RTM Nagpur University

Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III	Applied Mathematics – III (BTAE 301T)	3	0	0	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	The objective of this course is to familiarize the prospective engineers with techniques in different transforms and calculus of variation and numerical computation.
2	It aims to equip the students with standard concepts and tools at an intermediate to advanced level.
3	It will serve them well towards tackling more advanced level of mathematics & applications that they would find useful in their disciplines.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Students will be able to understand Laplace Transform and should be able to solve differential equations.
CO2	Expand the function in periodic form using Fourier series and understand the relationship between z transform and the Fourier transform for discrete time signals.
CO3	Apply concept of complex variable for solving integration and engineering problem.
CO4	Formulate and solve linear partial differential equations in the field of Industrial Organization and Engineering.
CO5	Use of the MATRIX theory to solve differential equations using Eigen values and Eigen vectors.

SYLLABUS	
Contents	**No. of Hours**
Unit I LAPLACE TRANSFORM: Definition, Properties (statement only), Evaluation of integrals by Laplace Transform, Inverse Laplace Transform (Partial fraction method) and its Properties, Convolution theorem (statement only), Laplace Transform of Periodic Functions (statement only), Unit Step Function and Unit Impulse Function (statement only), Applications of Laplace Transform to solve ordinary Differential Equations, Integral Equations & Integro-differential Equations.	8
Unit II FOURIER SERIES & FOURIER TRANSFORM: Periodic functions and their Fourier Expansions, Even and Odd functions, change of interval, Half Range Expansions. Fourier Transform: Definition and Properties (excluding FFT), Fourier Integral Theorem, Applications of Fourier Transform to Solve Integral Equation.	6

Unit III FUNCTIONS OF COMPLEX VARIABLE: Analytic function, Cauchy- Riemann Conditions, Harmonic Functions (excluding orthogonal system), Milne- Thomson Method, Cauchy Integral Theorem & Integral Formula (Statement only), Taylor's & Laurent's series (Statement only), Zeros and Singularities of Analytic function, Residue Theorem (Statement only).	8
Unit IV PARTIAL DIFFERENTIAL EQUATIONS: Partial Differential Equations of First Order First Degree i.e. Lagrange's form, Linear Homogeneous Equations of higher order with constant coefficients. Method of separations of variables, Simple Applications of Laplace Transform to solve Partial Differential Equations (One dimensional only).	8
Unit V MATRICES: Linear dependence of vectors, Eigen values and Eigen vectors, Reduction to Diagonal form, Singular value decomposition, Sylvester's theorem [without proof], Largest eigen value and corresponding eigen vector by iteration method.	6

Total: 36 Ho

Text Books:

1. Higher Engineering Mathematics by B.S. Grewal, 40th Edition, Khanna Publication
2. Advanced Engineering Mathematics by Erwin Kreysizig, 8th Edition, Wiley India
3. Applied Mathematics for Engineers & Physicist by L.R. Pipes and Harville,
4. Calculus of variation by Forrey.

Reference Books:

1. A Text Book of applied Mathematics, Volume II , by P.N. Wartikar & J.N. Wartikar, Poona Vidyarthi Griha Prakashan
2. Introductory methods of Numerical Analysis, by S.S. Sastry, PHI
3. Mathematics for Engineers by Chandrika Prasad
4. A text book of Engineering Mathematics by N. P. Bali & M. Goyal, Laxmi Publication.

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Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III	Aero-Thermodynamics (BTAE 302T)	3	0	0	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	Understand the laws of thermodynamics and determine thermodynamic properties, gas laws.
2	Apply knowledge of pure substances, mixtures, usage of steam tables and Mollier chart, psychrometric charts.
	Understanding of steam properties, air standard cycles and applications of various components like compressor, turbine etc.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Memorize and understand basics of thermodynamics along with basic of zeroth law.
CO2	Understand and apply basics of thermodynamics along with basic laws of thermodynamics.
CO3	Understand the limitations of first law of thermodynamics and different forms of second law of thermodynamics.
CO4	Understand and apply the basics of Properties of Steam.
CO5	About the basics of Air Standard Cycles. Understanding the applications of Nozzle, diffuser, compressor and turbine.

SYLLABUS

Contents	No. of Hours
Unit I : Introduction to Thermodynamics Basic concepts of Thermodynamics, Closed & Open Systems, Forms of energy, Properties of system, State & Equilibrium, Processes & Cycles, Temperature & Zeroth Law of Thermodynamics. Introduction to First Law of Thermodynamics (Law of Conservation of Energy), Heat & Work, Mechanical forms of work, Non-Mechanical forms work (Electrical, Magnetic etc.) The Ideal Gas equation of state, Difference between Gas & Vapor, Compressibility factor, Internal energy & specific heats of gases, Universal Gas Constant.	7
Unit II : First Law of Thermodynamics Closed Systems (Control mass system), Work done, Change in internal energy, Heat transferred during various thermodynamic processes, P-V diagrams. Open systems (Control volume systems), Thermodynamic analysis of control volumes, Conservation of energy principle, Flow work & enthalpy.	10
Unit III : Second Law of Thermodynamics Introduction (Law of degradation of energy), Thermal energy reservoirs, Kelvin-Plank & Clausius statements, Heat engines, Refrigerator & Heat pump, Perpetual motion machines, Reversible & Irreversible processes, Carnot cycle, Thermodynamic temperature scale. Entropy: - The Clausius inequality, Entropy, Principle of increase of entropy, Change in entropy for Closed & Steady flow open systems. Second law analysis of engineering systems: - Availability, Reversible work, Irreversibility, Temperature-entropy diagram.	10

Unit IV : Properties of Steam Critical state, Sensible heat, Latent heat, Super heat, Wet steam, Dryness fraction, Internal energy of steam, External work done during evaporation, T-S diagram, Mollier chart, Work & Heat transfer during various thermodynamics processes with steam as working fluid. Determination of dryness fraction using various calorimeters.	8
Unit V : Air Standard Cycles Otto cycle, Diesel cycle, Stirling & Ericsson cycle, Brayton cycle, Vapour cycles :- Simple & Modified Rankine cycle with reheat & regeneration. Applications to i) Nozzles & Diffusers ii) Turbine & Compressors iii) Throttle Valves. (Simple systems like charging & discharging of tanks).	10

Total: 45 Hours

Text Books:

1. Engineering Thermodynamics by P. K. Nag, Tata Mc-Graw Hill Publication

2. Thermodynamics by C. P. Arora, Tata Mc-Graw Hill Publication

3. Fundamentals of engineering Thermodynamics by R. K. Rajput

Reference Books:

1. 'Thermodynamics: An engineering approach' by Yunus Cengal, M.A.Boles
2. Fundamentals of classical by Gorden J. V. Wylen, Sonntag

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Syllabus (Practical)

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
III	Aero-Thermodynamics (BTAE 302P)	0	0	2	1	25	25	50

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	To provide an understanding about the steam turbines
CO2	To provide an understanding about the construction and working of internal combustion engines.
CO3	To provide an understanding about the working and types of compressors
CO4	To provide an understanding about the steam turbines
CO5	To be able to understand and evaluate the performance of Rotary air Compressor and Reciprocating air Compressor

Sr. No.	List of Practical's
01	Study of steam turbines
02	Study of internal combustion engines.
03	Study of various types of compressors.
04	Performance and evaluation of Rotary air Compressor.
05	Performance and evaluation of Reciprocating air Compressor.
06	Visit to thermal power plant. (Case study to be prepared by students).

References:

1. Thermodynamics An engineering approach by Yunus Cengal, M.A.Boles
2. Thermodynamics by C. P. Arora, Tata Mc-Graw Hill Publication
3. Fundamentals of classical by Gorden J. V. Wylen, Sonntag
4. Engineering Thermodynamics by P. K. Nag, Tata Mc-Graw Hill Publication
5. Fundamentals of engineering Thermodynamics by R. K. Rajput
6. Lab Manual

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Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III	Fluid Mechanics and Machinery (BTAE 303T)	3	0	0	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	This course is designed to develop an understanding of the behavior of fluids at rest or in motion and the subsequent effects of the fluids on the boundaries as the mechanical engineers has to deal with fluids in various applications.
2	This course will also develop analytical abilities related to fluid flow. It is expected that students will gain conceptual understanding of fluids and their properties and will be able to apply the analytical tools to solve different types of problems related to fluid & fluid flow.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Remember the basic fluid properties, Newton's law of viscosity and its application & detailed idea about different pressure measuring device(like manometer, bourdon's gauge)
CO2	Get basic idea about flow visualization techniques, Euler's equation of motion & Bernoulli's equation & it's application
CO3	Able to get a clear idea about the types of flow depending on the Reynolds' number, Significance of Reynolds' and Mach number in the fluid flow, Phenomena for separation of flow and after the completion of this unit student will be able to find lift and drag force on an immersed body.
CO4	Able to understand Classify the hydraulic machines (such as turbines & pumps) understand about the working principle, Constructional features, Performance Characteristics , Governing & Selection criteria for- Impulse Turbines
CO5	Able to evaluate the hydraulic machines (such as turbines & pumps) understand about the working principle Constructional features, Performance Characteristics , Governing & Selection criteria for Reaction Turbines, Get the basic ideas regarding the classification of pumps, Applications of pumps.

SYLLABUS	
Contents	**No of hours**
Unit I: Introduction to Fluid Mechanics Properties of fluids, Newton's law of viscosity and its applications, Pascal's law, Basic equation of fluid statics, Fluid pressure & its measurement (Manometers & Bourdon's pressure gauge), Pressure variations in compressible & Definition of Fluids :-the science of fluid mechanics, fluid properties, capillarity, surface tension, compressibility, units and dimensions, Normal and Shear stresses in fluid flows, measurement of fluid velocity, Pascal's law, types of forces on a fluid system, measurement of pressure, use of manometers and gauges, numerical problems. Hydraulic devices, forces on partially and fully submerged bodies, including that on curved surfaces, numerical problems, buoyancy, stability of floating bodies, Centre of gravity and meta centric heights, Incompressible fluids.	9

Unit II: Kinematics of Fluid Flow Types of flow, Stream line, Path line, Streak line, Stream tube, Continuity equation, One & Two dimensional flow, Velocity & Acceleration at a point, Potential lines, Flow net, Stream function, Velocity potential, Circulation, Vortex motion. Dynamics of Fluid Flow: One dimensional method for flow analysis, Euler's equation of motion, Derivation of Bernoulli's equation for incompressible flow & its applications	8
Unit III : Viscous Flow Introduction to laminar and turbulent flow, Reynolds number and its significance, Mach number and its significance, Boundary layer concept, Wall shear and boundary layer thickness, Displacement thickness and Momentum thickness, Separation, Drag and Lift on immersed bodies. Flow of viscous fluids through parallel plates, Pipes, Kinetic energy correction factor.	8
Unit IV : Principles & Classification of Hydraulic Machines Impulse Turbines :- Principle, Constructional features, Installation of Pelton turbine, Velocity diagram & analysis, Working proportions, Design parameters, Performance characteristics, Governing & selection criteria.	10
Unit V : Reaction or Pressure turbine P ciples of operation, Degree of reaction, Comparison over Pelton turbine, Development of reaction turbines, Classification, Draft tubes, Cavitation in turbines. Francis turbine, Propeller turbine, Kaplan turbine: Types, Constructional features, Installations, Velocity diagram & analysis. Working proportions, Design parameters, Performance characteristics, Governing, Selection of hydraulic turbines, Classification & Applications: Introduction to Centrifugal, axial & mixed flow Pumps, Self-priming Pumps. Introduction to Reciprocating Piston / Plunger Pumps. Rotary Displacement Pumps: - Introduction to gear pumps, Sliding vane pumps, Screw pumps.	10

Total: 45 Hours

Text Books:

1. Fluid Mechanics & Fluid Power Engineering by D.S.Kumar

2. Fluid Mechanics & hydraulic Machines by R.K.Bansal

3.Fluid Mechanics for Engineers by P.N. Chartterjee

4.Fluid Mechanics by J.F.Douglas, J.M. Gasiorek

R ference Books:

1. Fluid Mechanics by Frank M. White

2.Mechanics of Fluids by B.S.Massey

3.Fluid Mechanics by A.K.Jain

4.Fluid Mechanics with engineering applications by Daugherty & Franizini

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Syllabus (Practical)

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
III	Fluid Mechanics and Machinery (BTAE 303P)	0	0	2	1	25	25	50

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	The objective of this lab is to teach students, the knowledge of various flow meters and the concept of fluid mechanics.
CO2	This lab helps to gain knowledge on working of centrifugal pumps, positive displacement pumps,hydraulic turbin
CO3	Students will compare the performance of various machines at different operating points.

