpur

Director Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
And Technology, Nagpur

Dr. Premanand Naktode
Principal
TGPCET, Nagpur

Programme: Aeronautical Engineering

List of **Program Electives** offered By Aeronautical Engineering Department

Program Elective- I	Program Elective-II	Program Elective- III	Program Elective- IV
Semester V	**Semester VI**	**Semester VI**	**Semester VII**
BAE33504: Boundary Layer Theory	**BAE33603:** Drone Technology	**BAE33607:** Control Theory & Systems	**BAE34704:** Unmanned Aerial vehicle and systems
BAE33505: Aircraft Systems & Instruments	**BAE33604:** Spacecraft Technology	**BAE33608:** Aviation Management	**BAE34705:** Composite Materials & NDT
BAE33506: Space Flight Mechanics	**BAE33605:** Aircraft Navigation & Communication Systems	**BAE33609:** Helicopter Engineering	**BAE34706:** Vibrations and Aero-elasticity
BAE33507: Industrial Aerodynamics	**BAE33606:** Aircraft Maintenance & Repair	**BAE33610:** Finite Element Methods (FEM)	**BAE34707:** Computational Fluid Dynamics

Programme: Aeronautical Engineering

List of **Open Electives** offered By **Aeronautical Engineering** Department (NBA Accredited if applicable)

Open Elective-I	Open Elective-II	Open Elective-III
Semester-III	**Semester-IV**	**Semester-V**
BAE32310: Introduction to Aerospace Engineering	**BAE32406: Avionics**	**BAE33511: Unmanned Arial Systems**

Course Category	HSSM (Humanities Social Science & Manag.)	BSC (Basic Science Course)	ESC (Engineering Science Course.)	PCC (Programme Core Courses	PEC (Programme Elective Courses)	OEC (Open Elective Courses)	MDM (Multi-disciplinary Course)	SEC (Skill Course)	ELC/FP/CEP Experien-tial Learning Courses)	CC (Liberal Learning Courses)	Semester Wise Credits
Semester-I	04	08	05	--	--	--	--	02	--	02	**21**
Semester-II	02	08	08	--	--	--	--	02	--	02	**22**
Semester-III	02	--	--	11	--	04	02	--	02	--	**21**
Semester-IV	04	--	--	11	--	02	02	02	--	--	**21**
Semester-V		--	--	12	04	02	04	--	--	--	**22**
Semester-VI		--	--	10	06	--	02	02	--	--	**20**
Semester-VII	--	--	--	**10**	**03**	--	**04**	**02**	**4**	--	**23**
Semester-VIII		--	--	-	-	--	--	--	16	--	**16**
Cumu. Sum	**12**	**16**	**13**	**54**	**13**	**8**	**14**	**10**	**22**	**4**	**166**

Chairperson	Director Academics/ Vice Principal	Director Administration	Principal	March, 2026 Date of Release	1.00 Version	Applicable For AY2023-24 Onwards

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Dr. Premanand Naktode
Principal
TGPCET, Nagpur

Fourth Year (Semester-VII) B. Tech. Aeronautical Engineering

BAE34701: Flight Mechanics

4thYear- (7th Semester)

BAE34701: Flight Mechanics

Teaching Scheme			**Examination Scheme**	
Lectures	3 Hr / Week		**ESE**	60 Marks
Tutorial	-		**CIE**	40 Marks
Practical	-		**Total**	100 Marks
Theory Credits : 3			**Duration of Exam:** 3 Hours	

Course Objectives

The Objectives of this course is:

1.	Understand the fundamentals of aerodynamics and standard atmosphere and their influence on aircraft performance.
2.	Analyze steady level flight performance, including thrust–drag relationships, and evaluate range and endurance of aircraft.
3.	Evaluate aircraft performance during climb, descent, and turning flight, and interpret the effect of flight conditions on maneuverability.
4.	Explain the principles of static stability and control, including longitudinal, lateral, and directional stability, and distinguish between stick-fixed and stick-free stability.
5.	Interpret the dynamic behavior of aircraft, including longitudinal and lateral-directional modes, and understand the qualitative aspects of flight dynamics.

