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 -Sixth

Programme: Aeronautical Engineering

From

Academic Year 2025-26

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: Third Year (VI Sem) B. Tech in Aeronautical Engineering

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	VI	PCC	AE	BAE33601	Aircraft Structures	T	3	-	3	3	30	10	60	3 Hrs	100
2	VI	PCC	AE	BAE33602	Rocket Propulsion	T	3	-	3	3	30	10	60	3 Hrs	100
3	VI	PEC	AE	BAE33603-06	Program Elective-II	T	3	-	3	3	30	10	60	3 Hrs	100
4	VI	PEC	AE	BAE33607-10	Program Elective-III	T	3	-	3	3	30	10	60	3 Hrs	100
5	VI	MDM	IT	BIT33615	Artificial Intelligence for Engineers	T	2	-	2	2	14	06	30	2 Hrs	50
6	VI	PCC	AE	BAE33611	Aircraft Structure Lab	P	-	4	4	2	-	25	25	2 Hrs	50
7	VI	PCC	AE	BAE33612	Rocket Propulsion Lab	P	-	4	4	2	-	25	25	2 Hrs	50
8	VI	VEC	AE	BAE33613	Computational Analysis Lab	P	-	4	4	2	-	25	25	2 Hrs	50
Total							14	12	26	20	134	121	345	20 Hrs	600

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	6	--	2	2	--	--
Cumu. Sum	12	16	13	44	10	08	10	08	02	04

Progressive total credits:107+20=127

Chairperson	Dean Academics	Vice Principal	Principal	Nov, 2025	1.00	Applicable For AY2025-26 Onwards
Head Aeronautical Engineering TGPCET, Nagpur	Dean Academics Tulsiramji Gaikwad-Patil College Of Engineering and Technology, Nagpur	Vice Principal (Academics) TGPCET, NAGPUR	Dr. Premanand Naktode Principal TGPCET, Nagpur	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
Semester V	**Semester VI**	**Semester VI**	**Semester VII/ VIII**
BAE33504: Boundary Layer Theory	**BAE33603:** Drone Technology	**BAE33607:** Control Theory & Systems	**BAE34803:** Unmanned Aerial Vehicles & Systems
BAE33505: Aircraft Systems & Instruments	**BAE33604:** Spacecraft Technology	**BAE33608:** Aviation Management	**BAE34804:** Composite Materials & NDT
BAE33506: Space Flight Mechanics	**BAE33605:** Aircraft Navigation & Communication Systems	**BAE33609:** Helicopter Engineering	**BAE34805:** Vibrations and Aero-elasticity
BAE33507: Industrial Aerodynamics	**BAE33606:** Aircraft Maintenance & Repair	**BAE33610:** Finite Element Methods (FEM)	**BAE34806:** Computational Fluid Dynamics

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**
BAE32310: Introduction to Aerospace Engineering	**BAE32406 :** Avionics	**BAE32511:** Unmanned Aerial Systems

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College Of Engineering
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Vice Principal
(Academics)
TGPCET, NAGPUR

Dr. Premanand Naktode
Principal
TGPCET, Nagpur

Course Category	HSSM (Humanities Social Science & Manag.)	BSC (Basic Science Course)	ESC (EngineeringScience Course.)	PCC (ProgrammeCore Courses	PEC (Programme Elective Courses)	OEC (Open Elective Courses)	MDM (Multi-disciplinary Course)	SEC (Skill Course)	ELC/FP/CEP Experimential 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	4	02	4	--	--	--	**22**
Semester-VI		--	--	10	06	--	02	02	--	--	**20**
Semester-VII		--	--	04	04	--	--	--	12	--	**20**
Semester-VIII		--	--	06	04	--	03	--	08	--	**21**
Cumu. Sum	**12**	**16**	**13**	**55**	**17**	**08**	**13**	**07**	**22**	**04**	**168**

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				Date of Release	Version	

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B. Tech. VIth Sem Aeronautical Engineering

BAE33601: Aircraft Structures

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 various failure theories and its application.
2.	To know stresses in the symmetrical and unsymmetrical bending of the beams.
3.	Able to calculate the Shear flow for the symmetrical and unsymmetrical bending of the beams
4.	To predict the deflection of structures for different types of loads
5.	To evaluate the stresses in the structure of fuselage and wings .

Course Contents

Unit I	Aircraft Structural components and loads, functions of structural components, airframe loads; Types of structural joints, type of loads on structural joints; Aircraft inertia loads; Monocoque and semi monocoque structures, stress in thin shells; Airworthiness, Factors of safety-flight envelope, Load factor determination, Symmetric manoeuvre loads, Gust loads, Fatigue, Safe life and fail-safe structures, Designing against fatigue, Fatigue strength of components, Prediction of aircraft fatigue life, Crack propagation. **Theories of failure**: Maximum normal stress theory, Maximum shear stress theory, Maximum strain theory, Strain energy theory, and Distortion energy theory, failure of brittle and ductile materials.
Unit II	**Structural Instability:** Euler's column theory, effective length, and crippling stress, **Unsymmetrical Bending of Beam**: Resolution of bending moments, direct stress distribution, Unsymmetrical bending, Direct stress distribution due to bending position of neutral axis; Deflections due to bending.
Unit III	**Shear Flow and Analysis**: Shear stresses in beams, Shear flow in stiffened panels, Shear flow in thin walled open tubes, Shear centre, Shear flow in open sections with stiffeners. Shear flow in closed sections with stiffeners, Angle of twist, Shear flow in two flange and three flange box beams, Shear centre, Shear flow in thin walled closed tubes, Bredth-Batho theory, Torsional shear flow in multi cell tubes, Flexural shear flow in multi cell stiffened structures
Unit IV	**Combined Open and Closed Section Beam:** Bending, Shear, Torsion for combined sections, Structural Idealization, Idealization of a panel, Effect of idealization on the analysis of open and closed section beams, Bending of open and closed section beams, Shear of open section beams, Shear loading of closed section beams, Alternative method for the calculation of shear flow distribution, Torsion of open and closed section beams, Deflection of open and closed section beams, Numerical problems.
Unit V	**Plates and Fuselage**: Rectangular sheets under compression, Local buckling stress of thin-walled sections, Shear and bending moment distribution for semi cantilever and other types of wings and fuselage, thin webbed beam. With parallel and non-parallel flanges, Shear resistant web beams, Tension field web beams (Wagner's). Fuselages: Bending, Shear, Torsion, Cut-outs in fuselages, Wings Three- boom shell, Bending, Torsion, Shear centre, Tapered wings, Cut-outs in wings, problems