Sr. No.	List of Practical's
List of Experiments in Fluid Mechanics and Machinery:	
01	To verify Bernoulli's Theorem
02	To determine the critical velocity of flow by Reynolds's apparatus.
03	Performance characteristics of Pelton Turbine
04	Performance characteristics of Francis Turbine
05	Performance characteristics of Kaplan Turbine
06	To study the Centrifugal Pump
07	To study the Axial Flow Pump
08	To study the Reciprocating Pump

References:

1. Fluid Mechanics by Frank M. White

2. Fluid Mechanics & Fluid Power Engineering by D.S.Kumar

3. Lab Manual

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Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III	Avionics –I (BTAE 304T)	3	0	0	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is to :
1	Understand the fundamentals behind the principles of operation of the various types of Avionic Systems and technical terms associated with it.
2	Understand the mathematical tools required for the determination of the reliability of avionic systems and the performance of actuation systems.
3	Learn about principles Information, Modulation, Transmission, Propagation

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand about the principle of information's, various communication systems, problem of communicating
CO2	Understand about the Modulation: Amplitude, angle and phase modulations and examples of coding and decoding circuits.
CO3	Describe about the Transmission lines and their circuit representation, Frequency and time division multiplexing.
CO4	Understand about the Radiation: Principles and apply basic formulae.
CO5	Remember and understand about the Propagation, bandwidth requirements and Circuits : Circuits for communication transmitters and receivers, The Systems and Special Systems (Principles) : VHF, UHF, Fiber optics and Laser Technology

SYLLABUS	
Contents	**No of hours**
Unit I: PRINCIPLES Information: Communication systems: signals, analogue, digital and coded forms, time and frequency representation, signal spectra, types of distortion Information: Nature and measure, influence of bandwidth and signal/noise ratio on channel capacity, elements of Shannon's theorem and its implications. Problems of communicating in presence of noise.	8
Unit II: Modulation: Amplitude, angle and phase modulations, single and vestigial sideband forms, demodulation, Super-heterodyne principle, automatic gain and frequency control, typical circuit arrangements. Pulse modulation: sampling principles, sampling criterion, quantization and quantization noise, selection of number and distribution of quantization levels, bandwidth requirements, examples of coding and decoding circuits.	9

Unit III: Transmission: Transmission lines and their circuit representation, characteristic impedance, complex propagation constant, standing wave radio, matching and impedance charts. Channel Performance: Amplitude and phase distortion, phase and group delay distortion caused by multiple effects. Noise, origin, measurements, noise figure and noise temperature effect on channel performance. Frequency and time division multiplexing.	10
Unit IV : RADIO & TELEVISION ENGINEERING Radiation : Principles: application of basic formulae for unipole and dipole, aerials, effective height, directional, properties, gain, impedance, linear arrays, traveling wave aerials, rhombicas, parasitic elements. Television Waveforms: Scanning, interlacing, horizontal and vertical resolution, bandwidth requirements. Color television, principles, chrominance and luminance signals	8
Unit V: Propagation: Principles: influence of ionosphere and troposphere reflection from earth's surface, field strength calculations, fading diversity reception. Basic definitions of photometry and colorometry, trichromatic systems. Circuits: Circuits for communication transmitters and receivers, block diagrams and examples of typical circuits, television receivers, Camera and display tubes. Systems: Description of typical point-to-point and broadcast radio systems, choice of typical parameters (e.g. operating frequency, type of modulation, transmitter power level, bandwidth). Special Systems (Principles) : VHF, UHF, Fiber optics and Laser Technology, Satellite communication and related equipment, electronic counter measures, low-level TV and Head-down displays, CR T displays.	10

Total: 45 H rs

Text Books:

1. F E Terman, Radio Engineering, McGraw Hill

2. E C Jordon, Electromagnetic Waves and Radiating System, Prentice Hall

3.B P Lathi, Communications Systems, John Wiley and Sons

Reference Books:

1.Prasad, Antenna and Propagation

2.Schwattz Bennet MWR and Stein S, Communication Systems and Techniques, McGraw Hill, NY

3. Carlson A. N., Communication Systems - An Introduction to Signals and Noise in Electrical Communication, McGraw Hill, New York, 1968.

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Syllabus (Practical)

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
III	Computer Programming (BTAE 305P)	0	1	2	2	25	25	50

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Write and compile programs using C programs.
CO2	The objective of this lab is to teach students, how to write program for swapping of two variables, sum of all digit of a five digit number and whether the year is a leap year or not.
CO3	Program to print Armstrong number, finding the factorial of a number and finding the factorial of a number, prime number & odd number or even number.
CO4	To make the students to imbibe the knowledge to write the program for palindrome, biggest number.
CO5	To demonstrate the call by value and reference method.

Tutorials	
1	Programme for swapping of two variables without using third variable
2	Programme to calculate the sum of all digit of a five digit number
3	Programme to check whether the year is a leap year or not.
4	Programme for finding the factorial of a number, prime number & odd number or even number.
5	Programme to check whether the entered string of number is paleindrome or not.
6	Programme to calculate or demonstrate call by value & call by reference

Sr. No.	List of Practical's
01	Write a programme to perform swapping of two variables without using third variable.
02	Write a programme to calculate the sum of all digit of a five digit number.
03	Write a programme to check whether the year is a leap year or not.
04	Write a programme to print Armstrong number from 1to 500.
05	A menu programme for finding the factorial of a number, prime number & odd number or even number.
06	Write a programme to check whether the entered string of number is paleindrome or not.
07	Write a programme to find the biggest number of three numbers.
08	Write a programme to calculate or demonstrate call by value & call by reference

References:

1. The C Programming Language : Dennis Ritchie & Brain Kernighan [Pearson]
2.Programming with C : K.R.Venugopal & S.R.Prasad [TMH]
3. Let Us C : Yashwant Kanetkar [BPB]
4. Lab Manual

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Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III	Elements of Aeronautics (BTAE-306T)	3	0	0	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	This course will able the student to understand the basic concepts of aerospace engineering.
2	Able to understand the technical terms associated in aviation industries.
3	This course will make the students aware and imbibe knowledge of various types of airplane engines and its working.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand the basic concepts of aerospace engineering, historical revolution, early airplanes, biplanes and monoplanes.
CO2	Able to understand the evolution in the field of aerodynamics, materials, structures and propulsion over the years.
CO3	Explain about the major components of an airplane and their functions, Different types of flight vehicles, classifications, flight instruments for flying, different types of air breathing and non airbreathing engines, their comparative merits demerits..
CO4	Understand the physical properties and structure of the atmosphere, Temperature, pressure and altitude relationships, Evolution of lift, drag and moment.
CO5	Understand different types of fuselage structures, wing structure and will able to get the knowledge of various Metallic and non-metallic materials, Use of aluminium alloy, titanium, stainless steel and composite materials.

SYLLABUS	
Contents	**No of hours**
Unit I: Introduction To introduce the basic concepts of aerospace engineering early airplanes, biplanes and monoplane	7
Unit II : Development Developments in aerodynamics, materials, structures and propulsion over the years.	8
Unit III : Aircraft Configurations and Power Plants Used In Airplanes Components of an airplane and their functions, Different types of flight vehicles, classifications. Conventional control, Powered control, Basic instruments for flying, Typical systems for control actuation.	10

Basic ideas about piston, turboprop and jet engines, Use of propeller and jets for thrust production. Comparative merits, Principles of operation of rocket, types of rockets and typical applications.	
Unit IV : Introduction to Principles of Flight Physical properties and structure of the atmosphere, Temperature, pressure and altitude relationships, Evolution of lift, drag and moment. Aerofoil's, Mach number, Maneuvers.	10
Unit V : Introduction to Airplane Structures ,Materials used in Airplanes General types of construction, Monocoque, semi-monocoque construction, Typical wing and fuselage structure. Metallic and non-metallic materials, Use of aluminium alloy, titanium, stainless steel and composite materials. General types of construction, Monocoque, semi-monocoque construction, Typical wing and fuselage structure. Metallic and non-metallic materials, Use of aluminium alloy, titanium, stainless steel and composite materials,	10

Total: 45 Hours

References:

Text Books Recommended:

1. Anderson, J.D., "Introduction to Flight", McGraw-Hill, 1995.

Reference Books Recommended:

1. Kermode, A.C., "Flight without Formulae", McGraw-Hill, 1997.

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Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III	Aerodynamics-I (BTAE 307T)	3	0	0	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	To impart knowledge of basics of air flow
2	To provide details regarding the flow over aerofoil and wings
3	To impart knowledge of forces and moments over an aerofoil and characteristics of lift and drag forces
4	To impart knowledge of shock waves and boundary layer problems.

Course Outcomes

After successful completion of this course the student will be able to:

CO1	Able to apply the knowledge in order to measure the lift and drag characteristics of an aerodynamic body
CO2	Able to apply the knowledge of potential flow theory in order to measure the lift and drag characteristics
CO3	Able to design and measure the lift and drag characteristics of an aerofoil.
CO4	Able to determine the flow characteristics in a variable are duct and the flow across a shock wave, flow characteristics across a shock wave.
CO5	Able to solve the boundary layer problems.

SYLLABUS

Contents	No o hours
Unit I: Introduction To understand the behavior of airflow over bodies with particular emphasis on airfoil sections in the incompressible flow regimes. Characteristics Parameters For Airfoil And Wing Aerodynamics, Characterizations of Aerodynamic Forces and Moments, Airfoil Geometry Parameters, Wing Geometry Parameters, Aerodynamic Force and Moment Coefficients, Wings of Finite Spans.	6
Unit II: Two Dimensional Flows Basic flows – Source, Sink, Free and Forced vortex, uniform parallel flow. Their combinations, Pressure and velocity distributions on bodies with and without circulation in ideal and real fluid flows. Kutta Joukowski's theorem.	8
Unit III: Incompressible Flows Around Airfoils General Comments, Circulation and the Generation of Lift, General Thin- Airfoil Theory, Thin, Flat Plate Airfoil (Symmetric Airfoil),Thin, Cambered Airfoil, High-Lift Airfoil Sections, Multi element Airfoil Sections for Generating High Lift, High-Lift Military Airfoils.	11

Unit IV: Compressible Flow Thermodynamic Concepts, Adiabatic Flow in a Variable Area Stream tube, Isentropic Flow in a Variable area stream tube, Characteristic equations and Prandtl- Meyer Flow, Shock Waves. Stagnation properties, speed of sound wave. Mach number, one dimensional isentropic flow, Stagnation properties, isentropic flow through convergent - divergent nozzles. Normal shock.	6
Unit V: Introduction To Boundary Layer Theory Concepts of laminar and turbulent boundary layer. Momentum integral equation. Approximate methods for solution of boundary later for simple cases.	7

Total: 45 Hours

Text Books:

1. Anderson, J.D., "Fundamentals of Aerodynamics", McGraw-Hill Book Co., New York, 1985.

Reference Books:

1. Houghton, E.L., and Carruthers, N.B., "Aerodynamics for Engineering students", Edward Arnold Publishers Ltd., London, 1989.
2. Milne Thomson, L.H., "Theoretical aerodynamics", Macmillan, 1985.
3. Clancy, L.J., "Aerodynamics", Pitman, 1986

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Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III	Essence of Indian Traditional Knowledge (BTAE308T)	2	0	0	Audit	Grades: (O, A, B, C)			-

Sr. No.	Course Objective The objective of this course is–
1	Students will have increased ability to understand the importance and application of: Indian Knowledge system and its scientific approach, Indian philosophical tradition, Indian artistic tradition, Traditional knowledge and protecti of nature.
2	The legality and its importance for the protection of Indian traditional knowledge.
3	The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care system

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	To understand Indian Knowledge system and its scientific approach
CO2	To understand Indian philosophical tradition
CO3	To understand Indian artistic tradition
CO4	To understand Traditional knowledge and protection of nature, importance for the protection of Indian traditional knowledge.
CO5	To obtain Knowledge about the Legal Framework and TK

SYLLABUS	
Contents	**No of hours**
Unit I: Basic Structure of Indian Traditional Knowledge Vedas, Upavedas, Vedang, Upadang, scientific approach.	6
Unit II : Ecology and Indian Traditional Knowledge Meaning, role, Case studies.	7
Unit III : Intellectual Property Rights and Indian traditional Knowledge Meaning, role in protection of Indian traditional knowledge, case studies.	7

Unit IV : Indian Philosophical traditions and Indian Artistic Traditions Nyay, Sankaya, Yog, Mimansa, Jainism, Buddhism, Sikhism, and other approaches, Chitrakala, Murtikala, Vastukala, Sangeet, Sthpatya, NrityaevamSahitya, case studies,	10
Unit V : Legal Framework and TK The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); B: The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indicators act 2003. ,	10

Total: 40 Hours

Text Books:

1. RR Gaur, Rajeev Sangal, GP Bagaria, Human Values and Professional Ethics (Excel Books, New Delhi, 2010)

Reference Books:

1.V. Sivaramakrishanan (ed.), Cultural Heritage of India – Course material, Bharatiya Vidya Bhavan, th Mumbai, 5 Edition, 2014

2. Swami Jitatmanand, Modern Physics and Vedant, BharatiyaVidyaBhavan

3. Swami Jitatmanand, Holistic Science and Vedant, BharatiyaVidyaBhavan

4. S.C. Chatterjee and D.M. Datta, An introduction to Indian Philosophy, University of Calcutta, 1984

5. Pramod Chandra, Indian Arts, Howard University Press, 1984

6. Krishna Chaitanya, Arts of India, Abhinav Publications, 1987.

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Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
IV	Manufacturing Process –I (BTAE 401T)	3	0	0	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	The main objective of this course is to emphasize the importance manufacturing sciences in the day-to-day life, and to study the basic manufacturing processes and tools used. The course is delineated particularly to understand th conventional manufacturing processes like casting, forming, joining.
2	To provide knowledge regarding the methods of joining, powder metallurgy process and plastics processing.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	The students will able to understand the basic concepts of Casting Process, types of Patterns, moulding process and various moulding machines
CO2	The students will able to understand the concepts of gating design process, various types of Melting furnaces and special casting processes.
CO3	The students will able to explain about the mechanics of forming processes, forging process, extrusion & wire drawing processes.
CO4	The students will able to illustrate the various kinds of metal joining processes, weldability of metals, defects & inspection of welding.
CO5	The students will able to demonstrate different types of powder metallurgy processes, sintered carbide cutting tools and types of composite materials and its applications, To explain different types of processing of plastics methods use for processing of plastic materials.