Course Contents

Unit I	**Standard Atmosphere:** Definition of altitude, Geometric Altitude, Geo-potential Altitude, Absolute Altitude, The hydrostatic equation, Relation between geopotential and geometric altitudes, Definition of standard atmosphere, Pressure, Density & temperature altitudes. Basic aerodynamic forces and moments, Lift, drag, and moment coefficients, Drag polar and aerodynamic efficiency, Airfoil characteristics, Introduction to aircraft performance parameters.
Unit II	**Airplane Performance for Steady Flight:** Introduction, Forces acting on aircraft in steady level flight, Thrust required, thrust available and maximum velocity, Power required, Power available and maximum velocity for jet engines and reciprocating engine-propeller combination, Altitude effect on power required and available, Range & endurance for propeller driven airplane and jet engine driven airplane.
Unit III	**Airplane Performance for accelerated Flight:** Climbing Flight, Gliding flight, rate of climb and angle of climb, Absolute and service ceilings, Time to Climb, Level turn, Pull-up and Pull-down maneuvers, V-n diagram, Accelerated rate of climb: Energy method, Take-off Performance, Landing Performance.
Unit IV	**Static Stability and Control:** Fundamentals of Stability, Types of stability: Longitudinal Static Stability, Aerodynamic center (AC) , Center of gravity (CG) , Neutral point , Stability condition: Stick-Fixed Stability, Stick-fixed neutral point , Static margin, Effect of CG position, Stick-Free Stability, Free elevator concept, Hinge moment basics, Stick-free neutral point , Free elevator factor , Comparison, Control and Trim, Elevator control and effectiveness Trim condition: Control derivatives (concept only), Lateral and Directional Static Stability, Dihedral effect Weathercock stability ,Role of vertical and horizontal tail.

Unit V	**Flight Dynamics:** Introduction to Flight Dynamics, Difference between: Static stability, Dynamic stability, Degrees of freedom (6 DOF overview only), Dynamic Stability Concept, Time response of aircraft, neutral dynamic behaviour, Damping, Longitudinal Dynamic Modes (Concept Only), Short Period Mode, Phugoid Mode, Lateral-Directional Dynamic Modes, Dutch Roll, Spiral Mode, Roll Mode, Stability Derivatives (Introductory).

Text Books	
1	Perkins, C. D. and Hage, R. E., Airplane Performance stability and Control, John Wiley & Son:, Inc, New York, 3rd Edn. 2008.
2	Nelson, R. C., Flight Stability and Automatic Control, McGraw-Hill Book Co., 1st Ed., 1998.
3	Etkin, B., Dynamics of Flight Stability and Control, John Wiley, New York, 2nd Ed., 1982.
Reference Books	
1	Babister, A. W., Aircraft Dynamic Stability and Response, Pergamon Press, Oxford, 1st Ed., 1980.
2	Dommasch, D. O., Shelby, S. S., and Connolly, T. F., Aeroplane Aero dynamics, Issac Pitman, London, 3rd Ed., 1981.
Useful Links	
1	https://nptel.ac.in/courses/101/106/101106033/
2	https://nptel.ac.in/courses/101/101/101101002/
3	https://nptel.ac.in/courses/101/106/101106082/

BAE34701	**Course Outcomes**	**CL**	**Class Sessions**
CO1	**Apply** principles of aerodynamics and standard atmosphere to determine fundamental flight parameters.	**3**	**9**
CO2	**Analyze** steady level flight performance using thrust–drag and power relationships, and compute range and endurance.	**3**	**9**
CO3	**Evaluate** aircraft performance in climb, descent, and turning flight, including maneuvering characteristics.	**3**	**9**
CO4	**Analyze** static stability and control of aircraft, including longitudinal, lateral, and directional stability, and differentiate between stick-fixed and stick-free stability.	**3**	**9**
CO5	**Interpret** dynamic stability modes of aircraft (phugoid, short period, Dutch roll, spiral, roll) and explain their effect on flight behavior.	**4**	**9**

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FourthYear (Semester-VII) B. Tech. Aeronautical Engineering

BAE34702: Aircraft Design

2nd Year- (3rd Semester)

BAE34702: Aircraft Design

Teaching Scheme			**Examination Scheme**	
Lectures	3 Hr / Week		**ESE**	60 Marks
Tutorial	-		**CIE**	40 Marks
Practical	-		**Total**	100 Marks
Theory Credits : 3			**Duration of Exam :**3 Hours	

Course Objectives

The Objectives of this course is:

1.	Understand the aircraft design process, including mission requirements, classification, and modern aircraft concepts.
2.	Apply methods for gross weight estimation and initial sizing based on mission profile and performance constraints.
3.	Develop the ability to design airframe components, including wing, fuselage, and control surfaces.
4.	Understand the integration of landing gear and propulsion systems into aircraft configuration.
5.	Analyze flight loads, performance envelopes, and environmental considerations in aircraft design.

