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 NEW NEP_2020)

SCHEME OF INSTRUCTION & SYLLABI

Semester -Fourth

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. Engineering Tool Usage
6. The Engineer and The World
7. Ethics
8. Individual and Collaborative Team work
9. Communication
10. Project management and finance
11. 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: Second Year B. Tech. in Aeronautical Engineering (As Per NEW NEP 2020)

Semester–IV

SN.	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	IV	PCC	AE	BAE42401	Fundamentals of Thermodynamics	T	3	-	3	3	30	10	60	3	100
2	IV	PCC	AE	BAE42402	Aerodynamics-I	T	3	-	3	3	30	10	60	3	100
3	IV	PCC	AE	BAE42403	Aerospace Materials	T	3	-	3	3	30	10	60	3	100
4	IV	MDM	AE	BAE42404	Solid Mechanics	T	3	-	3	3	30	10	60	3	100
5	IV	PCC	AE	BAE42405	Thermodynamic Lab	P	-	2	2	1	-	25	25	-	50
6	IV	VSEC	AE	BAE42406	Aeromodelling Lab	P	-	2	2	1	-	25	25	-	50
7	IV	VSEC	AE	BAE42407	Smart Manufacturing Lab (Idea Lab)	P	-	4	4	2	-	50	50	-	100
8	IV	OEC	AE	BAE42408	Open Elective-II	T	2	-	2	2	14	6	30	2	50
9	IV	HSSM	AE	BAE42409	Industrial Management	T	2	-	2	2	14	6	30	2	50
10	IV	CC	BSH	BSH424__	Liberal Learning Module-IV	P	-	2	2	1	-	50		-	50
TOTAL							16	10	26	21	148	202	400	18	750

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)	VSEC (Skill Course)	ELC/FP/CEP (Experiential Learning Courses)	CC (Liberal Learning Courses)
Credits	2	--	--	10	--	2	3	3	--	01
Cumu. Sum	08	16	13	20	--	6	5	09	2	06

Progressive Total Credits =64+21 = 85

BoS Chairperson Head Aeronautical Engineering TGPCET, Nagpur	Dean Academics/ Vice Principal Vice Principal (Academics) TGPCET, NAGPUR	Director (Administration) Dr. Pragati Nathe Director (Administration) Tulsiramji Gaikwad - Patil College Of Engineering Technology, Nagpur.	Principal Dr. Premanand Naktode Principal TGPCET, Nagpur	June, 2026	4.00	Applicable For AY2025-26 Onwards
				Date of Release	Version	

Programme: B.Tech. Aeronautical Engineering

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

Program Elective- I	Program Elective-II	Program Elective- III	Program Elective- IV	Program Elective- V
Semester V	**Semester VI**	**Semester VI**	**Semester VII**	**Semester VII**
BAE43508 Aircraft Systems & Instruments	**BAE43608** Aircraft Maintenance & Repair	**BAE43611** Drone Technology	**BAE44704** Aviation Management	**BAE44707** Unmanned Aerial Vehicles & Systems
BAE43509 Space Technology	**BAE43609** Helicopter Engineering	**BAE43612** Boundary Layer Theory	**BAE44705** Rockets and Missiles	**BAE44708** High Speed Aerodynamics
BAE44510 Mechanics of Machines	**BAE43610** Composite Materials & NDT	**BAE43613** Finite Element Methods	**BAE44706** Computational Fluid Dynamics	**BAE44709** Vibrations and Aero elasticity

Program: B.Tech. Aeronautical Engineering

List of **Open Electives** offered by Department of Aeronautical Engineering

Open Elective-I	Open Elective-II	Open Elective-III
Semester-III	**Semester-IV**	**Semester-V**
BAE42307: Introduction to Aerospace Engineering	**BAE42408: Avionics**	**BAE43506: 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 (Experiment Learning Courses)	CC (Liberal Learning Courses)	Semester Wise Credits
Semester-I	02	08	06	--	--	--	--	02	--	02	20
Semester-II	02	08	07	02	--	--	--	02	--	02	23
Semester-III	2	--	--	08	--	4	2	02	2	01	21
Semester-IV	2	--	--	10	--	2	3	3	--	01	21
Semester-V	--	--	--	11	3	2	4	2	--	- -	22
Semester-VI	--	--	--	11	6	--	02	02	01	- -	22
Semester-VII	--	--	--	08	06	--	04	--	03	- -	21
Semester-VIII	--	--	--	-	04	--	--	--	12	- -	16
Cumu. Sum	8	16	13	50	19	8	15	13	18	6	166

BoS Chairperson	Dean Academics/ Vice Principal	Director (Administration)	Principal	June, 2026	4.00	Applicable For AY2025-26 Onwards
				Date of Release	Version	

Head
Aeronautical Engineering
TGPCET, Nagpur

Vice Principal
(Academics)
TGPCET, NAGPUR

Dr. Pragati Naiknaware
Director (Administration)
Tulsiramji Gaikwad - Patil
College Of Engineering
Technology, Nagpur.