SYLLABUS	
Contents	**No of hours**
Unit I: Casting Process Introduction. Pattern making: - Types, materials used, Type of Pattern, allowances, colour codes. Core making: - Types of core, Core materials & its properties. Moulding: - Types of sand moulds, moulding sand composition, moulding sand properties, moulding machines	9

Unit II: Gating design Type of gating systems, pouring time, riser design (Analytical treatment) Melting furnaces: - Types, Electric furnace, Induction furnace, Cupola - construction & operation. Cleaning, inspection & casting defects. Special casting processes such as investment casting, centrifugal casting, shell moulding, Slush casting, Die casting	10
Unit III: Mechanics of forming processes Rolling - rolling pressure & roll separation force, driving force & torque, power loss in bearing. Forging - forging forces & stresses, equipment (Hammer / Press), capacity required. Extrusion & Wire Drawing.	8
Unit IV : Joining Processes Introduction to Welding, Soldering, Brazing Processes. Types of Welding, Arc Welding & Gas Welding Processes, Joints, Electrodes, Weldability of Metals, Defects & Inspection of Welding, Welding equipments of Fixtures. Soldering, Brazing Processes	8
Unit V: Powder Metallurgy and Processing of Plastics Powder manufacturing & conditioning, Fabrication methods, Production of Sintered Structural Components. Self-lubricating bearing, Cemented Carbides, Ceramics, Sintered Carbide cutting tools Composite Materials: - Classification, Different types of composite materials and its applications,Thermoplastic, Thermosetting plastics, General properties & applications of Thermosetting & Thermoplastics. Extrusion, Injection Moulding, Compression Moulding, Transfer Moulding, Blow Moulding, Calendering, Wire Drawing, Embossing	10

Total: 45 Hours

Text Books:

1. Manufacturing Science by Ghosh & Mallik, Affiliate East –West Press – Pvt Ltd.
2. Manufacturing Engineering & technology 4th Edn by S. Kalpakjian & SR Schmid, Addison Wesley Longman Pvt.Ltd.
3. Production Technology 8th Edn by R.K.Jain, Khanna Publication , New Delhi

Reference Books:

1. WorkShop Technology, Vol. I - III by WAJ Chapman.
2. Manufacturing Processes by M. Begman
3. Processes & Materials of Manufacture by R. Lindberg.
4. Work Shop Technology (Volume - I & II) by Bawa
5. Work Shop Technology (Volume - I & II) by B. S. Raghuvanshi

RTM Nagpur University

Syllabus (Practical)

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
IV	Manufacturing Process Lab. (BTAE 401P)	0	0	2	1	25	25	50

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	To provide an understanding about the cupola furnance working and construction, moulding techniques and casting process.
CO2	To be able to understand the pattern making, various joining processes and forming process.
CO3	To be able to understand the drawing process.
CO4	To impart knowledge in detail about the pattern making process.
CO5	To impart knowledge in detail about the process of casting and welding

Sr. No.	List of Practical's
Minimum Eight out of the following shall be performed:	
01	Study of Cupola Furnace.
02	Study of Moulding Techniques.
03	Study of Casting Process.
04	Study of Pattern Making.
05	Study of Joining Processes.
06	Study of Forming Processes.
07	Study of Drawing Processes.
08	One Job – Pattern Making.
09	One Job – Casting.
10	One Job – Welding.

References:

1. Work Shop Technology, Vol. I - III by WAJ Chapman.
2. Manufacturing Processes by M. Begman
3.Processes & Materials of Manufacture by R. Lindberg.

4. Work Shop Technology (Volume - I & II) by Bawa
5. Work Shop Technology (Volume - I & II) by B. S. Raghuvanshi

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Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
IV	Aircraft Structure- I (BTAE 402T)	3	1	0	4	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	To provide an understanding the concepts of stress and strain, Shear force and Bending moment
2	To provide knowledge regarding the methods of determining the deflections of beams and Torsion of shaft
3	To impart basic knowledge about strain energy, columns and Principle stresses and strains.

Course Outcomes

After successful completion of this course the student will be able :

CO1	To understand the concept of stresses & strains, Torsion of circular shafts and Thin cylinders and spherical shells subjected to internal pressure.
CO2	To understand and analyze the Shear force & bending moment, Pure bending, deflection of beams and Shear stresses in beams concept.
CO3	To be able to understand and apply the Strain energy & impact loading and Statically indeterminate beams and frames.
CO4	To establish relations for Principal stresses & strains and analyze member's subjected to different types of stresses simultaneously. And understand the Buckling of columns.
CO5	To analyze the derivation of maximum, minimum principle stresses & maximum shear stress induced in shaft when it is subjected to bending moment, torque & axial load.

SYLLABUS

Contents	No of hours
Unit I: Concept of simple stresses & strains Concept of stresses & strains: - Introduction, stress, strain, types of stresses, stress-strain diagram for brittle & ductile material, elastic limit, Hooks law, 2-D and 3-D state of stress, Airy's stress function, Equilibrium and compatibility equations of stressed body. Torsion of circular shafts: -Torsion, shear stress induced in the shaft. Strength & rigidity criterion for design of shaft. Torque transmitted by solid & hollow circular shaft. Thin cylinders and spherical shells subjected to internal pressure.	10
Unit II: Shear force & bending moment Shear force & bending moment: - Types of beams,Types of loads, Shear force & bending moment diagrams for different types of beams subjected to different types of loads, Relation between load, shear force & bending moment. Stresses in beams: - Pure bending, theory of simple bending with assumptions & expressions for bending stress, Bending stresses in symmetrical sections. Deflection of beams: - Derivation of differential equation of elastic curve with the assumptions made in it.Relation	10

between slope, deflection & radius of curvature. Macaulay's method, Area moment method. Shear stresses in beams: - Concept, derivation of shear stress distribution formula, shear stress distribution diagram for common sections, maximum & average shear stress.	
Unit III: Strain energy & Impact loading Strain energy & impact loading: - Definition of strain energy stored in a body when it is subjected to gradually applied load, suddenly applied loads & impact loads. Strain energy under uniaxial tension and compression, bending and torsion. Castigliano's theorem. Statically Indeterminate beams and frames, Clapeyron's three moment equation method, Moment distribution method.	8
Unit IV: Principal Stresses & Strains, Buckling of Columns. Principal stresses & strains :- Definition of principal planes & principal stresses, analytical method of determining stresses on oblique section, Mohr's circle for representation of stresses. Derivation of maximum & minimum principle stresses & maximum shear stresses (i.e. combined stress). Buckling of columns with various end conditions, column curves, Columns with initial curvature, with eccentric loading, South well plot, and short column formulae like Rankine's Johnsons, etc. Energy methods. Beam Column.	10
Unit V : Application Derivation of maximum, minimum principle stresses & maximum shear stress induced in shaft when it is subjected to bending moment, torque & axial load. Theories of failure, modes of failure, compound stresses, eccentric axial loading, variable stresses in machine parts, stress concentration & stress raisers, notch sensitivity, stress concentration factor, methods for reducing stress concentration factor, Factor of safety.	7

Total: 45 Hours

Text Books:

1. Strength of Material by S. Ramamurtham.
2. Strength of Material by R. K. Rajput
3. Strength of Material by F. L. Singer
4. Mechanics of Material by Beer & Johnson
5. Timoshenko, S., "Strength of Materials", Vols, I and II, Princeton D.Von Nostrand Co., 1988.
6. Donaldson, B.K., "Analysis of Aircraft Structures - An Introduction", McGraw Hill, 1993.

Reference Books:

1. Strength of materials by Timoshenks
2. Machine Design by Black & Adam
3. Machine Design by J. E. Shigley

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Syllabus (Practical)

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
IV	Aircraft Structures - I (BTAE 402P)	0	0	2	1	25	25	50

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	To demonstrate to the students about various strain measuring instruments mechanical, electrical types
CO2	To perform the tensile test, hardness test, torsion test, impact test on different metals.
CO3	To perform the deflection test, deflection of spring and Absorption Test.

Sr. No.	List of Practical's
01	Study of strain measuring instruments mechanical, electrical types.
02	Tension test on metals
03	Hardness test on metals.
04	Torsion test on metals
05	Impact test metals
06	Transverse test on beams including deflections
07	Notch Bar Test for toughness of metals.
08	Measurement of static strains using electrical resistance gauges
09	Verification of S.T. in beams.
10	Deflection of springs.
11	Aircraft structure material: Absorption Test, Dimension Test, Crushing strength

References:

1. Strength of Material by S. Ramamurtham
2. Strength of Material by R. K. Rajput
3. Lab Manual

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Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
IV	Aerodynamics-II (BTAE-403T)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objective The objective of this course is–
1	To explain advanced concepts of Aerodynamics.
2	To explain experimental set ups, measurement techniques and visualization techniques used in aerodynamics.

Course Outcomes

After successful completion of this course the student will be:

CO1	Able to explain the formation of wing tip vortex and will able to measure the lift and induced drag characteristic using momentum theory.
CO2	Able to apply the knowledge of lifting line theory in order to measure the induced drag characteristics
CO3	Able to measure the drag and moment characteristics of complete airplane using different theories.
CO4	Able to understand and estimate the lift and drag characteristics over an airfoil section at supersonic speed.
CO5	Able to explain the classification, construction and working of a wind tunnel will its application in Aerospace industry and the instrumentation part along with flow visualization techniques used in Wind tunnel.

SYLLABUS

Contents	No of hours
Unit I Description of flow past a wing - Streamline pattern, formation of tip vortices - Down wash - Induced angle of attack and induced drag - Momentum theory of wing for lift and induced drag - Schrenk's method of estimation of wing characteristics from airfoil data.	8
Unit II Representation of lifting effect of wing by vortex lines - Lifting line theory - Formulation of governing integro - Differential equation - Method of solution by Fourier series - Effect of Individual terms of the series (first 3 terms) - Effect of taper twist and sweep back - Influence of flaps on wing lift distribution.	9
Unit III Extended lifting theory - Low aspect ratio wings - Jones theory - Winglets and strakes - Flow past slender bodies of revolution - Lift, drag and moment characteristics of complete airplane. Shoc.k expansion method for flow over airfoils - small perturbation equation for compressible flow - Glauret and Geothert's rules - Ackert's supersonic airfoil theory.	10

Unit IV Three dimensional thin wings in supersonic flows - Perturbation potential - Non-lifting wings - Lifting wings of simple plan form - Conical flows - Numercial integration procedures - Drag at supersonic speeds - Supersonic area rule.	8
Unit V Principles of model testing - Types of subsonic wind tunnels - Balances and measurements - Interference effects - transonic, Supersonic and hypersonic wind tunnels and characteristic features, their operation and performance - Shock tubes and shock tunnels. Free flight testing - Measurements of pressure, velocity and Mach number - Flow visualization methods of subsonic and supersonic flows.	10

Total: 45 Hours

Text Books:

1.Clancy J., " Aerodynamics ", Pitman, 1986.
2.Houghton And Caruther, " Aerodynamics for engineering students ", Edward Arnold Publishers, London, 1989.
3.Anderson J.D., " Fundamental of Aerodynamics ", McGraw Hill Book Co., New York, 1985.

Reference Books:

1.Allen Pope, " Low Speed Wind Tunnel Testing ", Vol. I - John Wiley & Sons Inc., New York, 1966.
2.Allen Pope, " High Speed Wind Tunnel Testing ", Vol. II - John Wiley & Sons Inc., New York, 1966.
3.Mccornick. W., "Aerodynamics, Aeronautics and Flight Mechanics ", John Wiley, New York, 1979.

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Syllabus (Practical)

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
IV	Aerodynamics (BTAE 403P)	0	0	2	1	25	25	50

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	To provide an understanding about various graphs, forces over cambered and un-cambered aerofoils.
CO2	To provide an understanding about the forces over flat plate
CO3	To provide an understanding about the pressure distribution on symmetrical, unsymmetrical aerofoil, flat plate and cylindrical body.

Sr. No.	List of Practical's
Based on above syllabus minimum eight practical's to be performed	
01	To draw the graph for different velocities verses manometer deflection.
02	Analysis of forces (Lift & Drag) over symmetrical airfoil.
03	Analysis of forces (Lift & Drag) over cambered/unsymmetrical airfoil
04	Analysis of forces (Lift & Drag) over flat plate.
05	To draw graph of pressure distribution on a symmetrical airfoil.
06	To draw graph of pressure distribution on an unsymmetrical airfoil.
07	To draw graph of pressure distribution on flat plate.
08	To draw graph of pressure distribution on a circular cylinder
09	To visualize the flow patterns over the surface of different model
10	To study the side force in yawing motion of an aircraft.
11	To study the boundary layer concept over the various models.

References:

1. Anderson, J.D., "Fundamentals of Aerodynamics", McGraw-Hill Book Co., New York, 1985
2. Lab Manual

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Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
IV	Propulsion- I (BTAE-404T)	3	1	0	4	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	To familiarize with Principles of Propulsion systems
2	To introduce working principles of Compressors and turbines
3	To familiarize with the concept of Matching of compressors and turbines and Off design performance

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Will able to explain about different types of jet engine, there working principal and performance characteristics, apply basic concept of gas turbine cycle on jet engine and thrust augmentation methods
CO2	Will able to explain about different types of inlets (mainly subsonic and supersonic), internal and external flow in terms of boundary layer separation and stall condition, diffuser performance and shock swallowing by area variation
CO3	Will be able to explain about various type of combustion chamber used in gas turbine cycle, and the factor affecting to design and performance parameters of combustion chamber, they can also able to apply the fundamental knowledge on different types flaming technique used in combustion chamber
CO4	At the compilation of Unit IV students will able to explain about various types of compressor and turbine, their performance parameters, their efficiency and component characteristics, the basic operating principle of convergent and divergent nozzles, the choking condition in nozzles, the various types of CD nozzles and thrust reversal methods.
CO5	Finally at compilation of Unit V student will able to explain about basic working principal of gas turbine components like: inlet, compressor, combustion chamber, turbine and nozzle, and able to apply fundamental concept on numerical technique.

SYLLABUS	
Contents	**No of hours**
Unit I: Fundamentals of Gas Turbine Engines Illustration of working of gas turbine engine - The thrust equation - Factors affecting thrust – Effect of pressure, velocity and temperature changes of air entering compressor - Methods of thrust augmentation - Characteristics of turboprop, turbofan and turbojet - Performance characteristics.	9
Unit II: Subsonic and Supersonic Inlets for Jet Engines Internal flow and Stall in Subsonic inlets - Boundary layer separation - Major features of external flow near a subsonic inlet - Relation between minimum area ratio and eternal deceleration ratio. Inlet Diffuser performance - Supersonic inlets - Starting problem in supersonic inlets – Shock swallowing by area variation – External deceleration - Modes of inlet operation.	10

Unit III: Combustion Chambers Classification of combustion chambers - Important factors affecting combustion chamber design – Combustion process - Combustion chamber performance - effect of operating variables on performance - Flame tube cooling - Flame stabilization - Use of flame holders - Numerical problems.	8
Unit IV : Compressors , Turbines and Nozzles Description Classification, type, performance parameters – efficiency, component characteristics , Theory of flow in isentropic nozzles - Convergent nozzles and nozzle choking - Nozzle throat conditions - Nozzle efficiency - Losses in nozzles - Over expanded and under-expanded nozzles - Ejector and variable area nozzles - Interaction of nozzle flow with adjacent surfaces – Thrust reversal.	11
Unit V: Matching of Gas Turbine Components Inlet, compressor, combustion chamber, turbine, and nozzle. Numerical problems.	7

Total: 45 Hours

Text Books:

1. V. Ganesan, "Gas-turbines" , Tata McGraw-Hill Education, 2010.
2. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. " Gas Turbine Theory ", Longman, 1989.
3. Mathur, M.L., and Sharma, R.P.,"Gas Turbine", "Jet and Rocket Propulsion", Standard Publishers and Distributors, Delhi, 1988.