Text Books	
1	Megson, T. H. G., Aircraft Structures for Engineering Students, Butterworth Heinemann, 4th Ed., 200
2	Peery, D. J., Aircraft Structures, McGraw-Hill Education, 1st Ed., 1950.
3	Donaldson, B. K., Analysis of Aircraft Structures, Cambridge Aerospace, 2nd Ed., 1993.
Reference Books	
1	Sun, C. T., Mechanics of Aircraft Structures, Wiley-Interscience, 2nd Ed., 2006.
2	Bruhn, E. F., Analysis and Design of Flight Vehicle Structures, Jacobs Pub., 3rd Ed., 1973.
3	Niu, M., Airframe Stress Analysis & Sizing, Adaso Adastra Engineering Center, 2nd Ed.,1999.
Useful Links	
1	https://nptel.ac.in/courses/101/105/101105084/
2	https://onlinecourses.nptel.ac.in/noc20_ae08/preview
3	https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ae08/

BAE33601	Course Outcomes	CL	Class Sessions
BAE33601.1	**Evaluate** the failure behavior of brittle and ductile materials considering stress concentration and stress concentration factors.	**4**	**10**
BAE33601.2	**Apply** the principles of beam bending to symmetrical and unsymmetrical sections.	**3**	**10**
BAE33601.3	**Analyze** shear flow distribution and shear centre in open and closed sections under torsional and flexural loads using Bredt-Batho theory.	**4**	**10**
BAE33601.4	**Evaluate** the behavior of idealized open and closed section beams under combined loading	**4**	**10**
BAE33601.5	**Evaluate** the stresses in the structure of fuselage and wings for an aircraft by using shear/bending stress analysis techniques	**4**	**10**

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B.Tech. VIth Sem Aeronautical Engineering

BAE33602: Rocket Propulsion

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.	Study the types of rockets and their working principles.
2.	Characterize the advancement, performance and parameters of rocket engines.
3.	Study different type of feed systems used in modern chemical rockets.
4.	Explain the basic concepts and working principle of electric and Ion Propulsion.
5.	Understand the configurations of rocket nozzles, associated problems its application.

Course Contents

Unit I	**History and Principles of Rocket Propulsion** The development of the rocket, Classification of rocket engines and their operating principle, Multi-stage rockets, Thermal Rocket engine: Basic configuration, The development of thrust and the effect of the atmosphere, The thermodynamics of the rocket engine, The thermodynamic thrust equation, Specific impulse of rocket engine; Numerical problems.
Unit II	**Rocket Nozzle Theory** Ideal Rocket Nozzle, Assumptions for ideal rocket nozzle, Thermodynamic relations, Isentropic flow through nozzle, under expanded and over expanded nozzles **Nozzle configurations**: Conical, Bell shaped nozzles, Two stepped nozzles, Nozzles with aerodynamic boundaries **Real nozzles**: Principal losses, multiphase flow, performance correction factors and performanceparameters.
Unit III	**Solid Propellant Rocket Engines** Basic configuration, The properties and the design of solid motors, Propellant composition: Additives, Toxic exhaust, Thrust stability, Thrust profile and grain shape; Integrity of the combustion chamber: Thermal protection, Inter-section joints, Nozzle thermal protection; Ignition, Thrust vector control.
Unit IV	**Liquid Propellant Rocket Motors** The basic configuration of the liquid propellant engine, The combustion chamber and nozzle: Injection, Ignition, Combustion instability, Thrust vector control; Liquid propellant distribution systems, Cooling of liquid-fuelled rocket engines. **Hybrid rocket motors**: The basic configuration of a hybrid motor, Propellants and ignition, Combustion, Grain cross-section, Propulsive efficiency.
Unit V	**Electric Propulsion:** Principles of electric propulsion: Electric vehicle performance, Vehicle velocity as a function of exhaust velocity, Vehicle velocity and structural/propellant mass. Electric thrusters: Electro-thermal thrusters, Arc- jet thrusters, Non-Thermal electric thrusters, Propellant choice, Electrical efficiency; Plasma thrusters, Low-power electric thrusters, Electrical power generation, Applications of electric propulsion. Introduction and fundamentals of Ion propulsion: Performance Analysis, Characteristic Velocity, Payload, Specific Power; Electrical Thrust Devices: Ion and Colloid. Electromagnetic thrusters: Ion propulsion, Electric field and

	potential, Ion thrust

Text Books	
1	George P. Sutton, Elements of rocket propulsion, Wiley and Sons, Inc, 7th Edition, 2001.
2	Martin J.L Turner, Rocket and Spacecraft Propulsion: Principles, Practice and New Developments,Springer: Praxis Publishing, 3rd Edition, 2009.
3	K. Ramamurthi, Rocket Propulsion, Trinity Press, 3rd Edition, Reprint, 2016.
Reference Books	
1	Mukunda H. S., Understanding Aerospace chemical propulsion, Interline publications, 2nd Ed. 2004.
2	Philip G. Hill, Carl R. Peterson, Mechanics and Thermodynamics of Propulsion, Pearson, 12th Edition,2014.
3	Gorden, C.V., Aerothermodynamics of Gas Turbine and Rocket Propulsion, AIAA Education Series, NewYork, 3rd Edition, 1986.
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/

BAE33602	**Course Outcomes**	**CL**	**Class Sessions**
BAE33602.1	**Understand** various concepts of advanced propulsion techniques.	**3**	**9**
BAE33602.2	**Identify** and describe various configurations of nozzles, problems associated with real nozzle andneed of idealization.	**3**	**9**
BAE33602.3	**Comprehend** the problems on solid, liquid and hybrid rocket motors and their composition.	**3**	**9**
BAE33602.4	**Solve** the problems on thermodynamic thrust equation and specific impulse.	**4**	**9**
BAE33602.5	**Explicate** the fundamentals of rocket propulsion and working of individual rocket propulsion components.	**2**	**9**

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PROGRAM ELECTIVE-II

B. Tech. VIth Sem Aeronautical Engineering

BAE33603: Drone Technology

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 explore various applications of drones in agriculture, defense, logistics, and mapping
2.	To learn about LiPo battery systems, connectors, and Power Distribution Boards (PDB).
3.	To introduce mission planning using software like Mission Planner and Q Ground Control.
4.	To explain the processes for obtaining UIN, UAOP, and Remote Pilot License in India.
5.	To explore AI, ML, and computer vision applications in autonomous drones.