Course Contents

Unit I	**Design Concepts Aircraft design**: three phases of design, Requirements and specifications, Classifications of aircraft, Special purpose airplanes, Types of civil & military aircrafts, UAVs, Control configured vehicles, Unique aircraft concepts.
Unit II	**Gross Weight Estimation** Estimation of weight of an aircraft based on type, mission, wing loading, aerodynamic efficiency, propulsion system and material, Iterative approach, Trends in wing loading and thrust loading, take-off & landing distance.
Unit III	**Airframe, Wing And Fuselage Design Considerations** Airfoil & wing geometry selection, Estimation of fixed & control surface geometry, Estimation of fuselage geometry, Structural layout of straight, tapered & swept (forward & aft) wings, Cockpit & passenger cabin layout, Wing-fuselage joining methods, Configuration layout and Lofting, Preparation of 3- views.
Unit IV	**Undercarriage And Power Plant Integration** Undercarriage: types, retraction mechanisms, Requirement of undercarriage, Different arrangements, Absorption of landing loads, Calculations of loads, Types of propulsion system, Rubber engine & fixed engine sizing, Various geometric locations of power plants, Types & location for inlets, Variable geometry inlets.
Unit V	**Operational And Environmental Issues** Classical methods of estimating symmetrical maneuvering loads on a wing in flight, Basic flight loading conditions, Span wise air loads variation, V-n diagram, Gust envelope, Payload-range 8 diagram, Noise & emission levels, Airworthiness, Crashworthiness.

Text Books	
1	"Aircraft Design: A Conceptual Approach", D. P. Raymer, AIAA. 2018
2	"Aircraft Performance and Design", J. D. Anderson Jr., TATA McGRAW-HILL 2010
Reference Books	
1	"Airplane Design Airplane Design Part V: Component Weight Estimation" Jon Roskam., DAR Corporation 2013.
2	"The Design of the Airplane", D. Stinton, Bsp Professional Books 1989
Useful Links	
1	https://nptel.ac.in/courses/112/102/112102284/
2	https://nptel.ac.in/courses/105/106/105106049/

BAE34702	**Course Outcomes**	**CL**	**Class Sessions**
CO1	**Explain** the aircraft design process, classifications, and requirements for various types of aircraft including UAVs.	**3**	**9**
CO2	**Estimate** gross weight, wing loading, and thrust loading using appropriate design methods and iterative approaches	**3**	**9**
CO3	**Design** basic airframe geometry, including wing, fuselage, and control surface layout, and prepare 3-view drawings.	**3**	**9**
CO4	**Analyze** landing gear loads and propulsion system integration, including engine placement and intake configurations	**4**	**9**
CO5	**Evaluate** flight loads, V–n diagram, gust effects, and payload–range characteristics, along with environmental and airworthiness considerations.	**2**	**9**

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FourthYear (Semester-VII) B. Tech. Aeronautical Engineering

BAE34703: Airport Planning and Management

4thYear- (7th Semester)

BAE34703: Airport Planning and Management

Teaching Scheme			**Examination Scheme**	
Lectures	3 Hr / Week		**ESE**	60 Marks
Tutorial	-		**CIE**	40 Marks
Practical	-		**Total**	100 Marks
Theory Credits : 4			**Duration of Exam:** 3 Hours	

Course Objectives

The Objectives of this course is:

1.	Understand the structure and classification of airport systems and their operational complexity.
2.	Apply principles of airport planning and design, including forecasting and infrastructure development.
3.	Analyze ground handling operations, including passenger and baggage handling systems.
4.	Understand passenger terminal and cargo operations, including layout and service management.
5.	Evaluate airport technical services and access systems and their integration with airport operations.

Course Contents

Unit I	**Airport as an Operational System:** Private Airports and Public Use Airports, Commercial Service Airports and Primary Commercial Service Airports, General Aviation Airports, Reliever Airports. Hub Classification –Large Hubs, Medium Hubs, Small Hubs, Non-Hubs. Components Of an Airports-Airside and Side. Airport As a System-Function of Airport –Complexity of airport operation.
Unit II	**Airport Planning:** Airport System Planning, Airport Master Plan, Airport Layout Plan – Forecasting, Facilities Requirements, Design Alternatives. Financial Plans, Land Use Planning, Environmental Planning.
Unit III	**Ground Handling:** Passenger Handling, Ramp Handling-Aircraft Ramp Servicing, Ramp Lay Out. Departure Control. Division Of Ground Handling Responsibility. Control Of Groundling Handling Efficiency. Baggage Handling Baggage Operations –Operating Characteristics of Baggage Handling Systems-Inbound Baggage Systems, Outbound Baggage System-Operating Performance-Organizing for the Task.
Unit IV	**Passenger Terminal Operations and Cargo Operations:** Function of the Passenger terminal, Philosophies of Terminal Management. Direct Passenger Services, Airline related passenger services. Airline related operations functions. Governmental requirements-Non-Passenger Related Airport Authority Functions, Processing very important people. Passenger Information System. Space Components Adjacencies-Aids to Circulation hubbing considerations. Air Cargo Market –Expanding the Movement. flow through the Cargo Terminal Unit, Loading Devices. Handling Within the Terminal-Cargo Apron Operations-Computerization of facilitation-Example of Modern Cargo Design-Freight Operations for the Integrated Carrier**.**

Unit V	**Airport Technical Services and Access:** Scope of Technical Services-Air traffic Control Telecommunications-Metrology-Aeronautical Information. Access as Part of airport System-access Users and Model Choice, Access Interaction with Passenger Terminal Operation, Access –Modes-In-Town and Off-Airport Terminals. Factor Effecting Access Mode Choice.