Dr. Premanand Naktode
Principal
TGPCET, Nagpur

Second Year (Semester-IV) B. Tech. Aeronautical Engineering

BAE32401: Fundamental of Thermodynamics

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 are:

1.	To understand the fundamental concepts of thermodynamics, thermodynamic properties, laws of thermodynamics, and energy interactions in closed and open systems.
2.	To analyze the first and second laws of thermodynamics, entropy, availability, irreversibility, and thermodynamic relations
3.	To understand the properties of pure substances, phase-change processes, steam tables, and the performance of vapour power cycles.
4.	To analyze real gas behaviour, equations of state, and thermodynamic properties of perfect gas mixtures
5.	To evaluate the performance of air-standard power cycles and understand the fundamentals of gas turbine cycles and jet propulsion.

Course Contents

Unit I	**Basic concepts and first law of Thermodynamics:** System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium State, Property, Process, Exact and Inexact Differentials, Cycle, Reversibility, Quasi – static Process, Irreversible Process, Causes of Irreversibility, Energy in State and in Transition, Types, Displacement and Other forms of Work, Heat Point and Path functions, Zeroth Law of Thermodynamics, Concept of Temperature, PMM - I, Joule's Experiments, First law of Thermodynamics, Corollaries, First law applied to a Process, applied to a flow system, Steady Flow Energy Equation
Unit II	**Second law of Thermodynamics:** Limitations of the First Law, Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin, Planck and Clausius Statements and their Equivalence , Corollaries, PMM of Second kind, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility –Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics. Numerical.
Unit III	**Pure substance and vapour power cycle:** Pure Substances, P - V- T surfaces, T- S and h- s diagrams, Mollier Charts, Phase Transformations: Triple point at critical state properties during change of phase, Dryness Fraction, Clausius - Clapeyron Equation, Property tables and application of these concepts in various thermodynamic processes, including steam calorimetry. Simple Rankine cycle and Reheat. Numerical.
Unit IV	**Real gas models and perfect gas mixtures:** Deviations from perfect Gas Model, Vader Waals Equation of State, and Compressibility charts, variable specific Heats, Gas Tables. Mixtures of perfect Gases: Mole Fraction, Mass friction Gravimetric and volumetric Analysis. Dalton's Law of partial pressure, Avogadro's Laws of additive volumes. Mole fraction, Volume fraction and partial pressure, Equivalent Gas constant and Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour. Numerical.

Unit V	**Power Cycle:** Otto, Diesel, Dual Combustion cycles, Description and representation on P-V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis, comparison of Cycles. Basics of Jet propulsion: Brayton cycle for gas turbine engines and its actual process, P-V and T-S diagram and its performance characteristics-Thrust equation

Text Books	
1	Engineering Thermodynamics by P. K. Nag, Tata Mc-Graw Hill Pub1ication,6th Edition,2017.
2	Thermodynamics: An engineering approach by Yunus Cengal, M. A. Boles, McGraw Hill Education, 9th Edition, 2019.
3	Fundamentals of classical Thermodynamics by G. J. V. Wylen, R. E. Sonntag, C. Borgnakke, John Wilev & Sons, 4th Edition, 2014.
Reference Books	
1	Thermodynamics by C. P. Arora, Tata Mc-Graw Hill Publication, 1st Edition,2004.
2	Fundamentals of engineering Thermodynamics by R. K. Rajput, Laxmi Publications, 4th Edition 2016.
Useful Links	
1	https://nptel.ac.in/courses/l12/105/112105123/
2	https://nptel.ac.in/courses/l12/104/112104113/
3	https://nptel.ac.in/courses/101/106/101106082/

BAE32301	**Course Outcomes**	**CL**	**Class Sessions**
CO1	**Apply** first law of thermodynamics to real time applications	**3**	**10**
CO2	**Evaluate** the performance parameters of energy transfers	**3**	**10**
CO3	**Evaluate** the properties of gases during phase changes.	**3**	**10**
CO4	**Compare** the process parameters in mixture of gases	**4**	**10**
CO5	**Distinguish** the processes of various power cycles and apply Brayton cycle principle to Jet Propulsion	**2**	**10**