Reference Books:

1.Hill, P.G & Peterson, GR. "Mechanics of Thermodynamics of Propulsion" Addison – Wesley Longman JNC, 1999.
2. Oates, G.C. "Aerothermodynamics of Aircraft Engine Components ", AIAA Education Series, New York, 1985.

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Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
IV	Aircraft Flight Mechanics (BTAE-405T)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objective The objective of this course is–
1	To make students familiar of ISA along with various similarity laws for models and prototypes applicable during flight conditions.
2	To make students aware of Airplane performance analysis in steady and accelerated situations.
3	To make students aware of general airplane stability and control with specific application to longitudinal stability and control.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand and apply the dimensional analysis, similarity laws and model laws with ISA for aircraft in various operating conditions.
CO2	Understand and analyze the general Forces and moment distribution of aircraft for different, flight conditions.
CO3	Analyze the performance of aircraft under steady straight level, Flight conditions.
CO4	Analyze the performance of aircraft during climbing, gliding, turning and other maneuvers.
CO5	Understand the establishment of aircraft stability criteria and co-relate various stability aspects with aircraft control. Further analyze the longitudinal stability and control aspect due to aircraft components including fuselage-engine nacelle and control surface effectiveness.

SYLLABUS

Contents	No of hours
Unit I Introduction and background. Dimensional analysis, Buckingham Pi theorem-applications-similarity laws and models, International Standard Atmosphere.	8
Unit II Forces and moments acting on a flight vehicle - Equation of motion of a rigid flight vehicle - Different types of drag - Drag Polar of vehicles from low speed to high speeds - Variation of thrust, power and SFC with velocity and altitudes for air breathing engines and rockets - Power available and power required curves.	8
Unit III Performance of airplane in level flight - Maximum speed in level flight - Conditions for minimum drag and power required - Range and endurance, Climbing flight (Maximum rate of climb and steepest angle of climb,) Service and absolute ceiling.	9

Unit IV Gliding flight (minimum rate of sink and shallowest angle of glide) Turning performance (Turning rate turn radius). Bank angle and load factor, take-off and landing performance - Limitations of pull up and push over.	10
Unit V Static and dynamic stability - Purpose of controls in airplanes -Inherently stable and marginal stable airplanes – Static, Longitudinal stability - Stick fixed stability - Basic equilibrium equation - Stability criterion. Effects of fuselage and nacelle - Influence of CG location - Power effects - Stick fixed neutral point - Stick free stability-Hinge moment coefficient - Stick free neutral points-Symmetric maneuvers - Stick force gradients - Stick _ force per 'g' - Aerodynamic balancing. Determination of neutral points and maneuver points from flight test.	10

Total: 45 Hours

Text Books:

1. Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley & Son:, Inc, New York, 1988.
2. J.D.Anderson, "Aircraft Performance & Design", McGraw-Hill Education, 1999.

Reference Books:

1. Etkin, B., "Dynamics of Flight Stability and Control", Edn. 2, John Wiley, New York, 1982.
2. Babister, A.W., "Aircraft Dynamic Stability and Re¬sponse", Pergamon Press, Oxford, 1980.
3. Nelson, R.C. "Flight Stability and Automatic Control", McGraw-Hill Book Co., 1998

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Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		College Assessment	University Examination	Total	
IV	Professional Ethics (BTAE-406T)	2	0	0	2	15	35	50	2

Sr. No.	Course Objective The objective of this course is–
1	To develop human values and ethical standards.

Course Outcomes

After successful completion of this course the student will be able to:

CO1	An understanding of business ethics, levels, myths, use and train oneself to be ethical.
CO2	Knowledge on Ethical principles, reasoning, roles & responsibilities.
CO3	An understanding of stake holder theory, Individual and corporate responsibilities towards stake holders.
CO4	Understanding on Corporate responsibilities towards Product Safety & Reliability and environment friendly approach.
CO5	Understanding between the Employee & Corporate on responsibilities on aspects of contracts, equal opportunity , Affirmative action, sexual harassment etc.,

SYLLABUS

Contents	No of hours
Unit I HUMAN VALUES: Definition of ethics-Morals values and ethics – integrity-Work ethics- Service learning-Civic virtue- Respect for others-Caring-Sharing-Honesty-Courage-Valuing time-Cooperation-Commitment- Empathy-Self-confidence-Character-Spirituality-Introduction to Yoga and meditation for professional excellence and stress management. Suggested Reading: Case study of Discovery failure	5
Unit II ENGINEERING ETHICS: Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories. Suggested Reading: Study the Bhopal gas tragedy	7
Unit III SAFETY, RESPONSIBILITIES AND RIGHTS: Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights –	7

Employee Rights – Intellectual Property Rights (IPR) – Discrimination. Suggested Reading: Chernobyl explosion, Nuclear and thermal power plant issues	
UNIT IV LIFE SKILLS: Definition, Relevance, Types of values, changing concepts of values-aims and values of value education- basic etiquette-morals and values in life-dealing with people. Personal values – Self – Strengths (self-confidence, self-assessment, self-reliance, self-discipline, determination, self- restraint, contentment, humility, sympathy and compassion, gratitude, forgiveness) Weaknesses.	6
UNIT V EMPLOYER & CORPORATE ON RESPONSIBILITIES : Influences - Peer pressure, familial and societal expectations, media.	5

Total: 30 Hours

Text Books:

1. Subramanian R., Professional ethics, Oxford University press

Reference Books:

1. Megan J. Murphy (Editor), Lorna Hecker (Editor), Ethics and Professional Issues in Couple and Family Therapy
2. Andrew Belsey (Editor), Ruth Chadwick (Editor), Ethical Issues in Journalism and the Media (Professional Ethics)
3. Warwick Fox (Editor), Ethics and the Built Environment (Professional Ethics)
4. RuchikaNath, Value Education, APH Publishing Corporation, New Delhi, 2012 5 Manoharan P.K., Education and Personality Development, APH Publishing Corporation, New Delhi, 2012

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Syllabus (Practical)

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
IV	Mini Project –I : {Internship/Case Study} (BTAE 407P)	0	0	4	2	25	25	50

Course Outcomes	
After successful completion of this course the student will be able :	
CO1	To create an Industrial environment and culture within the institution.
CO2	To understand production lab, utilizing the infrastructure of the institution.
CO3	To standardize laboratories to industrial standard, thereby giving exposure to industrial housekeeping standards.
CO4	To provide students hands on experience on, troubleshooting, maintenance, fabrication, innovation, record keeping, documentation etc., thereby enhancing the skill and competency part of technical education.

Sr. No.	List of Practical's
The mini project-I can be organized based on the recommendations and evaluation criteria listed below.	
01	Standardization of Laboratories: This phase of the mini project can be clubbed with laboratory hours of the semester. Before the commencement of cycle of experiments for the semester, the students should be given instructions on 5S method of industrial housekeeping. Video resources available in the internet can be utilized for the purpose. After the initial summarizing, students should be grouped into batches of 5 and should be entrusted with activities of implementing or maintaining 5S standardization of the laboratory. This ensures that all experiments of the laboratory are performed as per industrial standard. To elaborate the concept of standardization let us consider a typical case of machine shop. The case can suitably be adopted for any departments as standardization concept is the same for all industry, whether it is manufacturing, service or hospitality.
02	Case study: Standardization of laboratory of Aeronautical engineering Department.
03	Phase-I of the mini project carries 30% of the total marks. The evaluation should be made as group performance in implementing the standardization and individual contribution in setting work place clean and tidy. Evaluations by way of surprise visits made by the Head of Department and Guide during laboratory hours at least twice the semester contribute to the part of total marks.

References:

Innovative ideas of commercial values should be encouraged to be continued as project for the forth coming semester.

1. Evaluation Standardization (30%), Group (15%) and Individual (15%).
2. Problem identification and solving (50%) or collaborative work (50%) or involvement in production center (50%).
3. Documentation (20%).

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Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks		Exam Duration (Hrs.)
		L	T	P		College Assessment	Total	
IV	**Environmental Studies (BTAE-408T)**	2	0	0	0	Grades: (O, A, B, C)		2

Sr. No.	Course Objective **The objective of this course is–**
1	This course provides an integrated and interdisciplinary approach to the study of environment and solutions to environmental problems. This course will spread awareness among the student s about environmental issues and all alert them to find solutions for sustainable development.
2	Knowledge of key factors of environment; awareness of interconnectedness of multiple factors in environmental challenges.
3	Attitude building for motivating to protect environment; contribution to analysis, innovation and entrepreneurships via development and realisation of sustainable products, systems and solutions.
4	A clear idea of the interdisciplinary nature of environment and health risk assessment

Course Outcomes

After successful completion of this course the student will be able to:

CO1	To understand relationship and interactions between organisms and the environment.
CO2	To acquire a knowledge of importance of natural resources and their sustainable uses.
CO3	To understand the delicate ecological balances in nature and role of Biodiversity.
CO4	To recognize the sources and impacts of various pollutions on human health and environment.
CO5	To, recognize and able to apply methodological approaches of the social sciences, natural sciences, and humanities

SYLLABUS

Contents	No of hours
Unit I: Introduction Definition, scope and importance; Need for public awareness -Institutions in environment, people in environment. Natural Resources: Renewable and non-renewable and associated problems; Role of an individual in conservation of natural resources; equitable use of resources for sustainable lifestyles.	5
Unit II: Ecosystems Concept of an ecosystem - understanding ecosystems, ecosystem degradation, resource utilization, Structure and functions of an ecosystem- producers, consumers) and decomposers. Energy flow in the ecosystem - water, carbon, oxygen, nitrogen; and energy cycles, integration of cycles in nature.	6

Ecological succession; Food chains, food webs and ecological pyramids; Ecosystem types - characteristic features, structure:, and functions of forest, grassland, desert and aquatic ecosystems	
Unit III: Biodiversity Introduction – Biodiversity at genetic, species and ecosystem levels Bio-geographic classification of India Value of biodiversity - Consumptive use value, productive use .value, social, ethical, moral, aesthetic and optional value of biodiversity. India as a mega-diversity nation; hotspots of biodiversity Threats to bio-diversity - habitat loss, poaching of wildlife, man-wild life conflicts. Common endangered and endemic plant and animal species of India. In-situ and Ex-situ conservation of biodiversity.	7
Unit IV : Pollution Definition; Causes, effects and control measures of air, water, soil, marine, noise and thermal pollutions and nuclear hazards. Solid waste management - Causes, effects and control measures of urban and industrial waste. Role of individual and institutions in prevention of pollution. Disaster management Floods, Earth quacks, Cyclone and land-slides.	5
Unit V: Social Issues and the Environment: Unsustainable to sustainable development; Urban problems, related to energy; Water conservation, rainwater harvesting, watershed management; Problems and concerns of resettlement and rehabilitation of affected people. Environmental ethics - issues and possible solutions – Resource consumption patterns and need for equitable utilization; Equity disparity in Western and Eastern countries; Urban and rural equity issues; need for gender-equity. Preserving Resources for future generations. The rights of animals; Ethical basis of environment education and awareness; Conservation ethics and traditional value systems of India. Climate change, global warming, acid-, rain, Ozone layer depletion, nuclear accidents and holocausts. Wasteland Reclamation; Consumerism and Waste products. Environment legislations - The Environment (protection) Act; The water (Prevention and Control of Pollution) Act; The. Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislations - environment impact assessment (EIA), Citizens action sand action groups. Public awareness — Using an environmental calendar of activities, self-initiation.	7

Total: 30 Hours

GUIDELINES FOR EVALUATION OF ENVIRONMENTAL STUDIES
SUBJECT (As per Ordinance No. 2 of 2012):
At the end of the course, the student shall be evaluated for 100 marks with distribution as below:
Field note book - 25 Marks
Objective Questions - 50 Marks (50 questions, each of one mark)
Essay type question - 25 Marks
[illegible]sing marks - 40 Marks

OR

In view of the above entire course the students in terms of batches of 20 students each may be assigned a project work encompassing People's Bio-diversity Register (PBR) of any Gram Panchayat as per the format of Bio-diversity Authority of India under the guidance of a teacher. The PBR should be evaluated for 100 marks.
The result shall be declared in grades as follows:
Grade O: above 75 Marks;
Grade A: 61–75 Marks;
Grade B: 51-60 Marks;
Grade C: 40-50 Marks

Text Books:

1. A Text Book of Environmental Studies for Undergraduate Courses, Erach Bharucha, University Press (India) Pvt. Ltd., Hyderabad

RTM Nagpur University
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
V	Propulsion - II (BTAE 501T)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objective
1	Students will understand the theory of non-Air-breathing and hypersonic propulsion methods, so that they get familiar with various propulsion technologies associated with space launch vehicles, missiles and space probes.
2	To get familiarity in rocket propulsion systems and gain knowledge about the advanced propulsion technique used for interplanetary mission.

Course Outcomes

After successful completion :

CO1	Students will able to explain about working principal and performance characteristics of Ramjet engine in terms of their subcritical, critical and supercritical operation and the combustion process in Ramjet engine, they can also able to apply the same on numerical concept, students will be also able to explain about working principal and performance characteristics of scramjet engine and hypersonic propulsion.
CO2	Students will be able to illustrate about the basic operating principal of rocket propulsion, Rocket nozzle classification, Rocket performance considerations and they able to apply the same of numerical concept.
CO3	Students will able to describe about the solid propellant, Selection criteria of solid propellants, Important hardware components of solid rockets and Propellant grain design considerations.
CO4	Students will be able to understand liquid propellant, Thrust control in liquid rockets, Cooling in liquid rockets, Limitations of hybrid rockets, Relative advantages of liquid rockets over solid rockets and must be able to apply the same on numerical problems.
CO5	Students will able to explain advanced propulsion technique like. Electric rocket propulsion, Ion propulsion techniques, Nuclear rocket, Types, Solar sail, Preliminary Concepts in nozzle less propulsion and their operating principal etc.