Course Contents

Unit I	Drone Fundamentals & Aerodynamics. Introduction, history & classification of UAVs, Principles of flight – lift, thrust, drag, weight, Multirotor configurations (quad, hexa, octa),Stability, yaw, pitch, roll & control axes, Flight modes – manual, GPS, loiter, altitude hold, Applications in agriculture, defense, logistics, mapping
Unit II	Drone Components & Assembly • Frame design & materials • Motors, KV rating, thrust-to-weight ratio • ESCs, propeller selection & balancing • Power systems: LiPo batteries, connectors, PDB • Flight controllers (Pixhawk/APM) setup & calibration • GPS, telemetry & radio systems • Pre-flight checklist & lab assembly demo
Unit III	Drone Dynamics, Maintenance & Troubleshooting • PID tuning & flight control fundamentals • Mission planning using Mission Planner/QGroundControl • Payload handling & lift calculations • Preventive maintenance & health checks, Troubleshooting common failures & case studies • Diagnostic tools – multimeter, oscilloscope, firmware logs • Component-level repair (motors, ESCs, sensors)
Unit IV	Drone Regulations & Certification • DGCA categories, NPNT guidelines, UIN, UAOP process • Remote Pilot Licensing (India context) • Airspace classification, operational limits, insurance policies • Flight logbook management & compliance reporting • Industrial case studies of regulatory compliance
Unit V	Emerging Trends in Drone Technology • BVLOS operations – challenges & opportunities • AI & ML applications in drones – autonomy & object detection • Swarm drone technology – applications in defense & logistics • IoT & 5G integration with UAVs • Industrial use cases: smart cities, disaster management

Text Books	
1	John Baichtal, Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs, Que Publishing, 2016
2	David McGriffy, Make: Drones – Teach an Arduino to Fly, Maker Media, 2016
3	Randy Beard & Timothy McLain, Small Unmanned Aircraft: Theory and Practice, Princeton University Press, 2012
Reference Books	
1	Dr. Luis Rodolfo Garcia Carrillo, Practical UAV Engineering, CRC Press, 2020
2	Prof. Rajeev Ratan, AI and Machine Learning for Onboard Drone Systems, O'Reilly Media, 2021
3	Anita Singh & Rajesh Kumar, UAVs and Drones: Applications, Challenges and Regulations, Narosa Publishing, 2022
Useful Links	
1	**DGCA India Drone Regulations Portal:** https://digitalsky.dgca.gov.in – NPNT, UIN, UAOP, and policy updates.
2	**ArduPilot & PX4 Documentation:** https://ardupilot.org, https://docs.px4.io – Open-source drone flight controller documentation.

BAE33603	**Course Outcomes**	**CL**	**Class Sessions**
BAE33603.1	**Interpret** the control axes and flight dynamics such as yaw, pitch, and roll.	**3**	**9**
BAE33603.2	**Identify** and describe the function of key drone components.	**3**	**9**
BAE33603.3	**Calculate** payload capacity and evaluate its effect on flight performance.	**3**	**9**
BAE33603.4	**Analyze** real-world case studies to understand regulatory best practices.	**4**	**9**
BAE33603.5	**Evaluate** future drone applications in smart cities and disaster management.	**4**	**9**

PROGRAM ELECTIVE-II

B.Tech. VI th Sem Aeronautical Engineering

BAE33604: Spacecraft Technology

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 introduce the fundamentals of spacecraft systems and subsystems
2.	To understand spacecraft propulsion, power systems, and structural components.
3.	To explore orbital mechanics and mission planning.
4.	To learn spacecraft thermal control, attitude dynamics, and communication systems.
5.	To analyze recent advances in space technologies and satellite systems.

Course Contents

Unit I	**Introduction to Spacecraft Systems** Types of spacecraft: satellites, probes, crewed missions; basic spacecraft structure and configurations; spacecraft classification by function; overview of space missions and launch systems.
Unit II	**Orbital Mechanics and Mission Design** Kepler's laws, orbit types, orbital elements, launch windows, transfer orbits, interplanetary travel basics, delta-v calculations, Hohmann transfer.
Unit III	**Spacecraft Propulsion and Power Systems** Chemical and electric propulsion systems, monopropellant and bipropellant engines, ion thrusters, solar sails; solar arrays, batteries, RTGs, power conditioning and distribution
Unit IV	**Attitude Determination and Control Systems (ADCS)** Attitude representations (quaternions, Euler angles), sensors (sun sensors, gyros, star trackers), actuators (reaction wheels, magnetorquers), stability and control strategies.
Unit V	**Communication, Thermal Control, and Emerging Space Tech** Telemetry, tracking, and command; onboard antennas and transceivers; spacecraft thermal environment, passive and active control methods; miniaturized satellites, cubesats, reusable space systems.

Text Books

1	Wertz, J.R. and Larson, W.J., Space Mission Analysis and Design, Microcosm Press, 3rd Ed., 1999.
2	Fortescue, P., Stark, J., and Swinerd, G., Spacecraft Systems Engineering, Wiley, 4th Ed., 2011.

Reference Books

1	Sellers, J., Understanding Space: An Introduction to Astronautics, McGraw-Hill.
2	Brown, C.D., Elements of Spacecraft Design, AIAA Education Series
3	Kaplan, M., Modern Spacecraft Dynamics and Control, Wiley.

Useful Links	
1	https://nptel.ac.in/courses/101104064 (Space Flight Mechanics)
2	https://www.nasa.gov (NASA - Space Missions and Tech)
3	https://nptel.ac.in/courses/101/104/101104071/

BAE33604	Course Outcomes	CL	Class Sessions
BAE33604.1	**Understand** various types of spacecraft and mission profiles.	**3**	**9**
BAE33604.2	**Apply** orbital mechanics principles for mission planning.	**3**	**9**
BAE33604.3	**Analyze** propulsion and power systems used in spacecraft.	**3**	**9**
BAE33604.4	**Describe** attitude control systems and their components..	**4**	**9**
BAE33604.5	**Evaluate** thermal, communication, and advanced space technologies.	**2**	**9**

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PROGRAM ELECTIVE-II

B. Tech. VI th Sem Aeronautical Engineering

BAE33605: Aircraft Navigation & Communication System

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 make students aware about flight control systems and operation of flight control system.
2.	To make the student understand the concept of Navigation & communication system
3.	To get the knowledge to Flight data recorder & Cockpit voice recorder system