Text Books	
1	Wells, A.T. and Young, S.B., Airport Planning and Management, 5th edn, McGraw-Hill, 2004.
2	Ashford, N., Stanton, H.P.M. and Moore, C.A., Airport Operations, McGraw-hill, 1997.
Reference Books	
1	Kazda, A. and Caves, R.E., Airport Design and Operation, 2nd edn., Elsevier, 2007.
2	Horonjeff, R., McKelvey, F.X., Sproule, W.J. and Young, S.B., Planning and Design of Airport, 5th edn., McGraw-Hill, 2010.
Useful Links	
1	https://nptel.ac.in/courses/101/106/101106033/
2	https://nptel.ac.in/courses/101/101/101101002/
3	https://nptel.ac.in/courses/101/106/101106082/

BAE34703	**Course Outcomes**	**CL**	**Class Sessions**
CO1	**Classify** airports and describe their operational components.	**3**	**9**
CO2	**Apply** airport planning concepts to infrastructure development.	**3**	**9**
CO3	**Analyze** ground handling and baggage systems performance.	**3**	**9**
CO4	**Evaluate** terminal and cargo operations.	**3**	**9**
CO5	**Explain** technical services and access systems in airports.	**4**	**9**

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FourthYear (Semester-VII) B. Tech. Aeronautical Engineering

BAE34704: Unmanned Arial Vehicle and Systems

4thYear- (7th Semester)

BAE34704: Unmanned Arial Vehicle and Systems

Teaching Scheme			**Examination Scheme**	
Lectures	3 Hr / Week		**ESE**	60 Marks
Tutorial	-		**CIE**	40 Marks
Practical	-		**Total**	100 Marks
Theory Credits : 3			**Duration of Exam:** 3 Hours	

Course Objectives

The Objectives of this course is:

1.	To introduce the basic concepts of unmanned aerial vehicles.
2.	To make students familiarize with the design aspects of UAS.
3.	To impart knowledge on the hardware components and their application in the UAS.
4.	To infer about the communication and control detail of UAS.
5.	To introduce the basic operational futures of UAS.

Course Contents

Unit I	**Introduction to UAS** History of UAS, classification, Introduction to Unmanned Aircraft Systems, models and prototypes, System Composition, applications.
Unit II	**The Design of UA S** Introduction to Design and Selection of the System, Aerodynamics and Airframe Configurations, Characteristics of Aircraft Types, Design Standards and Regulatory Aspects, India, UK, USA and Europe, control surfaces, specifications.
Unit III	**Avionics Hardware** Autopilot, AGL, pressure sensors, servos, accelerometer, gyros, actuators, power supply, processor, integration, installation, configuration, and testing. Working Principles of various types of battery and its applications.
Unit IV	**Communication Payloads and Controls** Payloads, Telemetry, tracking, Aerial photography, controls, PI, PD and PID feedback, Radio controlfrequency range, modems, memory system, simulation, ground test, analysis, trouble shooting.
Unit V	**Development of UAS** Waypoints navigation, ground control software, System Ground Testing, System In-flight Testing, Future Prospects and Challenges, Case Studies – Mini and Micro UAS. different types of vehicles launchers.

Text Books

1	Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2nd Ed., 2007.
2	Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc, 4th Ed., 1998.
3	Reg Austin "Unmanned aircraft systems: UAV design, development and deployment", Wiley, 5th Ed., 2010.
Reference Books	
1	Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics Company, 1st Ed., 2001.
2	"Design of Unmanned Air Vehicle Systems", by Stoecker & Jones. McGraw-Hill
Useful Links	
1	https://nptel.ac.in/courses/101/106/101106033/
2	https://nptel.ac.in/courses/101/101/101101002/
3	https://nptel.ac.in/courses/101/106/101106082/

BAE34704	**Course Outcomes**	**CL**	**Class Sessions**
CO1	**Acquire** knowledge on the importance of UAS with respect totheir applications.	**3**	**9**
CO2	**Distinguish** between various subsystems and configurations of UAS.	**3**	**9**
CO3	**Perform** ground test and troubleshooting with respect to UAS operation.	**3**	**9**
CO4	**Distinguish** between needs of mini and micro UAS.	**3**	**9**
CO5	**Gain** insights with design standards and regulatory aspects of UAS.	**4**	**9**

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FourthYear (Semester-VII) B. Tech. Aeronautical Engineering				
BAE34705: Composite materials and NDT				
4thYear- (7th Semester)				
BAE34705: Composite materials and NDT				
Teaching Scheme			**Examination Scheme**	
Lectures	3 Hr / Week		**ESE**	60 Marks
Tutorial	-		**CIE**	40 Marks
Practical	-		**Total**	100 Marks
Theory Credits : 3			**Duration of Exam :**3 Hours	

Course Objectives

The Objectives of this course is:

1.	Understand the types, constituents, and advantages of composite materials used in aircraft
2.	Apply mechanics of composites to evaluate material behavior under loading.
3.	Understand various manufacturing techniques and defects in composite structures.
4.	Analyze different non-destructive testing (NDT) techniques used in aerospace applications.
5.	Understand advanced NDT methods and structural health monitoring systems for damage detection.