SYLLABUS	
Contents	**No. of Hours**
UNIT I: RAMJET PROPULSION Operating principle - Subcritical, critical and supercritical operation - Combustion in ramjet engine. Ramjet performance - Sample ramjet design calculations. Scramjet and Hypersonic Propulsion.	8
UNIT II: FUNDAMENTALS OF ROCKET PROPULSION Operating principle - Specific impulse of a rocket - internal ballistics - Rocket nozzle classification – Rocket performance considerations - Numerical problems.	10
UNIT III: SOLID PROPELLENTS Solid propellant rockets - Selection criteria of solid propellants - Important hardware components of solid rockets - Propellant grain design considerations.	8
UNIT IV: LIQUID PROPELLANT Selection of liquid propellants – Thrust control in liquid rockets - Cooling in liquid rockets - Limitations of hybrid rockets - Relative advantages of liquid rockets over solid rockets - Numerical problems.	10
UNIT V: ADVANCED PROPULSION TECHNIQUES Electric rocket propulsion - Ion propulsion techniques - Nuclear rocket - Types -Solar sail - Preliminary Concepts in nozzle less propulsion.	9

Total: 45 Hours

Text Books:

1. Sutton, G. P. & Oscar Bilbraz, "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 7th Edition, 2004.
2. Gorden, C. V., "Aerothermodynamics of Gas Turbine and Rocket Propulsion ", AIAA Education Series, New York, 1986.

Reference Books:

1. Mukunda H. S. "Understanding Aerospace chemical propulsion", Interline publications, 2004.
2. Mechanics and Thermodynamics of Propulsion 2nd Edition by Philip Hill and Carl Peterson.

RTM Nagpur University

Syllabus (Practical)

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
V	Propulsion – II Lab (BTAE 501P)	0	0	2	1	25	25	50

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand various propulsion systems with classification.
CO2	Understanding of the characteristics of the several types of propulsion systems.

Minimum Eight out of the following shall be performed:

Sr. No.	List of Practical's
01	Experiment on Subsonic free wall jet apparatus.
02	Experiment on Subsonic forced wall jet apparatus.
03	Study on Supersonic free jet apparatus.
04	Experiment on Propeller performance test apparatus.
05	Study of aircraft engine models.
06	Study/Experiment on Cascade Test setup.
07	Experiment on free convective heat transfer test setup.
08	Experiment on forced convective heat transfer test setup.
09	Study of aircraft's magneto ignition system.
10	Study of gas turbine engine's combustion characteristics.

References:

1. "Gas Turbines", by Ganesan V, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2nd Edition, (1999).
2. Mathur, M. L., and Sharma, R. P., Gas Turbine, Jet and Rocket Propulsion, Standard Publishers and Distributors, Delhi, 2014.

RTM Nagpur University
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
V	Aircraft System & Instrumentation (BTAE502T)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objectives
1	To impart students in depth understanding of various airplane control/operation systems.
2	To illustrate students operational and maintenance requirements of various airplane control/operation systems.

Course Outcomes

After successful completion of this course:

CO1	Students will be able to understand airplane control systems
CO2	Students will be able to describe aircraft hydraulic systems
CO3	Students will be able to describe aircraft pneumatic & hybrid systems
CO4	Students will be able to understand and illustrate different Engine Systems
CO5	Students will be able to understand and explain auxiliary system of the aircraft

SYLLABUS

Contents	No. of Hours
UNIT I: AIRPLANE CONTROL SYSTEMS Conventional Systems - Power assisted and fully powered flight controls - Power actuated systems– Engine control systems - Push pull rod system, flexible push pull rod system Modern control systems - Digital fly by wire systems - Auto pilot system active control Technology, Communication and Navigation systems Instrument landing systems, VOR - CCV case studies.	10

UNIT II: AIRCRAFT HYDRAULIC AND PNEUMATIC SYSTEMS Hydraulic systems - Study of typical workable system - components - Hydraulic system controllers - Modes of operation. Pneumatic systems - Advantages - Working principles, Typical Air pressure system – Brake system - Typical Pneumatic power system - Components, Landing Gear systems - Classification – Shock absorbers Retraction mechanism	10
UNIT III: ENGINE SYSTEMS Fuel systems for Piston and jet engines, - Components of multi engines. Lubricating systems for piston and jet engines - Starting and Ignition systems - Typical examples for piston and jet engines.	8
UNIT IV: AUXILIARY SYSTEM Basic Air cycle systems - Vapor Cycle systems, Boost-Strap air cycle system - Evaporative vapor cycle systems - Evaporative air cycle systems - Oxygen systems - Fire protection systems, Deicing and anti-icing systems.	8
UNIT V: AIRCRAFT INSTRUMENTS Flight Instruments and Navigation 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.	9

Total: 45 Hours

Text Books:

1. McKinley, J.L., and Bent, R.D., "Aircraft Maintenance & Repair", McGraw-Hill, 1993.
2. "General Hand Books of Airframe and Power plant Mechanics", U.S. Dept. of Transportation, Federal Aviation Administation, The English Book Store, New Delhi1995.

Reference Books:

1. Mekinley, J.L. and Bent, R.D., "Aircraft Power Plants", McGraw-Hill, 1993.
2. Pallet, E.H.J., "Aircraft Instruments & Principles", Pitman & Co., 1993.
3. Treager, S.,"Gas Turbine Technology", McGraw-Hill, 1997.

RTM Nagpur University
Syllabus (Practical)

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
V	Aircraft Systems & Instrumentation Lab (BTAE-502P)	0	0	2	1	25	25	50

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Know wood crafting and the technology of new materials
CO2	Understand the various procedures of aircraft ground handling
CO3	Knowledge of various procedures related to pressure, temperature tests.
CO4	Get some exposure on Aerospace and related industries.

Minimum Eight out of the following shall be performed:

Sr. No.	List of Practical's
01	Study/Experiment on aircraft "Jacking Up" procedure
02	Study/Experiment on aircraft "Leveling" procedure
03	Study/Experiment on aircraft "Rigging check" procedure
04	Study/Experiment on aircraft "Symmetry Check" procedure
05	"Flow Test" to assess of filter element clogging
06	"Pressure Test" to assess hydraulic External/Internal Leakage
07	"Functional Test" to adjust operating pressure
08	"Pressure Test" procedure on fuel system components
09	"Brake Torque Load Test" on wheel brake units
10	Maintenance and rectification of snags in hydraulic and fuel systems.

Text Books:

1. McKinley, J. L., and Bent, R.D., "Aircraft Maintenance & Repair", McGraw-Hill, 1993.
2. "General Hand Books of Airframe and Power plant Mechanics", U.S. Dept. of Transportation, Federal Aviation Administration, The English Book Store, New Delhi1995.

Reference Books:

1. Pallet, E.H.J., "Aircraft Instruments & Principles", Pitman & Co., 1993.

RTM Nagpur University
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
V	Aircraft Structure-II (BTAE503T)	3	1	0	4	30	70	100	3 Hours

Sr. No.	Course Objective
1	To impart students in depth understanding of various airplane structural aspects.
2	To illustrate students constructive, operational and design requirements of various airplane structural components.

Course Outcomes

After successful completion of this course:

CO1	Students will be able to understand Unsymmetrical Bending
CO2	Students will be able to describe and analyze Shear Flow in Open Sections.
CO3	Students will be able to describe and analyze Shear Flow in Closed Sections.
CO4	Students will be able to understand different types of buckling of plates.
CO5	Students will be able to explain Stress analysis of Wing and Fuselage.

SYLLABUS

Contents	No. of Hours
UNIT I: UNSYMMETRICAL BENDING Theory of Basic Elasticity, Review of bending of symmetrical sections, Stresses in beams of Un-symmetric sections.	8
UNIT II: SHEAR FLOW IN OPEN SECTIONS General stress, strain and displacement relationships for open and single cell closed section thin-walled beams. Thin walled beams, Concept of shear flow, Shear Centre, Elastic axis.	8
UNIT III: SHEAR FLOW IN CLOSED SECTIONS Membrane Analogy, Bredt - Batho formula, Single and multi-cell structures. Shear flow in single and Multi-Cell structures under torsion. Shear flow in single and Multi-Cell under bending with walls effective and ineffective.	10
UNIT IV: BUCKLING OF PLATES Rectangular sheets under compression, Local buckling stress of thin walled sections, Crippling stresses by Needham's and Gerard's methods, Thin walled column strength. Sheet stiffener panels. Effective width, Inter rivet and sheet wrinkling failures.	9

UNIT V: STRESS ANALYSIS OF WING AND FUSELAGE	
Procedure - 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).	10

Total: 45 Hours

Text Books:

1. Megson, New edition T.M.G., "Aircraft Structures for Engineering Students", Edward Arnold, 1985.
2. Bruhn. E.H, "Analysis and Design of Flight vehicles Structures", Tri-state off set company, USA, 1965.
3. L.S.Shrinath, "Advanced Mechanics of Solids", McGraw-Hill 2017.

Reference Books:

1. Peery, D.J., and Azar, J.J, "Aircraft Structures ", 2nd edition, Mcgraw-Hill, N.Y., 1993.
2. Rivello, R.M., "Theory and Analysis of Flight Structures ", McGraw Hill, 1993.

RTM Nagpur University
Syllabus (Practical)

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
V	Aircraft Structure – II Lab (BTAE-503P)	0	0	2	1	25	25	50

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Know unsymmetrical bending for different section.
CO2	Understand the various procedures of determining Shear Centre location.
CO3	Knowledge of various procedures related to flexibility matrix for Beams.
CO4	Get some exposure on determination of resonance frequency of Beams.

Minimum Eight out of the following shall be performed:

Sr. No.	List of Practical's
01	Verification of Maxwell's Reciprocal theorem & principle of superposition
02	Determination of Unsymmetrical bending for different sections using bend test set up.
03	Determination of Shear Centre location for open sections
04	Determination of Shear Centre location for closed sections
05	Experiment on Constant strength beam
06	Demonstration of flexibility matrix for cantilever beam
07	Testing of Beam with combined loading
08	Determination of resonance frequency of Beams using free vibrations
09	Determination of resonance frequency of Beams using forced vibrations
10	Column testing and South-well plot.

References:

1. Standard Lab Manual.
2. Peery, D.J., and Azar, J.J, "Aircraft Structures ", 2nd edition, Megraw-Hill, N.Y., 1993.
3. L.S.Shrinath, "Advanced Mechanics of Solids", McGraw-Hill 2017.

Syllabus of Open Electives - I

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
V	Intellectual Property Right (BTAE504T(OE)-1)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objective
1	The objective of the course is to give an idea about IPR, registration and its enforcement.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand the concept and importance of organizational behavior
CO2	Acquire the knowledge of interpersonal behavior and transaction analysis
CO3	Know different traits and theories of personality
CO4	Acquire a know-how on entrepreneurship development and its ecosystem
CO5	Get the knowledge of various sources of finance

SYLLABUS	
Contents	No. of Hours
UNIT I: INTRODUCTION Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.	10
UNIT II: REGISTRATION OF IPRs Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad	8
UNIT III: AGREEMENTS AND LEGISLATIONS International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.	10

UNIT IV: DIGITAL PRODUCTS AND LAW Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.	10
UNIT V: ENFORCEMENT OF IPRs Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.	7

Total: 45 Hours

Text Books:

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India Pvt Ltd, 2012
2. S. V. Satakar, "Intellectual Property Rights and Copy Rights, Ess Publications, New Delhi, 2002

REFERENCES:

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli,"Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

RTM Nagpur University
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
V	Gender Sensitization (BTAE504T(OE)-2)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objective
1	The objective of the course is to create awareness among learners about the various essential aspects of gender sensitization.

Course Outcomes	
After successful completion of this course the student will be able:	
CO1	To develop students sensibility with regard to issues of gender in contemporary India.
CO2	To provide a critical perspective on the socialization of men and women.
CO3	To introduce students to information about some key biological aspects of genders.
CO4	To expose the students to debates on the politics and economics of work.
CO5	To help students reflect critically on gender violence and expose students to more egalitarian interactions between men and women.

SYLLABUS

Contents	No. of Hours
Unit-I: UNDERSTANDING GENDER: Gender: Why should we Study It? Socialization: Making Women, Making Men Introduction. Preparing for Womanhood. Growing up Male. First lessons in caste. Different Masculinities. Just Relationships: Doing together as equals Mary Kom and Onler. Love and acid just to do not Mix. Love Letters, mothers and fathers. Further Reading: Rosa Parks - The Brave Heart.	10
UNIT – II: GENDER AND BIOLOGY: Missing Women: Sex selection and consequences Declining sex ration. Demographic consequences. Gender Spectrum: Beyond the Binary Two or Many? Struggles with Discrimination. Additional Reading: Our Bodies, Our Health	8
UNIT – III: GENDER AND LABOUR: Housework: The Invisible Labour "My Mother doesn't Work "Share the Load." Women's work: Its Politics and Economics Fact and Fiction: Unrecognized and Unaccounted work. Further Reading: Wages and conditions of work.	8

UNIT – IV ISSUES OF VOILENCE: Sexual Harassment: Say No! Sexual Harassment, no Eve teasing-Coping with Everyday Harassment-Further Reading "Chupulu". Domestic Violence: Speaking out Is Home a Safe Place? – When Women unite [Film].Rebuilding Lives. Further Reading: New Forums for Justice. Thinking about Sexual Violence Blaming the Victim- "I Fought for my Life…." Further Reading: The Caste Face of Violence.	10
UNIT – V GENDER STUDIES: Knowledge: Through the Lens of Gender Point of View. Gender and the Structure of Knowledge. Further Reading: Unacknowledged Women Artists of Telangana. Who's History? Questions for Historians and Others Reclaiming a Past. Writing other Histories.	9

Total: 45 Hours

TEXT BOOKS:

1. "Towards a world of equals: A Bilingual Textbook on Gender" written by A. Suneetha et al.
2. Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubban-Penguin Books, 2012.

REFERENCES:

1. Sen Amartya "More than one Million Women are Missing" New York review of Books 37.20 (20th December 1990). Print "We Were Making History…" Life stories of Women in the Telangana People's struggle. New Delhi: Kail for Women, 1989.
2. Tripti Luhiri: By the Numbers. Where Indian Women's Work "Women's studies journal (14November 2012) .Available online at: http://blogs.wsj.com/ India real time/2012/11/14/by the numbers - where - Indian – Women- work.
3. K.Satyanarayana and Susie Tharu (Ed) Steel Nibs Are Sprouting: New Dalit Writing From South India, Dossier 2: Telugu And Kannad http://harpercollins.co.in/BookDetail.asp?Book Code=3732.
4. Vimala. "Vantillu (The Kitchen)". Women Writing in India: 600 BC to the Present. Volume II: The 20th Century. Ed, Susie Tharu and K.Lalita. Delhi: Oxford University Press, 1995, 599-601.
5. Shatrughna, Veena et al. Women's Work and its Impact on Child Health and Nutrition. Hyderabad, National Institute of Nutrition, Indian Council of Medical Research. 1993.
6. Stree Shakti Sanghatana. "We Were Making History …. 'Life Stories of Women in the Telangana People's Struggle. New Delhi: Kali for Women, 1989.
7. Jayaprabha, A. "Chupulu (Stares)". Women Writing in India: 600BC to the Present. Volume II: The 20th Century Ed, Susie Tharu and K. Lalita. Delhi: Oxford University Press, 1995. 596-597.