Course Contents

Unit-I	**Introduction** The radio frequency spectrum, Electromagnetic waves, Frequency and wavelength, The atmosphere, Radio wave propagation, The ionosphere, MUF and LUF, Silent zone and skip distance, Space weather, Satellite communications (SATCOM), Communication systems integration and management, Aircraft communications and reporting system (ACARS), ACARS communication systems. **Antennas** The isotropic radiator, The half-wave dipole, Impedance and radiation resistance, Radiated power and efficiency, Antenna gain, The Yagi beam antenna, Directional characteristics, Other practical antennas, Feeders, Connectors, Standing wave ratio, Waveguide. **Transmitters and receivers** Modulation and demodulation, AM transmitters, FM transmitters, Tuned radio frequency receivers, Superhet receivers, Selectivity, Image channel rejection, Automatic gain control, Double superhet receivers, Digital frequency synthesis.
Unit-II	**VHF communications:** VHF range and propagation, DSB modulation, Channel spacing, Depth of modulation, Compression, Squelch, Data modes, ACARS, VHF radio equipment, **HF communications,** HF range and propagation, SSB modulation, SELCAL, HF datalink, HF radio equipment, HF antennas and coupling units, Flight-deck audio systems, Flight interphone system, Cockpit voice recorder. Emergency locator transmitters, Types of ELT, Maintenance and testing of ELT, ELT mounting requirements, Typical ELT, Cospas–Sarsat satellites
Unit-III	**Aircraft navigation,** The earth and navigation, Dead reckoning, Position fixing, Maps and charts, Navigation terminology, Navigation systems evolution, Automatic direction finder, Introducing ADF, ADF principles, ADF equipment, VHF omnidirectional range, VOR principles, Airborne VOR equipment, Operational aspects of VOR, Distance measuring equipment, Radar principles, DME overview, DME operation, Equipment overview, En route navigation using radio navigation aids, Instrument landing system ILS ground equipment airborne equipment, ILS approach, Operational aspects of the ILS, Doppler navigation The Doppler effect Doppler navigation principles, Typical Doppler installations
Unit-IV	**Advance Navigations**: Area navigation, RNAV overview, RNAV equipment, Kalman filters, Required navigation performance (RNP), PBN system errors, Actual navigation performance (ANP) Inertial navigation systems, Inertial navigation principles, System overview, System description, Alignment process, Inertial navigation accuracy, Global navigation satellite systems, GPS overview, Principles of wave propagation, Satellite navigation principles, GPS segments, GPS signals, GNSS Operation, GNSS evolution, GNSS augmentation, GNSS – The future Flight management systems, FMS overview, 246 17.2 Flight management computer system (FMCS), System initialisation, FMCS operation, General Aviation FMS, Four-dimensional (4D) navigation, Automatic DME tuning,

BAE33605	Course Outcomes	CL	Class Sessions
BAE33605.1	**Describe** fundamentals of electronic communication systems and their application inaviation	**3**	**9**
BAE33605.2	**Examine** Different types of Navigation & communication system	**3**	**9**
BAE33605.3	**Scrutinize** different types of Flight data recorder & Cockpit voice recorder system	**3**	**9**
BAE33605.4	**Perform** qualitative analysis on simple electronic communication system	**4**	**9**
BAE33605.5	**Study** the RADAR & INS System and its application to an aircrafts.	**2**	**9**

PROGRAM ELECTIVE-II

B.Tech. VI th Sem Aeronautical Engineering

BAE33606: Aircraft Maintenance & Repair

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.	Provide an understanding of welding processes and maintenance of aircraft structural components.
2.	Introduce the maintenance and repair techniques for plastic and composite materials in aircraft.
3.	Familiarize students with procedures for aircraft jacking, weighing, and rigging.
4.	Develop knowledge of hydraulic and pneumatic systems, and their maintenance in aircraft
5.	Emphasize safety practices, handling hazardous materials, and proper troubleshooting techniques.

Course Contents

Unit I	**MAINTENANCE OF AIRCRAFT** Rules and Regulations for Civil Aviation in India, Indian aircraft rules, Civil aviation requirement, CAR 66, Comparing with EASA and FAA Regulations, Aircraft System, Ensuring quality welds - Welding jigs and fixtures - Soldering and brazing – laser welding. Sheet metal repair and maintenance: Selection of materials; Tools - power/hand; Repair techniques; Peening - Close tolerance fasteners; Sealing compounds; forming/shaping; Calculation of weight of completed repair; Effect of weight - change on surrounding structure. Sheet metal inspection
Unit II	**PLASTICS AND COMPOSITES IN AIRCRAFT** Review of types of plastics used in airplanes - Maintenance and repair of plastic components - Repair of cracks and holes - various repairs schemes - Scopes. Cleaning of fibre reinforced plastic (FRP) materials prior to repair; Break test - Repair Schemes; FRP/honeycomb sandwich materials; laminated FRP structural members and skin panels; Tools/equipment;
Unit III	**AIRCRAFT JACKING, ASSEMBLY AND RIGGING** Airplane jacking and weighing and C.G. Location. Balancing of control surfaces - Inspection maintenance. Helicopter flight controls. Tracking and balancing the main rotor. Aircraft Electrical System, Inspection of Aircraft and Basic Aircraft Design.
Unit IV	**REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM** Trouble shooting and maintenance practices - Service and inspection - Inspection and maintenance of landing gear systems, Inspection and maintenance of air-conditioning and pressurization system, water and waste system. Installation and maintenance of Instruments, handling, Testing, Inspection. Inspection and maintenance of auxiliary systems, Fire protection systems, Ice protection system, Rain removal system, Position and warning system, Auxiliary Power Units (APUs).

Unit V	**SAFETY PRACTICES** Hazardous materials storage and handling, Aircraft furnishing practices, troubleshooting. Theory and practices.