Course Contents

Unit I	**Introduction to Composite Materials** Definition and classification of composites, Advantages over conventional materials (Al, Ti alloys) Matrix materials: Polymer Matrix Composites (PMCs), Metal Matrix Composites (MMCs), Ceramic Matrix Composites (CMCs), Reinforcements: Fibers (glass, carbon, aramid), Particulates and whiskers, Basic properties and applications in aircraft
Unit II	**Mechanics of Composite Materials** Micromechanics: Rule of mixtures (longitudinal & transverse properties), Elastic behavior of lamina, Stress–strain relations, Anisotropy and orthotropy, Introduction to laminate theory , Failure theories (maximum stress, Tsai–Hill, Tsai–Wu – concept)
Unit III	**Manufacturing of Composite Structures:** Manufacturing techniques: Hand lay-up Filament winding, Pultrusion, Resin Transfer Moulding (RTM), Autoclave curing, Prepregs and curing cycles, Sandwich structures (honeycomb cores), Defects in composites: Voids, Delamination, Fiber misalignment**.**
Unit IV	**Non-Destructive Testing (NDT) Methods:** Importance of NDT in aerospace **,**Visual inspection **,**Ultrasonic testing (UT), Radiographic testing (RT – X-ray, Gamma ray), Eddy current testing (ECT), Magnetic particle inspection (MPI), Dye penetrant testing (DPT), Acoustic emission testing.

Unit V	**Advanced NDT and Structural Health Monitoring** Thermography (infrared inspection), Shearography, Laser-based NDT methods, Structural Health Monitoring (SHM) systems, Sensors in composites (fiber optic sensors), Damage detection and evaluation, Case studies in aircraft composite inspection
Text Books	
1	"Aircraft Design: A Conceptual Approach", D. P. Raymer, AIAA. 2018
2	"Aircraft Performance and Design", J. D. Anderson Jr., TATA McGRAW-HILL 2010
Reference Books	
1	"Airplane Design Airplane Design Part V: Component Weight Estimation" Jon Roskam., DAR Corporation 2013.
2	"The Design of the Airplane", D. Stinton, Bsp Professional Books 1989
3	Strength of Materials by S. S. Bhavikatti,Vikas Publishing House, 4th Edition, 2013.
Useful Links	
1	https://nptel.ac.in/courses/112/102/112102284/
2	https://nptel.ac.in/courses/105/106/105106049/

BAE34705	Course Outcomes	CL	Class Sessions
CO1	Classify composite materials and their constituents.	**3**	**9**
CO2	Compute composite properties using micromechanics relations.	**3**	**9**
CO3	Compare composite manufacturing techniques and associated defects.	**3**	**9**
CO4	Select appropriate NDT methods for defect detection.	**4**	**9**
CO5	Explain advanced inspection and structural health monitoring techniques.	**2**	**9**

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FourthYear (Semester-VII) B. Tech. Aeronautical Engineering

BAE34706: Vibration and Aero- Elasticity

4thYear- (7th Semester)

BAE34706: Vibration and Aero- Elasticity

Teaching Scheme			**Examination Scheme**	
Lectures	3 Hr / Week		**ESE**	60 Marks
Tutorial	-		**CIE**	40 Marks
Practical	-		**Total**	100 Marks
Theory Credits : 3			**Duration of Exam:** 3 Hours	

Course Objectives

The Objectives of this course is:

1.	Understand the fundamentals of vibration systems and mathematical modeling of mechanical systems.
2.	Analyze single degree of freedom systems, including free and forced vibrations with damping.
3.	Apply methods to analyze multi-degree of freedom systems using Lagrange's equations and modal analysis.
4.	Understand the principles of aeroelasticity, including static and dynamic aeroelastic effects.
5.	Evaluate aeroelastic phenomena such as divergence, flutter, and control reversal in aircraft structures