RTM Nagpur University
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
V	Organizational Behavior and Entrepreneurship Development (BTAE504T(OE)-3)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objective
1	The objective of the course is to create awareness among learners about the various essential aspects of organizational behavior and to impart know how on entrepreneurship development.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand the concept and importance of organizational behavior
CO2	Acquire the knowledge of interpersonal behavior and transaction analysis
CO3	Know different traits and theories of personality
CO4	Acquire a know-how on entrepreneurship development and its ecosystem
CO5	Get the knowledge of various sources of finance

SYLLABUS

Contents	No. of Hours
Unit I Introduction to organizational behavior. Concept of organization behaviour, Importance of organization behaviour, Key elements of organization behaviour, scope of organizational behaviour.	8
Unit II Introduction to interpersonal behavior. Nature and meaning of interpersonal behavior, concept of transaction analysis, benefits and uses of transaction analysis, Johari window model.	9
Unit III Introduction to personality Definition and meaning of personality, importance of personality, theories of personality, personality traits.	10
Unit IV Concept of Entrepreneurship Concept of entrepreneurship, characteristics of an Entrepreneur, types of Entrepreneurship, Functions of Entrepreneurs, factors affecting the growth of entrepreneurship, Women entrepreneurship in India, Problems and challenges of women entrepreneurs, Government's support system to develop women entrepreneurship.	9

Unit V Sources of Finance Sources of financing the enterprise, Concept of fixed and working capital, factors influencing the requirement of working capital, Concept of start-up and start-up echo system, Concept of product life cycle.	9

Total: 45 Hours

Text Books:

1. Organizational behaviour by M. N. Mishra, published by S. Chand.
2. The human side of organization by Michale Drafke, published by Pearson Education.
3. Management and Organizational behaviour by Laurie.J. Mullins, published by Pearson Education.
4. Organizational behaviour by K. Aaswathappa, Published by Himalaya publications.

Reference Books:

1. Entrepreneurial Development By, S. S. Khanka S. Chand & Co. Ltd. New Delhi, 1999.
2. Entrepreneurial Development. By, S. Anil Kumar. New Age International.
3. Small Scale Industries and Entrepreneurship. By, Dr. Vasant Desai, Himalaya Publication.
4. Management of Entrepreneurship. By, N.V.R. Naidu, I.K. International Pvt. Ltd.

RTM Nagpur University
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
V	Industrial Economics & Management (BTAE504T(OE)-4)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objective
1	This course is designed to familiarize the learners with important economic terminologies and key industrial concepts and to create awareness about functions of Industrial management and the concept of marketing and financial management.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand the concept of demand and supply and its relationship with the price
CO2	Relate various factors of production with reference to different economic sectors
CO3	Analyze the causes and effects of inflation and understand the market structure
CO4	Acquire knowledge of various functions of management and marketing management
CO5	Perceive the concept of financial management for the growth of business

SYLLABUS

Contents	No. of Hours
Unit I Industrial Economics: Law of demand, Demand analysis, Types of demand, Determinants of demand, Supply, Law of diminishing marginal utility, Elasticity of demand, Types of elasticity of demand.	8
Unit II Factors of production, Firm and Industry, Law of return, Cost concepts, Fixed variable, Average, Marginal and Total cost, Depreciation and methods for depreciation, direct and indirect taxes	9
Unit III Inflation, effect of inflation, Monetary and fiscal measures to control inflation, deflation, Market and market structures, Perfect competition, Monopoly, Monopolistic competition, Oligopoly, Concept & overview of share market, Effect of share market on economy, Share market terminologies	10
Unit IV Definition, nature and scope of management, functions of management, Meaning and concepts of Marketing management, Marketing Mix, Channels of distribution, Advertising and sales promotion.	9

Unit V Meaning, nature and scope of financial management, Brief outline of profit and loss account, balance sheet, Budgets and their importance, Types of budgets- Rigid and flexible budgets.	9

Total: 45 Hours

Text Books:

1. Modern Economics, H. L. Ahuja, S. Chand Publishers
2. Modern Economic Theory, K. K. Dewett., S. Chand Publishers
3. Engineering Economics, D. N. Dwivedi, A. Dwivedi, Vikas Publishing House

Reference Books:

1. Industrial Management I.K. Chopde, A. M. Sheikh
2. Business Organization and Management S. A. Sherlekar

Syllabus of Elective-I

RTM Nagpur University
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
V	Heat and Mass Transfer (BTAE505T(E)-1)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objectives
1	To impart students in depth understanding of heat transfer aspects.
2	To impart students in depth understanding of mass transfer aspects.
	Course Outcomes
After successful completion of this course:	
CO1	Students will be able to understand basic heat transfer modes and conduction.
CO2	Students will be able to describe and analyze Convection problems
CO3	Students will be able to describe and analyze radiative heat transfer problems.
CO4	Students will be able to understand different types of heat exchangers and aerodynamic heating.
CO5	Students will be able to explain basic concepts mass transfer.

SYLLABUS

Contents	No. of Hours
UNIT I: INTRODUCTION Basic modes of heat transfer, conduction, convection and radiation, Laws of heat transfer and conservation of energy requirement. Heat Conduction – One dimensional steady state heat conduction: Composite Medium – Critical thickness – Effect of variation of thermal Conductivity – Extended Surfaces – Unsteady state. Lumped System Analysis – Heat Transfer in Semi-infinite and infinite solids – Use of Transient – Temperature charts– Biot Number.	7
UNIT II: FREE & FORCED CONVECTION Free or natural convection, Grashoff number, Rayleigh number, Horizontal and vertical plate. Empirical co-relations for cylinders and spheres. Heat transfer with phase change, pool boiling curve & regimes of pool boiling. Film & Drop wise condensation, laminar film condensation on vertical surface, film condensation on horizontal tubes, effect of super-heated & non-condensable gasses on condensation heat transfer, Introduction to heat pipe. Physical significance of non-dimensional parameters. Flow of high moderate & low Prandtl number, fluid over flat surface. Concept of velocity & thermal boundary layer thickness, local and average heat transfer coefficients. Empirical co-relations for external, internal flow, laminar & turbulent flow through conduits.	10

UNIT III: RADIATIVE HEAT TRANSFER Radiation, nature of thermal radiation, black body radiation, radiation intensity, laws of radiation– Kirchoffs, Planks, Weins displacement, Stefan Boltzmann & Lamberts Co-sine law. Emissivity, Absorptivity, Transmissivity, Reflectivity, Radiosity, Emissive power, irradiation. Radiation network, radiation exchange between surfaces, idea of shape factor & reciprocity theorem, radiation between parallel plates, cylinder & spheres. Radiation shields, effect of radiation on temperature measurement.	9
UNIT IV: HEAT EXCHANGERS Classification, Overall heat transfer coefficient, fouling factor, LMTD method of heat exchange analysis for parallel, counter flow & cross flow arrangement. Effectiveness NTU method, heat exchanger analysis by NTU method, design aspects of heat exchangers. Introduction to compact heat exchanger. Heat Transfer problems in gas turbine combustion chambers – Rocket thrust chambers – Aerodynamic heating – Ablative heat transfer.	10
UNIT V: INTRODUCTION TO MASS TRANSFER Basic Concepts — Diffusion Mass Transfer — Fick's Law of Diffusion — Steady state Molecular Diffusion — Convective Mass Transfer — Momentum, Heat and Mass Transfer Analogy –Convective Mass Transfer Correlations.	9

Total: 45 Hours

Text Books:

1. Heat Transfer -A practical approach Yunus A. Cengel , "Tata Mcgraw Hill publication Second Edition
2. Heat and Mass Transfer (McGraw Hill) By P K Nag.
3. Elements of Heat and Mass Transfer, New Age International, 1 By Vijay Gupta.

Reference Books:

1. Introduction to heat Transfer Incropera. F.P.and Dewitt.D.P. , John Wiley and Sons – 2002.
2. Elements of Heat Transfer M. N. Ozisik
3. Heat Transfer J. P. Holman McGraw Hill Publication

RTM Nagpur University
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
V	Smart materials and Introduction to Composites (BTAE 505T(E) -2)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objectives
1	To understand the mechanical behavior of Smart materials use in aerospace sector.
2	To get an overview of the methods of manufacturing composite materials.

Course Outcomes

After successful completion of this course the student will be able to:

CO1	Understand the Aerospace Materials, Classification and their properties.
CO2	Understand the composites and manufacture of composite/Smart materials.
CO3	Describe the moulding techniques for manufacturing of composites.
CO4	Explain creep and design for creep resistance
CO5	Explain about various Super alloys and Other Materials use in aerospace sector

SYLLABUS

Contents	No. of Hours
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 & application of aluminium and its alloys. Titanium alloys, Special alloys for high temperature.	8
UNIT II: INTRODUCTION TO COMPOSITE MATERIALS Definition – Classification of Composite materials based on structure – based on matrix. Advantages of composites – application of composites – functional requirements of reinforcement and matrix. FIBERS: Preparation, properties and applications of glass fibers, carbon fibers, Kevlar fibers and metal fibers – properties and applications of whiskers, particle reinforcements.	10
UNIT III : MANUFACTURING OF ADVANCED COMPOSITES Polymer matrix composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing	10

UNIT IV : CREEP Factors influencing functional life of components at elevated temperatures, definition of creep curve, various stages of creep, metallurgical factors influencing various stages, effect of stress, temperature and strain rate. Design for Creep Resistance: Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monk man-Grant relationship.	8
UNIT V : SUPER ALLOYS AND OTHER MATERIALS Iron base, Nickel base and Cobalt base super alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, embrittlement, solidification of single crystals, Intermetallic, high temperature ceramics.	9

Total: 45 Hours

TEXT BOOKS

1. Material Science and Technology – Vol 13 – Composites by Cahn – VCH, West Germany Composite Materials – K. K. Chawla.
2. Calcote, L R. "The Analysis of laminated Composite Structures", Von – Noastrand Reinhold Company, New York 1998.
3. Jones, R.M., "Mechanics of Composite Materials", McGraw-Hill, Kogakusha Ltd., Tokyo, 1985.
4. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites", John Wiley and sons. Inc., New York, 1995.
5. Lubin, G., "Handbook on Advanced Plastics and Fibre Glass", Von Nostrand Reinhold Co., New York, 1989.
6. Aircraft Structures by THG Megson

REFERENCE BOOKS:

1. Raj. R., "Flow and Fracture at Elevated Temperatures", American Society for Metals, USA, 1985.
2. Hertzberg R. W., "Deformation and Fracture Mechanics of Engineering materials", 4th Edition, John Wiley, USA, 1996.
3. Courtney T.H, "Mechanical Behavior of Materials", McGraw-Hill, USA, 1990.
4. Boyle J.T, Spencer J, "Stress Analysis for Creep", Butterworths, UK, 1983.
5. Bressers. J., "Creep and Fatigue in High Temperature Alloys", Applied Science, 1981.
6. McLean D., "Directionally Solidified Materials for High Temperature Service", The Metals Society, USA, 1985.

RTM Nagpur University
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
V	Airworthiness & Certification BTAE 505T(E)-3	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objectives
1	Describe the legal basis which underpins airworthiness regulation in aircraft design, production, operation and maintenance.
2	Communicate the importance of airworthiness requirements as they relate to aircraft design, production, operation and maintenance.
3	Illustrate the issues to be faced in the certification of new systems and aircraft.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand Regulatory Frameworks. Interpret the principles of airworthiness as applied to the process of aircraft and engine certification.
CO2	Articulate the process for Continuing Airworthiness management for different types and sizes of operator.
CO3	Understand National and International Requirements for airworthiness.
CO4	Understand various approaches to the problems of assessing the safety of increasingly complex aircraft systems.
CO5	Evaluate and apply the technique(s) appropriate for the system and differentiate between the various stages of safety assessment in the development of the aircraft systems.

SYLLABUS

Contents	No. of Hours
UNIT I Regulatory Framework, CAR - 66 Certifying Staff - Maintenance, CAR-145 - Approved Maintenance Organizations. Introduction to Airworthiness: Air Law, Certification Process, including the safety assessment of aircraft systems, Airworthiness Lessons learned - Review of significant accidents.	8
UNIT II Aircraft Operations and Aircraft Certification : Maintenance and Operations Approvals, Continuing Airworthiness management, Engine certification, Application of Safety Management Systems in the field of airworthiness, Human Factors in maintenance, Incident reporting and Service Difficulty Reports (SDRs), Engine failure modes.	10

UNIT III CAR-M, Applicable National and International Requirements. Air traffic management safety culture, accidents and incidents investigations, human factors in training.	8
UNIT IV Safety Management System : Requirements for safety assessment as part of regulatory approval and continued airworthiness process, Development of requirements for safety assessment, FAR and EASA CS25-1309, Introduction to probability methods and safety analysis techniques, Fuel Tank Safety.	9
UNIT V Common mode failures Fault tree analysis, dependence diagrams and Boolean algebra for quantification of system reliability, Reliability analysis using Weibull distribution, Zonal safety analysis (ZSA) and Particular Risk Analysis (PRA), Failure Mode and Effect Analysis (FMEA). Typical safety assessment for a stall warning and identification system. Certification maintenance requirements, Current airworthiness challenges.	10

Total: 45 Hours

Text Books:

1. 'AIRWORTHINESS PROCEDURES MANUAL' Issue 2 Rev 24, December, 2019.
2. "Initial Airworthiness : Determining the Acceptability of New Airborne Systems" By Guy Gratton · 2018.

Reference Books:

1. Airworthiness: An Introduction to Aircraft Certification and Operations, Third Edition by 'Filippo De Florio'.
2. "Aircraft System Safety: Assessments for Initial Airworthiness Certification" Book by Duane Kritzinger.