Text Books	
1	Kroes, Watkins, Delp, "Aircraft Maintenance and Repair", McGraw Hill, New York, 1992
Reference Books	
1	Brimm D.J. Bogges H.E., "Aircraft Maintenance", Pitman Publishing corp., New York, 1940.
2	Delp. Bent and Mckinely “Aircraft Maintenance Repair”, McGraw Hill, New York, 1987
3	Larry Reithmeir, "Aircraft Repair Manual", Palamar Books, Marquette, 1992.
Useful Links	
1	https://nptel.ac.in/content/syllabus_pdf/101104005.pdf
2	https://nptel.ac.in/courses/101/108/101108056/
3	https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ae06/

BAE33606	**Course Outcomes**	**CL**	**Class Sessions**
BAE33606.1	Identify and apply the principles of function and safe operation to aircraft as per FAA	**3**	**9**
BAE33606.2	Understand general airframe structural repairs, the structural repair manual and structural control programme	**3**	**9**
BAE33606.3	Know about aircraft adhesives, sealants, bonding techniques, repair procedures and the types and detection of defects in aircraft composite materials	**3**	**9**
BAE33606.4	Identify, inspect, fabricate and repair aircraft sheet metal and synthetic, material structures.	**4**	**9**
BAE33606.5	Explain the maintenance schedule, safety and inspection procedures of Cessna airplane	**2**	**9**

PROGRAM ELECTIVE-III

B. Tech. VIth Sem Aeronautical Engineering

BAE33607: Control Theory & 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 are:

1.	To known the Automatic control of industrial processes is essential for increasing the output and in turn the profit of an industry
2.	To make students familiarize with Necessity of Control System.
3.	To impart knowledge on the Introduction to Controller Design & Stability.
4.	To infer about the analysis the Various State variable Analysis.
5.	To introduce the Stability of linear discrete-time systems.

Course Contents

Unit I	**Control System modelling and feedback control:** Basic components of control system, open loop system, closed loop system, effect of feed back on overall gain, stability, sensitivity & on noise, Linear Vs Non- linear system, Timeinvariant Vs time varying systems. Modelling of dynamical system by differential equations. Linearization of non-linear system. System type, steady state error, error constant. Composition, reduction of block diagrams of complex systems-rules and conventions. Control system components- sensors, transducers, servomotors, actuators, filters, modelling, transfer function.
Unit II	**Introduction to control problem:** Necessity of Control System with examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time.
Unit III	**Time Domain & Frequency Domain Analysis**. Control system performance, time domain description, output response to control inputs. Characteristic parameters-relation to system parameters. Review of Laplace Transform, applications to differential equations, Poles and zeroes, partial fraction decomposition of transfer function. Frequency domain analysis, specification: resonant peak, resonant frequency and band width. Bode Plot, Polar plot. Experimental determination of transfer function by frequency response measurement.
Unit IV	**Introduction to Controller Design:** Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Design of Controller for any physical system.
Unit V	**State variable Analysis:** Concepts of state variables: State space model. Diagonalization of State Matrix. Solution of state equations. Eigen values and Stability Analysis. Concept of controllability and observability. State Space to transfer Function & Transfer Function to State Space Representation, State Transition Matrix, Pole-placement by state feedback. Discrete-time systems. Difference Equations.

	State-space models of linear discrete-time systems. Stability of linear discrete-time systems.
Text Books	
1	M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
2	K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.
3	B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.
Reference Books	
1	J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009.
2	"Automatic Control System" Principles and Applications – Blazek, J.
3	
Useful Links	
1	https://nptel.ac.in/content/syllabus_pdf/101104005.pdf
2	https://nptel.ac.in/courses/101/108/101108056/
3	https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ae06/

BAE33607	Course Outcomes	CL	Class Sessions
BAE33607.1	**Understand** the fundamentals of the Control system	**3**	**9**
BAE33607.2	**Understand** about Type & Order of the system with Time Response Specification.	**3**	**9**
BAE33607.3	**Analysis** of the examiner different techniques for Time & Frequency Response	**3**	**9**
BAE33607.4	**Design** controller as per given specifications using different techniques	**4**	**9**
BAE33607.5	**Express and solve** the system equations in state-variable form.	**2**	**9**

PROGRAM ELECTIVE-III

B. Tech. VIth Sem Aeronautical Engineering

BAE33608: Aviation Managements

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 introduce the basic concepts of the air traffic managements.
2.	To make students familiarize with air traffic controller.
3.	To impart knowledge about the flight phases.
4.	To infer about the basic concepts air space managements.
5.	To introduce the aircraft emergency.

Course Contents

Unit I	**Introduction to ATM:** Comparison with other modes of transport, Role of IATA, ICAO, The general aviation industry airline, Factors affecting general aviation, use of aircraft, airport: airline management and organization, levels of management, functions of management, Principles of organization planning the organization, chart, staff departments and line departments.
Unit II	**Air Traffic Controller (ATC):** Vocabulary and units, Missions and actors of the air traffic management system, Visual flight rules and instrumental flight rules, Airspace classes, Airspace organization and management, Flight information regions and functional airspace blocks, Lower and upper airspace, Controlled airspace: en route, approach or airport control, Air route network and airspace sectoring.
Unit III	**The Flight Phases:** The Context of Air Traffic Management, Traffic separation, Separation standard, loss of separation Conflict detection and resolution, The distribution of tasks among controllers, The controller tools, Traffic regulation, Capacity and demand, Workload and air traffic control complexity, Airspace management in en route air traffic control centers, Operating air traffic control sectors in real time, Anticipating sector openings (France and Europe), Air traffic flow management.
Unit IV	**Airspace Management:** Airspace sector design, Functional airspace block definition, Simulated annealing algorithm, Ant colony algorithm, A fusion–fission method, Comparison of fusion–fission and classical graph partitioning methods, Prediction of air traffic control sector openings, Problem difficulty and possible approaches, Using a genetic algorithm, Tree-search methods, constraint programming, A neural network for workload prediction, Conclusion on the prediction of sector openings.
Unit V	**Aircraft Emergency:** Introduction, Airports' main challenges, Known difficulties, Optimization problems in airport traffic management, Gate assignment, Problem description, Resolution methods, Runway scheduling, Problem description, An example of problem formulation, Resolution methods, Surface routing, Problem description, Related work, Global airport traffic optimization, Problem description , Coordination scheme between the different predictive systems.

Text Books	
1	Fedric J.H., "Airport Management", English Book House, New Delhi-I.
2	Alexander T. Wells and Seth B. Young (2011), Airport Planning and Management, 6th edition, McGraw-Hill, New Delhi.
3	Wilson & Bryon, "Air Transportation", English Book House, New Delhi-I.
Reference Books	
1	Indian Aircraft manual", Published by DGGA, English Book House, New Delhi-I.
2	Alexander T. Wells, John G. Wensveen (2008), Air Transportation: A Management Perspective, 8th edition, Ashgate Publishing, New Delhi.
3	
Useful Links	
1	https://nptel.ac.in/content/syllabus_pdf/101104005.pdf
2	https://nptel.ac.in/courses/101/108/101108056/
3	https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ae06/

BAE33608	Course Outcomes	CL	Class Sessions
BAE33608.1	**Understand** the history of air traffic managements and its roles in airlines.	**3**	**9**
BAE33608.2	**Study** about concept of airspace structures and air traffic controller.	**3**	**9**
BAE33608.3	**Apply the** concept of phases of flight in ATM.	**3**	**9**
BAE33608.4	**Understand** flight scheduling methods and related practices	**4**	**9**
BAE33608.5	**Identify** the problems solving between ATC and ATM.	**2**	**9**

PROGRAM ELECTIVE-III

B.Tech. VIth Sem Aeronautical Engineering

BAE33609: Helicopter Engineering

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 fundamentals of rotorcraft flight and helicopter configurations
2.	To explore rotor blade aerodynamics and helicopter performance characteristics.
3.	To introduce students to helicopter components, engines, and transmissions.
4.	To examine flight control systems and handling qualities of helicopters
5.	To familiarize with helicopter stability, vibration issues, and modern applications.