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Second Year (Semester-IV) B.Tech. Aeronautical Engineering

BAE32402: Aerodynamics-I

Teaching Scheme			Examination Scheme	
Theory	**3 Hrs/Week**		**CT-I**	**15 Marks**
Tutorial	**0 Hrs/Week**		**CT-II**	**15 Marks**
Total Credits	**3**		**CA**	**10 Marks**
Duration of ESE: 3 Hrs			**ESE**	**60 Marks**

Course Objectives

The Objectives of this course are:

1.	To understand the fundamentals of fluid mechanics and aerodynamic forces.
2.	To analyze potential flow and its applications in aerodynamics.
3.	To study airfoil aerodynamics using circulation and thin airfoil theory.
4.	To analyze finite wing aerodynamics and induced drag.
5.	To understand aircraft aerodynamic performance and high-lift systems.

Course Contents

Unit I	**Review of Basic Fluid Mechanics:** Derivation of Continuity, momentum and energy Equation in both Cartesian and polar coordinates, Control volume approach to Continuity, momentum and energy equation, continuum analysis, Euler equation, incompressible Bernoulli's equation from momentum equation, Types of flow, pathlines, streamlines, and streaklines, units and dimensions, inviscid and viscous flows, compressibility, Mach number regimes. Vorticity, Angular velocity, Stream function, velocity potential function, Circulation, Numerical, Mach cone and Mach angle, Speed of sound. Characterizations of Aerodynamic Forces and Moments, Airfoil Geometry Parameters, Wing Geometry Parameters, Aerodynamic Force and Moment Coefficients, Wings of Finite Spans.
Unit II	**Potential Flow Theory:** Uniform flow, Source flow, Sink flow, Combination of a uniform flow with source and sink. Doublet flow. Non-lifting flow over a circular cylinder. Vortex flow. Lifting flow over a circular cylinder. Kutta Joukowski theorem and generation of Lift, D'Alembert's paradox, real flow over smooth and rough cylinder, Numericals.
Unit III	**Incompressible flow Over aerofoil -** Incompressible flow over airfoils: Kelvin's circulation theorem and the starting vortex, vortex sheet, Kutta condition, Cauchy-Riemann relations, complex potential, methodology of conformal transformation, Kutta Joukowski transformation and its applications, Classical thin airfoil theory for symmetric and cambered airfoils. Kutta-Joukowski theorem and generation of Lift, Numericals.
Unit IV	**Incompressible flow over Finite Wing -** Effect of Aspect ratio and Tapered ratio on Wing Lift, Biot-Savart law and Helmholtz's theorems, Vortex filament: Infinite and semi-infinite vortex filament, Induced velocity. Prandtl's classical lifting line theory: Downwash and induced drag. Elliptical and modified elliptical lift distribution. Lift distribution on wings. Limitations of Prandtl lifting line theory. Extended lifting line theory- lifting surface theory. Lift, drag and moment characteristics of complete airplane.

Unit V	**Applications of Finite Wing Theory and High Lift Systems:** Lift augmentation and Drag Reduction methods, influence of downwash on tail plane, ground effects. Swept wings: Introduction to sweep effects, swept wings, pressure coefficient, typical aerodynamic characteristics, Introduction to high-lift systems, flaps, leading-edge slats and typical high, lift characteristics. Critical Mach numbers, Lift and drag divergence, shock induced separation, Effects of thickness, camber and aspect ratio of wings, Transonic area rule, Tip effects.

Text Books	
1	Anderson, J.D., "Fundamentals of Aerodynamics", McGraw Hill Book Co., 2nd Ed., 2010.
2	Houghton, E.L., and Caruthers, N.B., "Aerodynamics for Engineering students", Edward Arnold Publishers Ltd., London, 5th Ed., 1989.
3	White, F. M., Fluid Mechanics, McGraw Hill, 7th Ed., Special Indian Edition, 2011.
Reference Books	
1	Panton, R. L., Incompressible Flow, 3rd Ed., Wiley India Edition, 2006.
2	Cengel, Y. A., Cimbala, J. M., Fluid Mechanics: Fundamentals and Applications, McGraw-Hill Higher Education, 6th Ed., 2006.
Useful Links	
1	https://nptel.ac.in/courses/101/105/101105059/
2	https://nptel.ac.in/content/storage2/courses/101105023/Mod1L1.pdf
3	https://nptel.ac.in/courses/101/105/101105023/