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Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
V	Introduction to Helicopter Dynamics (BTAE 505T(E)-4)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objectives
1	Describe & comprehend the basic concepts of helicopter dynamics.
2	Acquire and Understand the knowledge of critical speed and rotor bearing system.
3	Understand the turbo-rotor system and blade vibration.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand the basics of helicopter.
CO2	Understand and illustrate the various hovering Theories.
CO3	Describe and Analyze Vertical Flight and Forward Flight of helicopters.
CO4	Understand the aspects of helicopter stability and control.
CO5	Understand the Standards and Specifications of helicopters for design variations in different applications.

SYLLABUS

Contents	No. of Hours
UNIT I Introduction: Historical Development of Helicopters, Helicopter Configuration, Control Requirements. Types of Rotor Systems, Basic Power Requirements.	8
UNIT II Introduction to Hovering Theory: Momentum Theory, Blade Element Theory, Combined Blade Element and Momentum theories, For non-uniform inflow calculation, Ideal Rotor Vs Optimum Rotor.	10
UNIT III Vertical Flight: Various flow states of Rotor, Autorotation in Vertical Descent, Ground Flight. Forward Flight: Momentum Theory, Variable Inflow Models, Blade Element Theory, Rotor Reference Planes. Hub Loads, Power variation with forward speed, Rotor Blade flapping Motion: Simple Model	8

UNIT IV Helicopter Stability and Control. Introductory concepts of stability. Forward speed disturbance, vertical speed disturbance, pitching angular velocity disturbance, side-slip disturbance, yawing disturbance. Static stability of Helicopters: longitudinal, lateral-directional and directional. Dynamic stability aspects. Main rotor and tail rotor control. Flight and Ground Handling Qualities-General requirements and definitions. Control characteristics. Levels of handling qualities. Flight Testing- General handing flight test requirements and, basis of limitations.	9
UNIT V Standards and Specifications: Scope of requirements. General and operational requirements. Military derivatives of civil rotorcraft. Structural strength and design for operation on specified surfaces. Rotorcraft vibration classification. Conceptual Design of Helicopters: Overall design requirements. Design of main rotors-rotor diameter, tip speed, rotor solidity, blade twist and airfoil selection. Fuselage design, Empennage design, Design of tail rotors, High speed rotorcraft.	10

Total: 45 Hours

Text Books:

1. 'Principles of Helicopter Aerodynamics', J. Gordon Leishman, Cambridge University Press, 2002
2. 'Dynamics of Helicopter Flight', George H. Saunders, John Wiley & Sons, Inc, NY, 1975

Reference Books:

1. Helicopter Dynamics', ARS Bramwell, George Done, and David Balmford, Butterworth-Heinemann Publication, 2nd Edition, 2001.
2. 'Basic Helicopter Aerodynamics', John, M. Seddon and Simon Newman, Wiley.2011

RTM Nagpur University
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks		Exam Duration (Hrs.)
		L	T	P		College Assessment	Total	
V	Introduction to Aero - Modeling (BTAE506T)	2	0	0	0	Grades: (O, A, B, C)		2

Sr. No.	Course Objectives
1	Apply their Engineering knowledge of all the fundamental, Core subjects & the Hardware and Software skills in the development (design, fabrication, analysis, testing and flying) of Aero models (UAV & DRONES).
2	Knowledge of key factors of environment; awareness of interconnectedness of multiple factors in environmental challenges.
3	Attitude building for motivating students for the aeromodelling.

Course Outcomes

After successful completion of this course the student will be able to:

CO1	To understand the basics of aero modelling and types of aero models
CO2	To acquire knowledge of various types of materials and tools require for aero modelling
CO3	To understand about the fixed wing aero models
CO4	To understand about the design and making of quadcopter
CO5	To apply their knowledge for designing and fabrication of a prototype

SYLLABUS

Contents	No. of Hours
Unit I: Introduction to Aero modeling, Basics of aircraft theory, components of an aircraft, history of aero modeling, Classification of aero models.	4
Unit II: Materials and tools used in aero modeling, Balsa, Styrofoam, wood, parchment, composites based model making, static model, powered model. Gliders: chuck glider, towline glider. Power plants used in aero models	5
Unit III: Introduction to fixed wing aero models , classification, electronic components of RC planes	5
Unit IV: Introduction to Quad/Hexa-copter, introduction to components of quadcopter, electronic component of quadcopter, quadcopter assembly.	5
Unit V: Design and fabrication of a particular prototype aero model.	5

Total: 24 Hours

GUIDELINES FOR EVALUATION

At the end of the course, the student shall be evaluated for 100 marks with distribution as below:
Model Report- 25 Marks
Objective Questions - 50 Marks (50 questions, each of one mark)
Model presentation- 25 Marks
Passing marks - 40 Marks

OR

In view of the above entire course the students in terms of batches of 10 students each may be assigned a Aero modelling work (designing, fabrication, report preparation) under the guidance of a teacher.

The result shall be declared in grades as follows:
Grade O: above 75 Marks;
Grade A: 61–75 Marks;
Grade B: 51-60 Marks;
Grade C: 40-50 Marks

Text Books:

1. RC advisor's Model Airplane Design Made Easy: The Simple Guide to Designing R/C Model Aircraft or Build Your Own Radio Control Flying Model Plane
2. The Basics of Aeromodelling by Vic Smeed, published by Nexus Special Interests 1995 1st Edition 67pp.

Reference Books:

1. Flight Mechanics Modeling and Analysis By Jitendra R. Raol, Jatinder Singh
2. Structural Design Optimization, Affiliated East-West Press Ltd., New Delhi, 1997, by G. R. Iyengar and S K Gupta.

RTM Nagpur University
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
VI	Aircraft Design (BTAE-601T)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objectives
1	To impart thorough understanding of conceptual, preliminary & detail design phases of aircrafts.
2	To familiarize students with analytical skill in various aircraft components design.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Explain and illustrate the airplane design process including conceptual, preliminary & detail design phases
CO2	Describe the principal features and various considerations for aircraft design
CO3	Analyze the weight estimation of an aircraft
CO4	Describe and illustrate wing designing parameters
CO5	Describe and illustrate fuselage designing parameters

SYLLABUS	
Contents	**No. of Hours**
Unit I Airplane design process – conceptual, preliminary & detail design phases, Classification of airplanes based on purpose and configuration, Factors affecting configuration, Merits of different airplane layouts	8
Unit II Shaping the Airplane: Principal features, Aerodynamic consideration, Lift, Drag and Interference effects, Weights and Strength considerations, Peculiarities in layout, Designing for manufacturability, Maintenance, Operational costs, Interactive design.	9
Unit III Conceptual Design Procedure: Data collection and 3-View drawings, their purpose, initial sizing - weight estimation, choice of wing loading and thrust loading, rubber engine sizing, fixed engine sizing. Constraint analysis. Power plant selection - Choices available, Comparative merits, Location of power plants, Functions dictating the locations.	9

Unit IV Design of Major Airplane Components – I Wing design: Airworthiness requirements, V-n diagram, loads, Elements of wing design, Structural features	9
Unit V Design of Major Airplane Components – II Fuselage design: Loads on fuselage, Elements of fuselage design, Determination of tail surface areas, Structural features and Landing gear design: Loads or Landing gear, Preliminary landing gear design.	10

Total: 45 Hours

Text Books:

1. Bruhn E F, Design and Analysis of Flight Vehicle Structures, Tri-state Offset Press.
2. Kuechemann, D., "Aerodynamic Design of Aircraft", Pergamon Press,1978

Reference Books:

1. Torenbeek, E., "Synthesis of Subsonic Airplane Design", Delft University Press, U.K.1986.
2. Raymer, D.P., "Aircraft Conceptual Design", AIAA Series, 1989s.

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Syllabus (Practical)

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
VI	Aircraft Design Laboratory (BTAE-601P)	0	0	2	1	25	25	50

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Describe about the aircraft design process.
CO2	Understand and able explain to about technical aspects of an aircraft

Sr. No.	List of Practical's
01	Study of different types of airplanes
02	Comparative graphs preparation and selection of main parameters for the design
03	Technical specifications of selected aircraft
04	Preliminary weight estimation of a selected aircraft
05	Design calculation to find wing loading and Thrust/Power loading
06	Selection of Power plant, type of wing and tail configuration
07	Preparation of mission profile of the selected aircraft
08	Design of wing and fuselage components
09	Preparation of 3View drawings of a selected aircraft
10	Preparation of a detailed design report with CAD drawings

References:

1. Kuechemann, D., "Aerodynamic Design of Aircraft", Pergamon Press, 1978.
2.Raymer, D.P., "Aircraft Conceptual Design", AIAA Series, 1989s

RTM Nagpur University
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
VI	Space Technology (BTAE-602T)	3	1	-	4	30	70	100	3

Sr. No.	Course Objectives
1	Knowing about our solar system and coordinate systems.
2	List out and explaining the various body problems in orbital system.
3	Operate and locate satellite injection in orbit by several methods.
4	Discussion on Interplanetary Trajectories, Ballistic Missile Trajectories and materials for Spacecraft.

Course Outcomes

After successful completion of this course the student will be able to:

CO1	Understand about basic concept of Solar System.
CO2	Outline the various aspects of orbital mechanics including N-Body Problems.
CO3	Explain the satellite injection and satellite general perturbations theory.
CO4	Understand about basic concept of interplanetary trajectories.
CO5	Outline about missile trajectories.

SYLLABUS

Contents	No. of Hours
Unit I BASIC CONCEPTS: The solar system - Reference frames and coordinate systems - The celestial sphere - The ecliptic - Motion of vernal equinox - Sidereal time - Solar time - Standard time - The earth's atmosphere.	8
Unit II THE GENERAL N-BODY PROBLEM: The Many body problems - Lagrange - Jacobi identity - The circular restricted three body problem – Libration points - Relative Motion in the N-body problem - The two - body problem - Satellite orbits - Relations between position and time - Orbital elements.	10
Unit III SATELLITE INJECTION AND SATELLITE ORBIT PERTURBATIONS: General aspects of satellite injections - Satellite orbit transfer - Various cases - Orbit deviations due to injection errors - Special and general perturbations - Cowell's Method - Encke's method – Method of variations of orbital elements - General perturbations approach.	10

Unit IV INTERPLANETARY TRAJECTORIES: Two dimensional interplanetary trajectories - Fast interplanetary trajectories - Three dimensional interplanetary trajectories - Launch of interplanetary spacecraft - Trajectory about the target plant.	8
Unit V BALLISTIC MISSILE TRAJECTORIES: The boost phase - The ballistic phase - Trajectory geometry - Optimal flights - Time of flight - Reentry phase - The position of the impact point - Influence coefficients. Space environment - Peculiarities - Effect of space environment on the selection of materials of spacecraft.	9

Total: 45 Hours

Text Books :

1. Sutton, G. P. & Oscar Bilbraz, "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 7th Edition, 2004.
2. Foundations of Space Dynamics, Wiley, Hoboken, N.J., U.S.A., 2021, by A. Tewari.

Reference Books:

1. Van de Kamp, P., "Elements of Astromechanic", Pitman, 1979.
2. Cornelisse, J. W., "Rocket propulsion and space dynamics", W. H. Freeman & Co., 1984.
3. Parker, E. R., "Materials for Missiles and Spacecraft", McGraw Hill Book Co., Inc., 1982.
4. Wiesel, W. E., "Spaceflight Dynamics", 2nd Edition, McGraw Hill, 1997.
5. Thompson, W. T., "Introduction to Space Dynamics", Dover, New York, 1986.

Syllabus of Open Electives - II

RTM Nagpur University
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
VI	Design of Machine Elements (BTAE603T(OE)-1)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objective
1	To study the basic principles of mechanical components design based on strength and rigidity using design data, various standards, codes, etc. and prepare component drawings.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Apply principals of static loading for design of Cotter joint, Knuckle joint
CO2	Design bolted, welded joints, power screws & pressure vessels
CO3	Design the power transmission shaft & coupling
CO4	Design components subjected to fatigue or fluctuating stresses. Also, will be able to apply principles for determining bending stresses for design of curved beams e.g. crane hook, C-Frame.
CO5	Design clutches, brakes and springs

SYLLABUS

Contents	No. of Hours
Unit I Mechanical Engineering Design, Design methods, Aesthetic and Ergonomics consideration in design, Material properties and their uses in design, Manufacturing consideration in design, Design consideration of casting and forging, Basic principle of Machine Design, Modes of failures, Factor of safety, Design stresses, Theories of failures (Selection in the process of designing), Standards, I.S. Codes, Preferred Series and Numbers Design of Joints against static loads: Cotter joint and Knuckle joint	9
Unit II Design of bolted and welded joints under axial and eccentric loading conditions. Design of power screw: Thread forms, multiple threaded screws, terminology of power screw, design of screw jack. Design of Cylinder & Pressure Vessels: Types of pressure vessel, stresses induced in pressure vessel, Lame's, Clavarino's and Bernie's equations. Design of cylindrical & spherical pressure vessels. Design of nut, bolt, gasket & covers for pressure vessel.	9

Unit III **Design of shaft** for power transmission, static and fatigue criteria for shaft design, ASME codes for shaft design, Design of keys. Design of rigid and flexible coupling.	9
Unit IV: **Design against fluctuating loads:** variables stresses, reversed, repeated, fluctuating stresses. Fatigue failure: static and fatigue stress concentration factors, Endurance limit- estimation of endurance limit, Design for finite and infinite life, Soderberg and Goodman design criteria, Fatigue design under combined stresses. **Curved Beams:** Assumptions made in the analysis of curved beams, Design of curved beams, bending stresses in curved beams, such as crane hook, C-frame, etc.	9
Unit V: **Design of clutches and brakes:** Single and multiple plate clutch, constant wear and constant pressure theory for plate clutches, Internal and external shoe brakes and band brakes. Introduction to disc brakes and its design concepts. **Design of Springs**: Spring material, Helical compression & tension springs under static and variable loads, Leaf spring, Laminated Springs.	9

Total: 45 Hours

Text Books:

1. Design of Machine Elements, B.D. Shiwalkar. Central Techno publications
2. Design of Machine Elements, V. B. Bhandari., McGraw Hill education.
3. Design of Machine Elements, Sharma & Purohit, PHI.
4. Design Data book, B.D. Shiwalkar, Central Techno publications.
5. Mechanical Engg. Design, Shigley J E, TMH.
6. Design Data Book, PSG.