Course Contents

Unit I	**Introduction to Helicopter Systems** History and evolution of helicopters, rotorcraft types and configurations, basic helicopter components, mission profiles and applications, comparison with fixed-wing aircraft.
Unit II	**Rotor Blade Aerodynamics** Airfoil characteristics, momentum theory, blade element theory, induced flow, lift and drag in hover, forward flight, autorotation, and blade stall phenomena.
Unit III	**Helicopter Performance** Hovering performance, forward flight, climb and descent, ceiling, payload range, endurance, power required and available curves, ground effect, vortex ring state.
Unit IV	**Helicopter Structures and Transmission Systems** Rotor hub types, blade design and materials, swashplate mechanism, gearbox and transmission system, tail rotor design, anti-torque mechanisms, engine integration.
Unit V	**Flight Controls, Stability and Vibration** Types of flight control systems – cyclic, collective, and anti-torque pedals, stability and control derivatives, vibration sources and suppression techniques, safety systems, case studies of modern helicopters.

Text Books

1	W.J. Wagtendonk, Principles of Helicopter Flight, ASA Publications, 2nd Ed., 2006.
2	J. Seddon and S. Newman, Basic Helicopter Aerodynamics, Wiley, 3rd Ed., 2011..

Reference Books	
1	John Fay, The Helicopter: History, Engineering, and Performance, McGraw-Hill.
2	R.W. Prouty, Helicopter Performance, Stability, and Control, Krieger Publishing.
3	A.R.S. Bramwell, Bramwell's Helicopter Dynamics, Butterworth-Heinemann.
Useful Links	
1	https://nptel.ac.in/courses/101104064
2	https://www.faa.gov
3	https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ae06/

BAE33609	Course Outcomes	CL	Class Sessions
BAE33609.1	**Understand** basic principles and components of helicopter systems.	**3**	**9**
BAE33609.2	**Analyze** rotor blade aerodynamics and forces in hover and forward flight.	**3**	**9**
BAE33609.3	**Evaluate** helicopter performance metrics including endurance and climb.	**3**	**9**
BAE33609.4	**Interpret** the structure, transmission, and power systems of helicopters.	**4**	**9**
BAE33609.5	**Understand** stability, control, and vibration aspects of helicopters.	**2**	**9**

PROGRAM ELECTIVE-III

B. Tech. VIth Sem Aeronautical Engineering

BAE33610: Finite Elements Method (FEM)

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 introduce the concepts of the plane stress & plane strain differential equation of equilibrium.
2.	To make students familiarize with equations of compatibility equation, with boundary conditions.
3.	To Know the Concept of discretization of body into elements and basic types of 2-D.
4.	To the analysis the types of 2D elements applied to plane stress, plane strain and axis symmetric problems.
5.	To the concept of the formulation of mass matrix for 1-D bar element, free vibration analysis using 1-D bar element.

Course Contents

Unit I	**Basics of Stress Analysis** Fundamentals of stress and strain, stress and strain components, stress strain relationship, Elastic constants, plane stress, plane strain, differential equation of equilibrium, compatibility equation, Boundary conditions, Saint Venant's principle, Airy's stress function.
Unit II	**Fundamental concepts of FEM** Historical background, Scope of FEM in Engg. Applications, Principle of minimum potential energy, Concept of Virtual work, Raleigh–Ritz method, FEM analysis procedure. Concept of discretization of body into elements, degrees of freedom, bandwidth, Basic types of 2-D & 3- D elements, displacement models, convergence requirements, shape function.
Unit III	**FEM Modeling** Finite element modeling and analysis using Bar and Beam elements, stiffness matrix, assembly, boundary conditions, load vector, temperature effects. Two dimensional plane trusses, Local & Global coordinate system, element stiffness matrix, assembly, boundary conditions, and load vector, force and stress calculations
Unit IV	**2D FEM Problems** Two dimensional problem using CST & LST, formulation of CST & LST elements, elemental stiffness matrix, assembly, boundary conditions, load vector, stress calculation, Temperature effect.
Unit V	**Dynamic Analysis** Introduction to Isoperimetric and Higher order elements. Introduction to dynamic analysis, formulation of mass matrix for one-dimensional bar element, free vibration analysis using one dimensional bar element. Torsion of prismatic bars using triangular elements. **Introduction to FEM Software:** Extension of the method to other engineering problems.

Text Books

1	Introduction to Finite Elements in Engineering– T. R. Chandrupatla & A. D. Belegundu.
2	Theory of Elasticity – S.P. Timoshenko.

3	Concept and applications of Finite element Analysis – P.D. Cook.
Reference Books	
1	The Finite Element Method–A Basic introduction for engineers–D. W. Griffths, D. A. Nethercot.
2	Introduction to Finite Element- Reddy J.N. - McGraw Hill.
3	Applied Finite Element Analysis - Larry J. Segelind - John Wiley.
Useful Links	
1	https://nptel.ac.in/courses/112/104/112104193/
2	https://nptel.ac.in/courses/105/105/105105041/
3	https://nptel.ac.in/courses/105/106/105106051/

BAE33610	Course Outcomes	CL	Class Sessions
BAE33610.1	**Understand** the plane stress & plane strain differential equation of equilibrium & compatibility equation, with boundary conditions	**3**	**9**
BAE33610.2	**Analyze** the Concept of discretization of body into elements and basic types of 2-D & 3-D elements, displacement models,	**3**	**9**
BAE33610.3	**Analyze** the various types of 2D elements applied to plane stress, plane strain and axis symmetric problems.	**3**	**9**
BAE33610.4	**Solve** complicated 2D & 3D Isoperimetric structural problems for stress analysis.	**4**	**9**
BAE33610.5	**Determine** formulation of mass matrix for one-dimensional bar element, free vibration analysis using one dimensional bar element.	**2**	**9**

B.Tech. VI Sem Aeronautical Engineering

BAE33611: Aircraft Structures Lab

Teaching Scheme		Examination Scheme	
Practical	**4 Hrs/week**	**CA**	**25 Marks**
Total Credit	**2**	**ESE**	**25 Marks**
		Total	**50 Marks**
		Duration of ESE: 02 Hours	

Course Objectives

The Objectives of this course are:

1	Apply fundamental principles of stress and strain to analyze structural components.
2	Apply failure criteria to predict the behavior of materials under various loading conditions.
3	Understand and calculate the impact strength of materials under dynamic loads.
4	Apply the principles of static and dynamic load analysis to aircraft structures.
5	Identify the types of structures (trusses, beams, and frames) and their static behavior.