BAE32402	**Course Outcomes**	**CL**	**Class Sessions**
CO1	Apply fluid mechanics principles to aerodynamic flow analysis.	3	9
CO2	Analyze potential flows and lift generation around cylinders.	3	9
CO3	Evaluate airfoil characteristics using thin airfoil theory.	4	9
CO4	Analyze finite wing lift distribution and induced drag.	4	9
CO5	Assess aircraft aerodynamic performance and high-lift devices.	4	9

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Second Year (Semester-IV) B. Tech. Aeronautical Engineering

BAE32403: Aerospace Materials

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 are:

1.	To understand the classification, properties, heat treatment, and applications of aerospace materials.
2.	To analyze the mechanical properties, strengthening mechanisms, fatigue, creep, and fracture of materials.
3.	To understand manufacturing techniques for polymer matrix and metal matrix composites.
4.	To study the classification, properties, and aerospace applications of composite materials.
5.	To understand the properties and applications of smart, magnetic, dielectric, and superconducting materials.

Course Contents

Unit-I	**Introduction to aerospace materials** Classification, composition, properties, heat treatment & application of plain carbon steels, alloy steels. Stainless steels. Classification, composition, properties, heat treatment and application of aluminum and its alloys. Titanium alloys, Special alloys for high temperature.
Unit-II	**Mechanical Properties** Tensile test, plastic deformation mechanisms, slip and twinning, role of dislocations in slip strengthening methods, strain hardening, refinement of the grain size, solid solution strengthening precipitation hardening, creep resistance, creep curves, mechanisms of creep, creep-resistant materials, fracture, the Griffith criterion, critical stress intensity factor and its determination, fatigue failure, fatigue tests, methods of increasing fatigue life, hardness, Rockwell and Brinell hardness, Knoop and Vickers micro hardness, Fracture and Fatigue, Stress Intensity Factor, Crack Growth Rate Derivation. ASTM Standards.
Unit-III	**Manufacturing of advanced composites** Polymer matrix composites: Preparation of moulding compounds and prepregs, hand layup methodAutoclave method, Filament winding method, Compression moulding, Reaction injection moulding. Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding, Hot isostatic pressing.
Unit-IV	**Composite Materials** Definition, classification of composite materials, classification of reinforcement, particulate, short fiber, whiskers, long fibers composites. Matrix materials, metals, ceramics, polymers (including thermoplastics and thermosets), Carbon Composites MMC with particulate and short fiber reinforcement, liquid and solid state processing of MMC, stir casting, squeeze casting. Propertiesof MMCs, Applications of Al, Mg, Ti based MMC.
Unit-V	**Smart Materials** Ferromagnetism, domain theory, types of energy, hysteresis, hard and soft magnetic materials, ferrites, dielectric materials, types of polarization, Langevin-Debye equation, frequency effects on polarization, dielectric breakdown, insulating materials, Ferroelectric materials, superconducting materials and their properties. Smart materials like Piezoelectric materials, Shape Memory Alloys (SMA), magneto-strictive materials, Electro-rheological Fluids, Magneto Rheological Fluids. etc

Text Books	
1	Material Science and Technology: A comprehensive Treatment by R. W. Cahn, P. Haasen, E. J. Kramer, Tsu-Wei Chou, Wiley-VCH; Volume 13 edition, 1993.
2	Composite Materials by K. K. Chawla, Springer-Verlag, New York, 1st edition, 1987.
3	The Analysis of laminated Composite Structures by Calcote, L. R., Von-Noastrand Reinhold, 1st edition, 1970.
Reference Books	
1	G. Askeland, D. "Materials Science and Engineering", Brooks Cole, 3rd edition, 2010.
2	Smith, W.F., Hashemi, J. and Prakash, R., "Materials Science and Engineering", Tata McGraw Hill, A. 5th edition, 2016.
Useful Links	
1	https://nptel.ac.in/courses/101/104/101104010/
2	https://nptel.ac.in/courses/101/106/101106038/
3.	https://nptel.ac.in/courses/101/105/101105084/

BAE32403	**Course Outcomes**	**CL**	**Class Sessions**
CO1	**Select** suitable aerospace materials based on their properties and applications.	**2**	**9**
CO2	**Evaluate** the mechanical behaviour, fatigue, creep, and fracture of engineering materials.	**2**	**9**
CO3	**Explain** manufacturing processes used for advanced composite materials.	**3**	**9**
CO4	**Analyze** the properties and applications of composite materials in aerospace structures.	**3**	**9**
CO5	**Identify** smart materials and evaluate their applications in aerospace engineering.	**4**	**9**

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Second Year (Semester-III) B. Tech. Aeronautical Engineering

BAE32304: Solid 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.	To understand stress, strain, deformation, and elastic behaviour of solids.
2.	To analyze shear force, bending moment, and deflection in beams.
3.	To determine principal stresses and strains using analytical methods and Mohr's circle.
4.	To evaluate flexural and shear stresses in beams of different cross-sections.
5.	To analyze strain energy, impact loading, and statically indeterminate beams.