Course Contents

Unit I	**Introduction** Overview of the course, practical applications and research trends, harmonic and periodic motions, vibration terminology, introduction to spring and mass system, representation of practical problems in spring and mass system, vibration model, equation of motion.
Unit II	**Single-DOF Free Vibrations** Natural frequency energy method, Rayleigh method, Principle of virtual work, Damping models. Viscously damped free vibration, Special cases: oscillatory, non-oscillatory and critically damped motions. Logarithmic decrement, Experimental determination of damping coefficient, Forced harmonic vibration, Magnification factor. Rotor unbalance, Transmissibility, Vibration Isolation Equivalent viscous damping, Sharpness of resonance.
Unit III	**Two-DOF Free Vibrations** Generalized and Principal coordinates, derivation of equations of motion Lagrange's equation, Coordinate coupling, Forced Harmonic vibration, Tuned absorber, determination of mass ratio. Tuned and damped absorber, unturned viscous damped Forced Harmonic vibration.
Unit IV	**Multi-DOF Vibration** Derivation of equations of motion, influence coefficient method, Properties of vibrating systems: flexibility and stiffness matrices, reciprocity theorem, Modal analysis: undamped, Modal analysis: damped.
Unit V	**Introduction of Aero elastic Problems** Deformation of Structures and Influence Coefficients. Energy Method. Classification and Solution of Aero elastic Problems, Static Aero elasticity. Divergence of 2-D airfoil and Straight Wing. Aileron Reversal. Control Effectiveness. Wing loading and deformation. Swept Wing. Dynamic Aero elasticity. Dynamic/Flutter model of 2-D Airfoil. Finite State Model. Flutter Calculation. U-g Method. P-k Method. Exact Treatment of Bending - Torsion Flutter of Uniform Wing.

Text Books	
1	P. Srinivasan, Mechanical Vibration Analysis, Tata Mc Graw Hill, New Delhi, 4th edition, 1985
2	J. P. Den Hartog, Mechanical Vibration, Mc Graw Hill, New York, 4th edition, 2005.
3	E.H. Dowell, A Modern Course in Aero elasticity, Springer-Verlag, 5th edition, 2012.
Reference Books	
1	N. L. Meirovitch, Elements of vibration Analysis, Mc Graw Hill, New York, 1st edition, 1986.
2	R. L. Bisplingh off, H. Ashley and R. L. Halfman, Aero elasticity, Addison- Wesley, 1st edition, 1955.
Useful Links	
1	https://nptel.ac.in/courses/101/106/101106033/
2	https://nptel.ac.in/courses/101/101/101101002/
3	https://nptel.ac.in/courses/101/106/101106082/

BAE34706	Course Outcomes	CL	Class Sessions
CO1	**Derive** equations of motion for vibration systems.	**3**	**9**
CO2	**Compute** response of SDOF systems under free and forced vibrations.	**3**	**9**
CO3	**Analyze** multi-degree systems using modal techniques.	**3**	**9**
CO4	**Evaluate** static aeroelastic stability of lifting surfaces.	**3**	**9**
CO5	**Interpret** flutter behavior using analytical methods.	**4**	**9**

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Fourth Year (Semester-VII) B. Tech. Aeronautical Engineering

BAE34707: Computational Fluid Dynamics

4thYear- (7th Semester)

BAE34707: Computational Fluid Dynamics

Teaching Scheme			**Examination Scheme**	
Lectures	3 Hr / Week		**ESE**	60 Marks
Tutorial	-		**CIE**	40 Marks
Practical	-		**Total**	100 Marks
Theory Credits : 3			**Duration of Exam:** 3 Hours	

Course Objectives

The Objectives of this course is:

1.	Understand the governing equations of fluid flow and their formulation in conservation and non-conservation forms.
2.	Apply discretization techniques (finite difference, finite volume, finite element methods) to solve heat transfer and fluid flow problems.
3.	Develop numerical solutions for steady and unsteady conduction problems using explicit and implicit schemes.
4.	Use appropriate numerical methods (direct, iterative, Runge–Kutta, shooting method) to solve algebraic and differential equations.
5.	Analyze incompressible and compressible flow problems using CFD techniques such as pressure–velocity coupling and numerical schemes

Course Contents

Unit I	**Importance of CFD** Importance of CFD to various engineering streams. Basic fluid dynamics equations – continuity, momentum and energy, Conservation law form and non-conservation law forms of the Governing Differential Equations, Lagrangian and Eulerian formulations.
Unit II	**Description and procedure used in Finite Difference** Finite Element and Finite Volume schemes for simple one-dimensional conduction problems, Application to unsteady one-dimensional conduction problems.
Unit III	**Application of Finite Difference method** Application of Finite Difference method to 1D & 2D steady and unsteady conduction problems. Central and backward difference schemes. Explicit and Implicit schemes, Crank-Nicholson scheme.
Unit IV	**Solution of linear algebraic equations** Direct solution methods and Iterative schemes. Boundary value and initial value problems and their solution procedure. Runge Kutta methods. Shooting methods.
Unit V	**Conduction and convection problems** Navier Stokes equations. Application to incompressible flow. Pressure correction scheme, staggered grid, SIMPLE and SIMPLER schemes. Finite Volume method for compressible flow. Schemes like Jameson, Mac Cormack. Acceleration devices, Grid independent studies, Grid Generation.