Sr. No.	List of Experiment	CO
1	Determination of unsymmetrical Bending of Z section Beam.	**1**
2	Testing of deflection of a beam under combined loading.	**1**
3	Demonstration of Simply supported Beam test setup.	**1**
4	Determination of Shear Center location for open channel sections.	**2**
5	To find Shear Center location for closed D sections.	**2**
6	Experiment on Constant strength Beam.	**3**
7	Demonstration of Flexibility matrix for cantilever Beam.	**3**
8	VerificationofCastingliano'sloadtheoremwithdifferentendconditions.	**4**
9	Verification of Maxwell's Reciprocal Theorem and Superposition Principle with different end conditions.	**4**
10	To find Young's modulus using dial gauge.	**5**
11	Strain measurement using electrical resistance strain gauges.	**5**
12	Buckling load of slender eccentric columns and construction of South well plot.	**5**

Text Books

1	Megson,T.H.G.,Aircraft Structures for Engineering Students,Butterworth Heinemann,4thEd., 2007.
2	Peery,D.J.,Aircraft Structures,McGraw-Hill Education,1stEd., 1950.
3	Donaldson,B.K.,Analysis of Aircraft Structures,Cambridge Aerospace,2nd Ed.,1993.

Reference Books

1.	Sun,C.T.,Mechanics of Aircraft Structures,Wiley-Interscience, 2ndEd.,2006.
2.	Bruhn,E.F.,Analysis and Design of Flight Vehicle Structures,Jacobs Pub.,3rdEd.,1973.
	Niu,M.,Airframe Stress Analysis&Sizing,Adaso Adastra Engineering Center, 2ndEd., 1999.

Useful Links

1	https://nptel.ac.in/courses/112104114/
2	https://nptel.ac.in/courses/112/104/112104121/

BAE33611	Course Outcomes	CL	Class Sessions
BAE33611.1	**Apply** the basic concepts of stress and strain analysis to compute the strength of material.	**3**	**9**
BAE33611.2	**Predict** life of materials and structures by using different failure theories and its application.	**3**	**9**
BAE33611.3	**Predict** the fatigue life of the structure and **calculate** impact and fatigue strength.	**3**	**9**
BAE33611.4	**Calculate** loads on the aircraft for different maneuvering conditions.	**4**	**9**
BAE33611.5	**Identify** determinate and indeterminate structures and solve the problems of truss structures using different methods.	**2**	**9**

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B.Tech VIth Sem Aeronautical Engineering

BAE33612:Rocket Propulsion Lab

Teaching Scheme		Examination Scheme	
Practical	**4 Hrs/week**	**CA**	**25 Marks**
Total Credit	**2**	**ESE**	**25 Marks**
		Total	**50 Marks**
		Duration of ESE: 02 Hours	

Course Objectives

The Objectives of this course are:

1	Study the performance of premixed flames and jet engine combustion chamber
2	Known the performance of aviation fuel/ propellant
3	Study the performance of hybrid rocket propellant
4	Study the performance of propeller at different speeds
5	To enable experimental analysis of boundary layers and flow separation

Sr. No.	List of Experiment	CO
1	Measurement of burning velocity of a premixed flame	**1**
2	Establishing flame stability of pre-mixed flame through flame stability setup.	**1**
3	Combustion performance studies in a jet engine combustion chamber	**1**
4	Compute burning rate of the propellant	**2**
5	Estimate the calorific value of solid rocket propellant	**2**
6	Determination of heat of combustion of aviation fuel	**3**
7	Performance study of hybrid motor using a thrust stand	**3**
8	Analysis of grain stress and strain of a solid propellant	**4**
9	Estimate the performance of a propeller at different speeds	**4**
10	Measurement of ignition delay of a single propellant with different shapes	**5**

Text Books

1	K. Ramamurthi, Rocket Propulsion, Trinity Press, 3rd Edition, Reprint, 2016.
2	Philip G. Hill, Carl R. Peterson, Mechanics and Thermodynamics of Propulsion, Pearson, 12th Edition, 2014.

Reference Books

1.	Mattingly J D, Elements of Propulsion: Gas Turbines and Rockets, AIAA Education Series, 2006.
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/

BAE33612	Course Outcomes	CL	Class Sessions
BAE33612.1	**Estimate** the performance of premixed flames and jet engine combustion chamber	**3**	**9**
BAE33612.2	**Evaluate** the performance of a aviation fuel/ propellant	**3**	**9**
BAE33612.3	**Determine** the performance of hybrid rocket propellant	**3**	**9**
BAE33612.4	**Estimate** the performance of propeller at different speeds	**3**	**9**
BAE33612.5	**Evaluate** the performance of premixed flames and jet engine combustion chamber	**2**	**9**

B. Tech. VIth Sem Aeronautical Engineering

BAE33613: Computational Analysis Lab

Teaching Scheme		Examination Scheme	
Practical	**4 Hrs/week**	**CA**	**25 Marks**
Total Credit	**2**	**ESE**	**25 Marks**
		Total	**50 Marks**
		Duration of ESE: 02 Hours	

Course Objectives

The Objectives of this course are:

1	Understand the fundamentals of stress analysis in beams under different loading conditions.
2	Study the behavior and stress distribution in axisymmetric components and evaluate buckling failures.
3	Learn the principles of steady-state and transient thermal analysis.
4	Explore the concept of natural frequencies and vibration characteristics of beams.
5	Understand and analyze the behavior of fluid flow over two-dimensional structures.