Course Contents

Unit I	**Stress, Strain and Deformation of Solids:** Introduction: Rigid bodies and deformable solids, Types of stresses and strains, Elastic constants and their relationships, Thermal Stresses, Analysis of the state of stress at a point, equations stress- strain relations, generalized Hooke's Law - Isotropy, Orthotropic, Anisotropy. Displacement and force methods of analysis. Concepts of linear and nonlinear problems. Linear elasticity solutions, problems in 2-D (rectangular and polar co-ordinates).
Unit II	**Shear force and bending moment:** Types of beams (cantilever beam, simply supported beam, overhung beam) Types of loads (Concentrated and UDL), Shear force and bending moment diagrams for different types of beams subjected to different types of loads, Sign. Conventions for bending moment and shear force. Point of contra flexure, Relation between SF, BM and rate of loading at a section of a beam
Unit III	**Principal Stresses and Strains:** Introduction, Stresses on an inclined section of a bar under axial loading, Compound stresses - Normal and tangential stresses on an inclined plane for biaxial stresses, two perpendicular normal stresses accompanied by a state of simple shear, Mohr's circle of stresses. **Deflection of beams**: Derivation of differential equation of elastic curve with the assumptions made in it. Deflection and slope of cantilever, simply supported, subjected to concentrated load, Relation between slope, deflection and radius of curvature.
Unit IV	**FLEXURAL STRESSES:** Theory of simple bending, Assumptions, Derivation of bending equation, Determination bending stresses, Section modulus of rectangular and circular sections (Solid and Hollow), I and T sections, Design of simple beam sections **Shear stresses in beams:** Concept, derivation of shear stress distribution formula, shear stress distribution diagram for common symmetrical sections, maximum and average shear stress.

Unit V	**Strain Energy and Impact Loading:** Definition of strain energy stored in a body when it is subjected to gradually applied load, suddenly applied loads and impact loads. Strain energy under uniaxial tension and compression, bending and torsion. Castiglione's theorem. Statically indeterminate beams and frames, Chaperon's three moment equation method, Moment distribution method.
Text Books	
1	Strength of Material by S. Ramamurtham and R. Narayanan, Dhanpat Rai Publishing Company Pvt. Ltd., 16th Edition, 2011.
2	Strength of Material by R. K. Rajput, S. Chand Publishing, 7th Edition, 2018.
3	Strength of Material by A. Singer and F. L. Singer, Longman, 4th Edition, 1990.
Reference Books	
1	Strength of materials by S. Timoshenko, CBS,3rd Edition, 2002.
2	A Textbook of Strength of Materials by R.K. Bansal, Laxmi Publications, 4th Edition, 2018.
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/

BAE32304	**Course Outcomes**	**CL**	**Class Sessions**
CO1	Analyze stress, strain, and deformation in elastic solids.	**3**	**9**
CO2	Construct shear force and bending moment diagrams for different beams.	**3**	**9**
CO3	Determine principal stresses and strains using Mohr's circle.	**3**	**10**
CO4	Calculate beam deflections and evaluate flexural and shear stresses.	**4**	**10**
CO5	Apply strain energy methods and analyze statically indeterminate beams.	**2**	**9**

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Second Year (Semester-IV) B. Tech. Aeronautical Engineering

BAE32405: Thermodynamics Lab

2nd Year- (4th Semester)

BAE32405: Thermodynamics 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 are:

1	Acquire knowledge on 4-stroke petrol and diesel engine.
2	Study the performance of air compressor.
3	Study the performance of steam turbine.
4	Determine the specific heat.
5	Determine the thermal conductivity of various materials.