Text Books	
1	Bose, T.K., "Computation Fluid Dynamics", Wiley Eastern Ltd., 1988.
2	Chow, C.Y., "Introduction to Computational Fluid Dynamic", John Wiley, 1979.
3	Hirsch, A.A., "Introduction to Computational Fluid Dynamics", McGraw Hill, 1989.
Reference Books	
1	Fletcher, "Computational Fluid Dynamics ", Vol. I & II, Springer Verlag, 1993.
2	Patankar, S.V., Numerical heat transfer and fluid flow, Hemispher Publishing Corporation, 1992
3	Anderson J.D., “Computational fluid dynamics”, 1995.
Useful Links	
1	https://nptel.ac.in/courses/101/106/101106033/
2	https://nptel.ac.in/courses/101/101/101101002/
3	https://nptel.ac.in/courses/101/106/101106082/

BAE34707	**Course Outcomes**	**CL**	**Class Sessions**
CO1	Classify governing equations and specify boundary conditions for fluid flow problems.	**3**	**9**
CO2	Apply finite difference schemes to solve 1D and 2D conduction problems.	**3**	**9**
CO3	Compute numerical solutions using explicit, implicit, and Crank–Nicolson methods.	**3**	**9**
CO4	Solve algebraic and differential equations using numerical methods.	**3**	**9**
CO5	Evaluate flow problems using pressure–velocity coupling and CFD schemes.	**4**	**9**

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Fourth Year (Semester-VII) B. Tech. Aeronautical Engineering				
BIT33616: Internet of Things				
4thYear- (7th Semester)				
BIT33616: Internet of Things				
Teaching Scheme			**Examination Scheme**	
Lectures	3 Hr / Week		**ESE**	60 Marks
Tutorial	-		**CIE**	40 Marks
Practical	-		**Total**	100 Marks
Theory Credits : 3			**Duration of Exam:** 3 Hours	

Course Objectives	
The Objectives of this course is:	
1.	Understand the fundamentals, architecture, and components of IoT systems.
2.	Analyze M2M communication and IoT architecture, including design principles and value chains..
3.	Understand networking and communication protocols used in IoT systems.
4.	Develop basic skills in IoT hardware platforms and programming.
5.	Apply IoT concepts to real-world applications in various domains.

Course Contents	
Unit I	**Introduction to IoT and Architecture:** - IoT definition & Characteristics, Advantages and disadvantages, IoT functional blocks, sensors, actuators, Physical Design of IoT, Logical design of IoT, Constraints affecting design in IoT. Introduction, Functional View, Information View, Deployment and Operational view
Unit II	**M2M to IOT:-** Introduction, Basic Concepts, Difference between IoT and M2M, M2M Value Chains, IoT Value Chains, Machine to Machine Communication, M2M to IoT Architecture, Design principles and capabilities.
Unit III	**Network and Communication Aspects:-** Wireless medium access issues, MAC protocol, Communication Protocols: ZigBee, 6 LoWPAN, Bluetooth NFC and RFID , Sensor deployment & Node discovery
Unit IV	**IoT Tools:** - Introduction to different IoT tools, Introduction to Arduino and Raspberry Pi & Its Programming.
Unit V	**IoT Applications:** - Intelligent Traffic systems, Smart Parking, flight controller and Agriculture.

Text Books	
1	Arshdeep Bahga, VijayMadisetti, ―Internet ofThings – A hands-on approach‖, Universities Press, 2015 .
2	Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things‖, Springer, 2011.
3	Introduction to IoT bySudip Mishra, Anandrup Mukherjee, Arijit Roy. Publisher : Cambridge University Press
Reference Books	
1	Raj Kamal, "Internet ofThings: Architecture and Design", McGraw Hill.2nd edition June 2022
2	Pethuru Raj, Anupama C. Raman ," The Internet of Things Enabling Technologies, Platforms, and Use Cases", Taylor and Francis group. February 2017
3	Peter Waher, "Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3", First Edition, Packt Publishing, 2018.
Useful Links	
1	NPTEL course on "Components and Applications of IoT" by Dr. Sanjoy Parida, https://onlinecourses.swayam2.ac.in/arp19_ap52/preview
2	https://onlinecourses.nptel.ac.in/noc23_cs82/preview

BIT33616	Course Outcomes	CL	Class Sessions
CO1	**Describe** IoT architecture and components.	**2**	**9**
CO2	**Compare** M2M and IoT systems.	**3**	**9**
CO3	**Analyze** IoT communication protocols.	**3**	**9**
CO4	**Implement** basic IoT applications using hardware platforms.	**4**	**9**
CO5	**Design** IoT solutions for real-world applications.	**4**	**9**

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Fourth Year (Semester-VII) B. Tech. Aeronautical Engineering

BIT33617: Internet of Things Lab

4thYear- (7th Semester)

BIT33617: Internet of Things lab

Teaching Scheme			Examination Scheme	
Practical	**2 Hrs/week**		**CA**	**25 Marks**
Total Credit	**1**		**ESE**	**25 Marks**
			Total	**50 Marks**
			Duration of ESE: 02 Hours	

Course Objectives

The Objectives of this course is:

1	Understand the fundamentals, architecture, and components of IoT systems.
2	Analyze M2M communication and IoT architecture, including design principles and value chains..
3	Understand networking and communication protocols used in IoT systems.
4	Develop basic skills in IoT hardware platforms and programming.
5	Apply IoT concepts to real-world applications in various domains.