Sr. No.	List of Experiment	CO
1	Structural analysis of beam with point load and distributed load for cantilever support	**1**
2	Structural analysis of beam with point load and distributed load for simply support	**1**
3	Buckling failure of the beam	**2**
4	Stress analysis of axi-symmetry structure	**2**
5	Radiation exchange between surfaces	**3**
6	Thermal analysis (convection and conduction) of structures.	**3**
7	Modal analysis of a cantilever beam	**4**
8	Harmonic analysis of stepped shaft	**4**
9	Flow over an airfoil section	**5**
10	2D analysis of road vehicles	**5**
11	2D analysis of high rise building	**5**
12	Supersonic flow over a wedge	**5**

Text Books

1	ANSYS FLUENT Tutorial Guide 18.0
2	Tdeusz Stolarski, Y Nakasone and S Yoshimoto, Engineering Analysis with ANSYS Software, Butterworth-Heinemann, 2006.

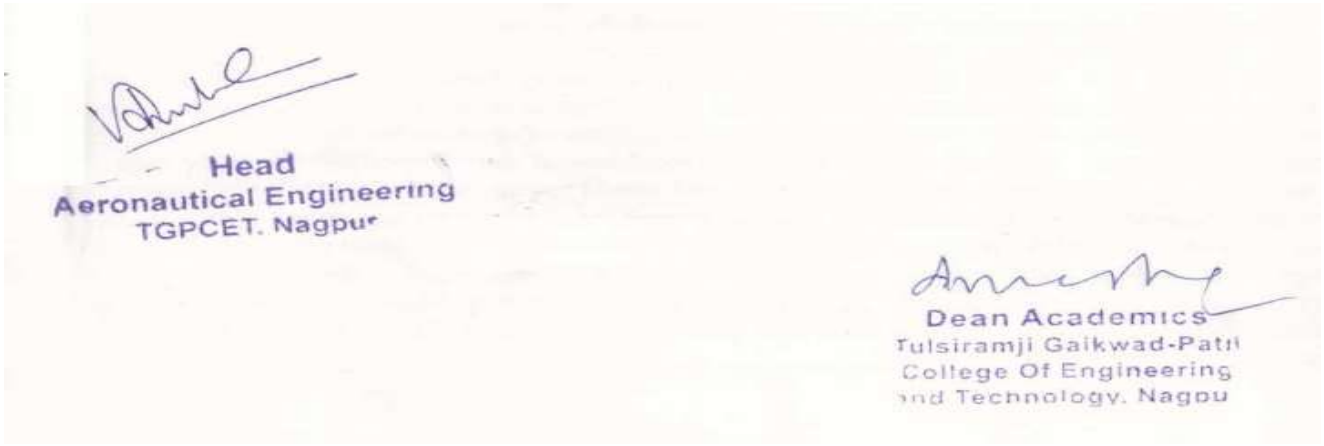
Reference Books

1.	DivyaZindani, ApurbaKumafr Roy and Kaushik Kumar, Working with ANSYS: A Tutorial Approach, I K International Publishing House Pvt. Ltd, 2017
2.	Thomas C. Corke, Design of Aircraft, Prentice Hall, 2003

Useful Links

1	https://nptel.ac.in/courses/l12/105/112105123/
2	https://nptel.ac.in/courses/l12/104/112104113/

BAE33613	Course Outcomes	CL	Class Sessions
BAE33613.1	Evaluate the stresses in beams under various loading conditions.	**3**	**9**
BAE33613.2	Analyze stresses in axisymmetric structures and assess failure due to buckling.	**3**	**9**
BAE33613.3	Evaluate steady-state and transient thermal analysis problems.	**3**	**9**
BAE33613.4	Determine the natural frequencies of beams.	**4**	**9**
BAE33613.5	Analyze the behavior of fluid flow over two-dimensional structures.	**2**	**9**



B. Tech. VIth Sem Aeronautical Engineering

Multidisciplinary Minor

BIT33615-:-Artificial Intelligence for Engineering

Teaching Scheme		Examination Scheme	
Practical	**2 Hrs/week**	CT-I	07 Marks
Tutorial	-	CT-II	07 Marks
		CA	06 Marks
Total Credit	**2**	**ESE**	**30Marks**
		Total	**50 Marks**
		Duration of ESE: 02 Hours	

Course Objectives

The Objectives of this course are:

1	To classify to the fundamental concepts of Artificial Intelligence including Machine Learning, NLP, and Deep Learning.
2	To explain the AI problem-solving through state-space representation with classical search algorithms and heuristic techniques.
3	To explore real-world AI applications, and analyze the ethical, societal, and economic implications of AI technologies.

Sr. No.	List of Experiment	CO
Unit I	**Introduction:** Introduction to AI: Definition, History, Importance, Current Status, and Scope of AI, Turing Test Concept, AI Characteristics and Task Domains, Introduction to Production Systems, , Examples of AI, Application domains of AI, Introduction to Machine Learning, NLP and Deep Learning	
Unit II	Problem Solving by Search and Problem Formulations Formulation of AI Problems as State-Space Search, Production Systems: Characteristics and Types Problem Solving Methods: Problem Graphs, Matching and Indexing, Heuristic Functions. Uninformed Search: Breadth-First Search (BFS), Depth-First Search (DFS), Uniform-Cost Search, Comparing Uninformed Techniques Informed Search: Generate-and-Test, Hill Climbing, Best-First Search, A* Algorithm, Problem Reduction, Search Optimization Techniques	
Unit III	**Building AI in Company:** Smart speaker, Case study: Self-driving car, Example roles of an AI team, AI pitfalls to avoid, Survey of major AI application areas **AI and Society**: A realistic view of AI, Discrimination / Bias, Adversarial attacks on AI, Adverse uses of AI, AI and developing economies, AI and jobs	

Text Books

T.1	Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", Book in preparation for MIT Press, 2016. (available online)
T.2	Jerome H. Friedman, Robert Tibshirani, and Trevor Hastie, "The elements of statistical learning", Springer Series in Statistics, 2009.

Reference Books	
R.1	Deep Reinforcement Learning Paperback – Import, 12 June 2022 by Aske Plaat (Author)
R.2	https://www.springerprofessional.de/en/deep-reinforcement-learning/23151324
Useful Links	
1	https://www.iitp.ac.in/~arijit/web/index.php?id=courses/2023_CS365
2	https://onlinecourses.nptel.ac.in/noc20_cs62/preview

BIT33615	Course Outcomes	CL	Class Sessions
BIT33615.1	**Explain** the fundamental concepts of Artificial Intelligence including Machine Learning, NLP, and Deep Learning.	2	09
BIT33615.2	**Formulate** AI problems as state-space models and apply suitable uninformed and informed search techniques for their solution.	3	09
BIT33615.3	**Analyze** real-world AI applications in industry and society.	4	09