Sr. No.	List of Experiment	CO
1	Performance Morse test on 4-stroke petrol engine	**1**
2	Performance evaluation of 4-stroke petrol engine without Morse test	**1**
3	Performance test on single cylinder 4-stroke diesel engine	**1**
4	Performance test of reciprocating air compressor	**2**
5	Study of steam turbine engine	**2**
6	Determination of specific heat of solid	**3**
7	Determination of thermal conductivity of solid (metal rod)	**3**
8	Determination of thermal conductivity of insulating powder	**4**
9	Determination of thermal conductivity of liquid	**4**
10	Determination of thermal resistance of composite wall	**5**

Text Books

1	Thermodynamics: An engineering approach by Yunus Cengal, M. A. Boles, McGraw Hill Education, 9th Edition, 2019.
2	Thermodynamics by C. P. Arora, Tata Mc-Graw Hill Publication, 1st Edition,2004.
3	Fundamentals of classical Thermodynamics by G. J. V. Wylen, R. E. Sonntag, C. Borgnakke, John Wilev & Sons, 4th Edition, 2014.

Reference Books	
1.	Engineering Thermodynamics by P. K. Nag, Tata Mc-Graw Hill Pub1ication,6th Edition,2017.
2.	Fundamentals of engineering Thermodynamics by R. K. Rajput, Laxmi Publications, 4th Edition 2016.
Useful Links	
1	https://nptel.ac.in/courses/l12/105/112105123/
2	https://nptel.ac.in/courses/l12/104/112104113/

BAE32305	**Course Outcomes**	**CL**	**Class Sessions**
CO1	**Demonstrate** 4-stroke petrol and diesel engine performance.	**3**	**9**
CO2	**Estimate** the performance of air compressor.	**3**	**9**
CO3	**Estimate** the performance of steam turbine.	**3**	**9**
CO4	**Evaluate** the specific heat.	**4**	**9**
CO5	**Evaluate** the thermal conductivity of various materials.	**2**	**9**

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BAE32406: Aeromodelling Lab

2nd Year- (4th Semester)

BAE32406: Aeromodelling 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 are:

1	Configure different types of aircrafts
2	Develop the unpowered aircraft models
3	Develop the powered aircraft models
4	Understand the flight simulator working
5	Explore flying using remote controlled aircraft.

Sr. No.	List of Experiment	CO
1	Comparative configuration study of different types of airplane configurations	1
2	Preparation of hot air balloons	1
3	Preparation of chuck glider aircraft models.	1
4	Preparation of boomerang models.	2
5	Preparation of R.C. glider aircraft models.	2
6	Preparation of control line aircraft models.	3
7	Preparation of R.C. powered aircraft models	3
8	Drone flight simulator training	4
9	Flight test of all the aircraft models prepared	4
10	Comparative configuration study of different types of airplane configurations	5

Text Books

1	John D. Anderson, Jr., “Introduction to Flight”, Mc-Graw Hill, 3rd edition, 1995.
2	Lalit Gupta and O P Sharma, Fundamentals of Flight, Vol-I to Vol-IV, Himalayan Books, 1st edition,2006
3	John D. Anderson, Jr., “The Airplane - History of its Technology”, AIAA Series, 1st edition, 2002.

Reference Books	
1.	G. P. Sutton, O.Biblarz,"Rocket Propulsion Elements", John Wiley & Sons, 7th edition, 2001.
	A. C. Kermode, "Flight without Formulae", Pearson Education, 5th edition, 2004.
2.	S. K. Ojha, "Flight Performance of Aircraft", AIAA Series, 1st edition, 1995.
Useful Links	
1	https://nptel.ac.in/courses/101/101/101101079/
2	https://nptel.ac.in/courses/101/105/101105059/

BAE32306	**Course Outcomes**	**CL**	**Class Sessions**
CO1	**Compare** different aircraft configurations	**3**	**9**
CO2	**Develop** different components of aircraft models (unpowered) with given material.	**3**	**9**
CO3	**Develop** different components of aircraft models (powered) with given material.	**3**	**9**
CO4	**Explore** the flight test of aircraft models on flight simulator.	**4**	**9**
CO5	**Explore** the flight test of prepared aircraft models.	**2**	**9**

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BAE32407: Smart Manufacturing Lab

2nd Year- (4th Semester)

BAE32407: Smart Manufacturing 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 are:

1	Understand the construction, working principles, controllers, coordinate systems, and tooling
2	Develop skills in part programming, toolpath generation, workpiece setup, and operation
3	Apply CNC manufacturing techniques to produce engineering components
4	Develop competency in dimensional inspection, quality assessment, assembly, and functional verification
5	Integrate CAD/CAM and digital manufacturing techniques to design and manufacture product