Sr. No.	List of Experiment	CO
1	Demonstrate the functionality and performance of core Arduino components through hands-on experiments	**1**
2	Execute programming for LED Blink.	**1**
3	Execute programming for LED Blink with Switch.	**2**
4	Execute programming for Buzzer.	**2**
5	Execute programming for LCD Display.	**3**
6	Perform programming for Bluetooth.	**3**
7	Prepare Program for Seven Segment Display.	**4**
8	Prepare Program for OLED.	**4**
9	Create Program for PIR Sensor.	**5**
10	Create Program for Ultrasonic Sensor.	**5**

Text Books

1	Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015 .
2	2 Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things‖, Springer, 2011

Reference Books

1.	Internet of Things Architecture and Design Principles by Rajkamal. Publisher : McGraw Hill Education (India) Pvt. Ltd.
2.	Introduction to IoT by Sudip Mishra, Anandrup Mukherjee, Arijit Roy. Publisher : Cambridge University Press

Final Year (Semester-VII) B. Tech. Aeronautical Engineering

BAE34709: Sustainable Development Goals

Teaching Scheme			Examination Scheme	
Lectures	2 Hrs./week		**CIE**	20 Marks
Tutorial	-		**ESE**	30 Marks
Total Credit	2		**Total**	50 Marks
			Duration of ESE: 01 Hrs. 00 Min.	

Course Objectives:

1.	To develop a comprehensive understanding of the UN Sustainable Development Goals (SDGs) and their interconnections.
2.	To analyze the global challenges addressed by the SDGs and their impact on various sectors.
3.	To explore innovative solutions and best practices for implementing the SDGs.
4.	To evaluate the progress made towards achieving the SDGs at national and international levels.
5.	To foster a sense of global citizenship and social responsibility among students.

Course Contents		Hours
Unit I	**Introduction to Sustainable Development Goals (SDGs):** Definition of Sustainability, Aspects of sustainability, historical perspective of sustainable development, Climate Change Conferences and Summits, the Brundtland Commission Report, transition from Millennium Development Goals (MDGs) to SDGs, the role of UN and the need for SDGs and Adoption by the World, scope and inclusion of the 2030 Agenda for Sustainable Development.	**(7)**
Unit II	**Framework & Structuring of the 17 SDGs:** SDG 1: No Poverty, SDG 2: Zero Hunger, SDG 3: Good Health and Well-being, SDG 4: Quality Education, SDG 5: Gender Equality, SDG 6: Clean Water and Sanitation, SDG 7: Affordable and Clean Energy, SDG 8: Decent Work and Economic Growth, SDG 9: Industry, Innovation and Infrastructure, SDG 10: Reduced Inequalities, SDG 11: Sustainable Cities and Communities, SDG 12: Responsible Consumption and Production, SDG 13: Climate Action, SDG 14: Life below Water, SDG 15: Life on Land, SDG 16: Peace, Justice and Strong Institutions, SDG 17: Partnerships for the Goal	**(7)**
Unit III	**SDGs Implementation and Future Perspectives:** Interconnections between the SDGs, the role of technology and innovation in SDG implementation, financing the SDGs, measuring SDG progress, future challenges and opportunities, Climate change and its impact on sustainable development, Case studies of successful SDG implementation – India, World	**(7)**

Text Books

1	Hazra, Somnath., Bhukta, Anindya (2020) Sustainable Development Goals An Indian Perspective, Springer International Publishing, Switzerland
2	Ziai, Aram (2016) Development Discourse and Global History from colonialism to the sustainable development goals. Routledge, London & New York

Reference Books	
1	Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., Fuller, G., Woelm, F. 2020. The Sustainable Development Goals and COVID-19. Sustainable Development Report 2020. Cambridge: Cambridge University Press.
2	OECD (2019), Sustainable Results in Development: Using the SDGs for Shared Results and Impact, OECD Publishing, Paris, https://doi.org/10.1787/368cf8b4-en.

Useful Links
1. https://nptel.ac.in/courses/109106200
2. https://www.un.org/sustainabledevelopment/

BAE34709	Course Outcomes	CL
CO 1	To explore the historical origins and evolution of the UN-SDGs.	2
CO 2	To analyze the 17 SDGs and their interlinkages.	2
CO 3	To analyze the role of technology and innovation in achieving the SDGs along with future challenges and opportunities.	2

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