Sr. No.	List of Experiment	CO
1	Study of the CNC Turning Machine, FANUC Controller and Coordinate System.	1
2	Part Programming, Work Setup and Demonstration of Basic CNC Turning Operations.	2
3	Manufacture and Dimensional Inspection of a Stepped Shaft.	3
4	Study of the CNC Milling Machine, FANUC Controller, Coordinate Systems and Tool Offsets.	1
5	Toolpath Preparation, Work Setup and Demonstration of Basic CNC Milling Operations.	2
6	Manufacture and Dimensional Inspection of a Pocketed Mounting Plate.	3
7	Study of the Lunyee CNC Engraver, Control Software and Printed Circuit Board Manufacturing Workflow.	1
8	Demonstration of Printed Circuit Board Isolation Milling, Drilling and Electrical Inspection.	2
9	Manufacture and Inspection of a Single-Sided Light-Emitting Diode Indicator Printed Circuit Board.	3
10	Study of the CNC Router, Controller, Tooling and Workpiece Setup.	1
11	Toolpath Preparation and Demonstration of Pocketing, Slotting and Profile Cutting.	2
12	Manufacture, Assembly and Fit Inspection of a Two-Piece Slotted Desktop Stand.	3
13	Study of the CO_2 Laser Cutter and Engraver, Controller and Job Preparation Software.	1
14	Demonstration of Laser Engraving and Cutting with Assessment of Kerf and Cut Quality.	2
15	Design, Manufacture and Inspection of an Engraved Acrylic Nameplate with a Slotted	3

Text Books

1	John D. Anderson, Jr., “Introduction to Flight”, Mc-Graw Hill, 3rd edition, 1995.
2	Lalit Gupta and O P Sharma, Fundamentals of Flight, Vol-I to Vol-IV, Himalayan Books, 1st edition,2006
3	John D. Anderson, Jr., “The Airplane - History of its Technology”, AIAA Series, 1st edition, 2002.

Reference Books	
1.	G. P. Sutton, O.Biblarz,"Rocket Propulsion Elements", John Wiley & Sons, 7th edition, 2001.
	A. C. Kermode, "Flight without Formulae", Pearson Education, 5th edition, 2004.
2.	S. K. Ojha, "Flight Performance of Aircraft", AIAA Series, 1st edition, 1995.
Useful Links	
1	https://nptel.ac.in/courses/101/101/101101079/
2	https://nptel.ac.in/courses/101/105/101105059/

BAE32307	**Course Outcomes**	**CL**	**Class Sessions**
CO1	Explain the construction, working principles, controllers, coordinate systems, and tooling of CNC manufacturing machines.	**3**	**9**
CO2	Develop part programs and toolpaths, perform workpiece setup, and operate CNC machines for basic manufacturing operations.	**3**	**9**
CO3	Apply CNC manufacturing techniques to produce engineering components with the required geometry and dimensional accuracy.	**3**	**9**
CO4	Perform dimensional inspection, assess manufacturing quality, assemble components, and verify their functional requirements.	**4**	**9**
CO5	Integrate CAD/CAM and digital manufacturing techniques to design and manufacture engineering products.	**2**	**9**

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BAE32409: Industrial Management

Teaching Scheme			Examination Scheme	
Lectures	2Hrs./week		**CIE**	20 Marks
Tutorial	-		**ESE**	30Marks
Total Credit	2		**Total**	50Marks
			Duration of ESE:02Hrs. 00Min.	

Course Objective:

1	Student will be able to provide an understanding of fundamental concepts in industrial management.
2	Student will be able to introduce principles of productivity, resource management, and organizational structure.
3	Student will be able to develop decision-making skills for solving industrial problems effectively.

	Course Contents	Hours
Unit I	**Introduction to Industrial Management:** Evolution and scope of industrial management; principles and functions of management: planning, organizing, staffing, directing and controlling; organizational structures; role of industrial engineers in management; decision-making, leadership, communication and teamwork; applications of industrial management in aircraft manufacturing and aerospace organizations.	**(10)**
Unit II	**Productivity and Work Study:** Concept and measurement of productivity; factors affecting productivity; techniques for productivity improvement; work study, method study and time study; process charts and operation analysis; work measurement and standard time; workplace layout and ergonomics; lean manufacturing, waste reduction and continuous improvement in aircraft assembly and aerospace component manufacturing.	**(10)**
Unit III	**Resource Operations and Quality Management:** Resource planning for materials, machinery and manpower; production planning and control; inventory management, Economic Order Quantity (EOQ) and ABC analysis; supply chain management and vendor selection; quality management, Total Quality Management (TQM), Six Sigma and continuous improvement; quality assurance and inspection in aerospace manufacturing; introduction to project management, industrial safety and maintenance practices in aircraft manufacturing and Maintenance, Repair and Overhaul (MRO) organizations.	**(10)**

Text Books

1	Koontz, H. & Weihrich, H. – *Essentials of Management*.
2	Bedi, K. – *Production and Operations Management*.
3	Chase, R. B. & Aquilano, N. J. – *Production and Operations Management*.

Reference Books

1	Mahajan, M. – *Industrial Engineering and Production Management*.
2	Buffa, E. S. & Sarin, R. K. – *Modern Production and Operations Management*.
3	Gopalakrishnan, P. – *Materials Management*.

Useful Links		
https://onlinecourses.nptel.ac.in/noc24_me15/		
nptel.ac.in/courses/110/105/110105155/		
BAE32409	**Course Outcomes**	**CL**
CO1	**Analyze** the role and significance of industrial management in organizational growth.	**4**
CO2	**Apply** productivity improvement techniques to enhance industrial efficiency.	**3**
CO3	**Evaluate** strategies for effective resource utilization and quality control.	**4**

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Second Year (Semester-IV) B. Tech. Aeronautical Engineering

BAE32408: Avionics

2nd Year- (4th Semester)- Open Elective-II

BAE32408: Avionics

Teaching Scheme			**Examination Scheme**	
Lectures	3 Hr / Week		**ESE**	60 Marks
Tutorial	-		**CIE**	40 Marks
Practical	-		**Total**	100 Marks
Theory Credits : 2			**Duration of Exam :** 3 Hours	

Course Objectives

The Objectives of this course is:

1.	Understand the aircraft control systems.
2.	Understand the aircraft systems.
3.	Acquire the knowledge of avionics systems.
4.	Analyze analog /digital conversions and use microprocessors.
5.	Understand the functioning of MIL-STD-1553B Data Bus

Course Contents

Unit-I	**Airplane Control Systems:** Conventional Systems, power assisted and fully powered systems, Power actuated systems, Modern control systems, Digital fly by wire systems, Auto pilot system. **Aircraft Systems:** Hydraulic systems, components, Pneumatic systems and components, Brake system, Landing Gear systems, Classification
Unit-II	**Engine Systems:** Fuel systems for Piston and jet engines, Components of multi engines. lubricating systems - Starting and Ignition systems. **Auxiliary System:** Basic Air cycle systems, Vapour Cycle systems, oxygen & pressurization systems, Fire protection systems, De-icing and anti-icing systems.
Unit-III	**Aircraft Instruments:** Flight Instruments, Gyroscope, Accelerometers, Air speed Indicators, TAS, EAS, Mach Meters, Altimeters, Principles and operation, Study of various types of engine instruments, Tachometers, Temperature gauges, Pressure gauges, Operation and Principles. **Flight Deck and Cockpits:** Control and display technologies CRT, LED, LCD, EL and plasma panel, Touch screen, Direct voice input (DVI), MFDS, HUD, MFK, HOTAS.

Text Books	
1	Ian Moir and Allan Seabridge, 'Aircraft Systems: Mechanical, Electrical and Avionics-Subsystem Integration', Wiley India Pvt Ltd, 3rd edition, 2012, ISBN-13: 978-8126535217.
2	Pallet, E.H.J., "Aircraft Instruments and Integrated Systems", Longman Scientific and Technical, 1996
3	R.P.G. Collinson., "Introduction to Avionics Systems", Springer,3rd edition, 2011, ISBN-13: 978-9400707078
Reference Books	
1	H. Lalit Gupta and OP. Sharma, 'Aircraft Systems (Fundamentals of Flight Vol. IV)', HimalayanBooks;2006.
2	Treager. S, "Gas Turbine Technology", McGraw-Hill, 3rd edition,2013, ISBN-13: 978- 1259064876.
3	R.W. Sloley and W.H. Coulthard, 'The aircraft Engineers Handbook, No 4, Instruments', 6th Edition, 2005, ISBN13: 978-8175980518.
Useful Links	
1	https://nptel.ac.in/courses/101104071
2	https://nptel.ac.in/courses/101/105/101105059/
3.	https://nptel.ac.in/courses/101/105/101105031/

BAE32408	**Course Outcomes**	**CL**	**Class Sessions**
CO1	**Distinguish** the conventional and modern control systems	**2**	**9**
CO2	**Categorize** different types of aircraft systems and instruments.	**2**	**9**
CO3	**Identify** the use of avionics systems.	**3**	**9**
CO4	**Perform** analog /digital conversions and use microprocessors.	**3**	**9**
CO5	**Handle** functioning of MIL-STD-1553B Data Bus	**4**	**9**

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