Reference Books:

1. Mechanical Design Analysis, M. F. Spotts, Prentice-Hall.
2. Machine Component Design, Robert C. Juvinall, Kurt M. Marshele, Wiley.
3. Machine Design, Maleev& Hartman, CBS publishers.
4. Hand book of Machine Design, Shigley&Mischke, McGraw Hill.
5. Machine Design, Robert L.Norton, Pearson.

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Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
VI	Finance and Accounting (BTAE603T(OE)-2)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objective
1	The objective of this paper is to help students to acquire conceptual knowledge of the financial accounting and to impart skills for recording various kinds of business transactions.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand the basic aspects of accounting principles and standards.
CO2	Explain the various types of accounting transactions.
CO3	Understand and illustrate basics of Capital and Revenue.
CO4	Understand the various aspects of Depreciation and Reserves.
CO5	Illustrate the basics of Company Accounts and Stock Trading.

SYLLABUS

Contents	No. of Hours
Unit I: Meaning and Scope of Accounting: Need, development, and definition of accounting; Bookkeeping and accounting; Persons interested in accounting: Disclosures; Branches of accounting; Objectives of accounting. Accounting Principles: International Accounting Standards (only outlines); Accounting principles; Accounting Standards in India.	10
Unit II: Accounting transactions: Accounting Cycle; Journal; Rules of debit and credit; Compound journal entry; Opening entry; Relationships between Journal and Ledger; Rules regarding posting; Trial balance; Subdivisions of a journal.	9
Unit III: Capital and Revenue: Classification of income; Classification of expenditure; Classification of receipts Accounting concepts of income; Accounting concepts and income measurement; Expired costs and income measurement Final Accounts; Manufacturing account; Trading account; Profit and loss account; Balance Sheet; Adjustment entries, Rectification of errors; Classification of errors; Location of errors; Suspense accounts; Effects on profit.	10

Unit IV: Depreciation Provisions and Reserves: Concept of depreciation; Causes of depreciation; Depreciation, depletion, amortization, and dilapidation; Depreciation accounting; Methods of recording depreciation; Methods for providing depreciation; Depreciation of different assets; Depreciation of replacement cost; Depreciation accounting as per accounting standard; Depreciation accounting; Provisions and reserves	8
Unit V: Introduction to Company Accounts: Introduction, Kinds of Companies, Formation of Companies, Share Capital, Issue of Shares, Under Subscription & Oversubscription, Issue of Shares at Premium & Discount, Buyback of Shares and Treasury Stock, Accounting Treatments and Ledger Preparation. Company Accounts: Introduction, Forfeiture of Shares, Reissue of Shares, Issue of Bonus Shares, Rights Issue, Share Split, Buy Back of Shares, Redemption of Preference Shares, Debentures	9

Total: 45 Hours

Text Books:

1. Lal, Jawahar and Seema Srivastava, Financial Accounting, Himalaya Publishing House.
2. Monga, J.R., Financial Accounting: Concepts and Applications, Mayoor Paper Backs, New Delhi.
3. Shukla, M.C., T.S. Grewal and S.C.Gupta. Advanced Accounts. Vol.-I. S. Chand & Co., New Delhi.

References Books:

1. S. N. Maheshwari, Financial Accounting, Vikas Publication, New Delhi.
2. T.S, Grewal, Introduction to Accounting, S. Chand and Co., New Delhi
3. P.C. Tulsian, Financial Accounting, Tata McGraw Hill, New Delhi.
4. Bhushan Kumar Goyal and HN Tiwari, Financial Accounting, Vikas Publishing House, New Delhi.

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Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
VI	Renewable Energy Sources (BTAE603T(OE)-3)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objectives
1	Understanding basic characteristics of renewable sources of energy and technologies for their utilization.
2	To give review on utilization trends of renewable sources of energy.
3	To give review on legislative and regulatory rules related to utilization of renewable sources of energy.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Define basic properties of different renewable sources of energy and technologies for their utilization.
CO2	Describe main elements of technical systems designed for utilization of renewable sources of energy e.g. Solar energy.
CO3	To provide importance of Wind Energy.
CO4	To get the utilization of Biomass as a renewable source.
CO5	Describe about ocean and geothermal energy as a renewable source.

SYLLABUS

Contents	No. of Hours
Unit I INTRODUCTION: Energy demand growth and supply: Historical Perspectives; Fossil fuels: Consumption and Reserve; Environmental Impacts of Burning of Fossil fuels; Sustainable Development and Role of Renewable Energy.	8
Unit II SOLAR ENERGY BASICS: Solar geometry; Primary and Secondary Solar energy and Utilization of Solar Energy. Characteristic advantages and disadvantages. Low temperature applications: solar water heating, space heating, drying. SOLAR THERMAL ELECTRICITY GENERATION: Solar concentrators and tracking; Dish and Parabolic trough concentrating generating systems, Central tower solar thermal power plants; Solar Ponds.	10

Unit III WIND Energy Systems: Types of turbines, Coefficient of Power, Betz limit, Wind electric generators, Power curve; wind characteristics and site selection; Windfarms for bulk power supply to grid; Potential of wind electricity generation in India and its current growth rate.	10
Unit IV BIOMASS ENERGY: Biomass: Sources and Characteristics; Wet biogas plants; Biomass gasifiers: Classification and Operating characteristics; Updraft and Downdraft gasifiers; Gasifier based electricity generating systems; Maintenance of gasifiers.	8
Unit V OCEAN ENERGY: Tidal power plants: single basin and two basis plants, Variation in generation level; Ocean Thermal Electricity Conversion (OTEC); Electricity generation from Waves: Shoreline and Floating wave systems. GEOTHERMAL ENERGY: Geothermal sites in India; High temperature and Low temperature sites; Conversion technologies- Steam and Binary systems; Geothermal power plants.	9

Total: 45 Hours

Text Book:

1. Renewable energy resources: Tiwari and ghosal, Narosa publication.
2. Non-conventional Energy Sources, Khanna Publication

Reference Books:

1. Renewable Energy Sources: Twidell & Weir, CRC Press.
2. Solar Energy/ S.P. Sukhatme, Tata McGraw-Hill.
3. Non-Conventional Energy Systems: K M. Mittal, A. H. Wheeler Publishing Co Ltd.
4. Renewable Energy Technologies: Ramesh & Kumar, Narosa publication.
5. Biomass Energy, Oxford &IBH Publication Co.

RTM Nagpur University
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
VI	Industrial Safety and Environment (BTAE603T(OE)-3)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objectives
1	The objective of the course is to prepare the students.
2	To recognize and evaluate occupational safety and health hazards in the workplace.
3	To determine appropriate hazard controls following the hierarchy of controls.
4	Students would get an insight into the dispersion of pollution in the atmosphere

Course Outcomes

After successful completion of this course the student will be able to:

CO1	Understand the safety terms and identify the various hazards around the work environment. Identify and analyze the failures of the components and subcomponents of mechanical items.
CO2	Use the safety measures while performing work on Mechanical Machine Tools and handling materials.
CO3	Aware of the safety measures while performing work on fire prone equipment and processes. Distinguish different concepts in maintenance and explore in order to increase the service life of the products/machines/Electric equipment's.
CO4	Realize the importance of safety training, safety displays and its application.
CO5	Understand the type and nature of air pollutants, the behavior of plumes and relevant meteorological determinants influencing environmental accounts and auditing.

SYLLABUS	
Contents	**No. of Hours**
Unit I Introduction to safety, safety terms: definitions, accident, safety, hazard, safe, safety devices, safety guard, security, precaution, caution, appliance, slip, trip, fall. Ladders and scaffolding. Unsafe acts, reason for accidents, OSHA & WHO norms. Safe material handling and storage. Evolution of modern safety concept-safety policy - creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign.	8
Unit II Mechanical safety, Personal protective equipment's, safety guards, SOP and safety rules to follow while working on Mechanical Machine Tools, Safety while handling materials and material handling devices. Concept of an accident, reportable and non-reportable accidents, reporting to statutory authorities – principles of accident prevention – accident investigation and analysis – records for accidents, departmental accident reports, documentation of accidents – unsafe act and condition – domino sequence – supervisory role – cost of accident., Bureau of Indian Standards on Safety and Health: 14489 – 1998 and 15001 – 2000, ILO and EPA Standards. Toxicity- TLV- Types of Chemical Hazards-Occupational diseases caused by dust, fumes, gases, smoke and solvent hazards- control measures.	10
Unit III Introduction to fire safety, Fire classes, Fire triangle, Fire extinguishers, Fire hazard and analysis, prevention of fire. Fire protection and loss prevention, steps after occurrence of fire. Portable fire extinguishers. Fire detection, fire alarm and firefighting systems. Safety sign boards. Introduction to electrical safety, effect of electric current on human body, Electric hazards, causes and prevention of electrical accidents, Electric shock and safety precautions.	10
Unit IV Education, Training and Employee Participation in Safety: Element of training cycle, Assessment of needs, Techniques of training, design and development of training programs. Training methods and strategies types of training. Evaluation and review of training programs. Competence Building Techniques (CBT), Concept for training, safety as an on-line function. Employee Participation: Purpose, areas of participation, methods, Role of trade union in Safety, Health and Environment Protection.	8
Unit V Environmental Management: Concept and scope, Systems and approaches, Standards -international and national; Ecomark Environmental Management. Concept and scope, Systems and approaches, Standards -international and national; Ecomark; Environmental accounts and auditing, Green funding and taxes, Trade and environmental management. Environmental accounts and auditing, Green funding and taxes, Trade and environmental management.	9
	Total: 45 Hours

Text Books:

1. Blake R.B., "Industrial Safety" Prentice Hall, Inc., New Jersey, 1973

2. Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, 1980.

3. Krishnan N.V. "Safety Management in Industry" Jaico Publishing House, Bombay, 1997.

4. John Ridley, "Safety at Work", Butterworth & Co., London, 1983.

5. Deshmukh L M, Industrial Safety and Management, McGraw Hill Education (India) private Limited, ISBN-13

6. Rao, Jain R. K. and Saluja, Electrical Safety, fire safety and safety management, Khanna Publishers, ISBN: 978-81-7409-306-6

Reference Books:

1. Safety and Health for Engineers - Roger L. Brauer, John Wiley Sons, 2006

2. Accident Prevention Manual for Industrial Operations", N.S.C.Chicago, 1982

3. Raju K S N, Chemical process Industrial safety, McGraw Hill Education (India) private Limited, ISBN-13

4. Gerard Kiely, Environmental engineering, McGraw Hill Education (India) private Limited.

5. Publications from International Standard Organizations like ISO, OSHA, IOSH, NEBOSH

RTM Nagpur University
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
VI	Aircraft Mechanisms Analysis and Synthesis (BTAE604T(E)-1)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objectives
1	To impart students understanding of Synthesis of Mechanisms and Balancing of linkages.
2	To impart students analyzing skill for Kinematics and Dynamics of 3D Mechanisms.
3	To impart students understanding of motion analysis of Mechanisms of Aircraft.

Course Outcomes

After successful completion of this course the student will be able to:

CO1	Understand Synthesis of Mechanisms.
CO2	Analyze and illustrate the Balancing of linkages.
CO3	Analyze and solve Kinematics of 3D Mechanisms based Problems.
CO4	Analyze and solve Dynamics of 3D Mechanisms based Problems.
CO5	Understand the basic motion analysis of Mechanisms of Aircraft.

SYLLABUS

Contents	No. of Hours
Unit I Synthesis of Mechanisms: Harding's notation, classification of four bar chains, Immersions, Deciding Mobility bonds of immersion, synthesis for rigid body guidance, space synthesis of mechanism, Analytical treatment for synthesis of planer mechanism.	10
Unit II Balancing of linkages: Force & moment balancing of four bar Mechanisms, Quantitative analysis of effect of unbalance, Treatment of Berkof & Oven.	8
Unit III Kinematics of 3D Mechanisms: D-H notation, Application of D-H Notation of RSSR, RSSS, PSC PSR Mechanisms, Forward and reverse kinematics.	8

Unit IV Dynamics of 3D Mechanisms: Derivation of (i) Lagragrian (ii) Largragrian Euler (iii) Recursive Lagrangian formulation for dynamics of 3D Mechanisms (iv) D-Alembart's formulation, Application of these treatments to RSSR, RSSS, RSCPSR linkages	9
Unit V Motion Analysis of Mechanisms of Aircraft I & II Kinematic Analysis, Dynamics & design of Mechanisms for operating Flaps & Aileron, Rudder, and Elevator, Landing Gear, Conveyor for luggage Transport in Cargo.	10

Total: 45 Hours

Text Books:

1. Sandor G.N., and Erdman A.G., "Advanced Mechanism Design Analysis and Synthesis", Prentice Hall, 1984.
2. Shigley, J.E., and Uicker, J.J., "Theory of Machines and Mechanisms", McGraw Hill, 1995.

Reference Books:

1. Amitabha Ghosh and Asok Kumar Mallik, "Theory of Mechanism and Machines", EWLP, Delhi, 1999.
2. Norton R.L., "Design of Machinery", McGraw Hill, 1999.
3. Kenneth J, Waldron, Gary L. Kinzel, "Kinematics, Dynamics and Design of Machinery", John Wiley-sons, 1999.

RTM Nagpur University
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
VI	Flight Dynamics (BTAE604T(E)-2)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objectives
1	To impart students understanding of airplane flight dynamics in detail.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand basics of airplane dynamics.
CO2	Illustrate in detail the longitudinal stability and control.
CO3	Illustrate in detail the Lateral-directional stability and control.
CO4	Understand and analyze dynamical equations of aircraft motion.
CO5	Understand and analyze the basic Aircraft motion modes and flight simulation.

SYLLABUS

Contents	No. of Hours
Unit I: Introduction to airplane dynamics: Equilibrium, static and dynamic stability, control.	8
Unit II Longitudinal stability and control: Longitudinal equilibrium and static stability, stick fixed neutral point, all moving horizontal tail OR elevator as longitudinal control. Trimmed lift curve slope and advantages of reduced/negative longitudinal static stability. Hinge moments, reversible control, stick force, and trim tab. Stick free static stability, stick-free neutral point.	9
Unit III Lateral-directional stability and control: Directional equilibrium, stability and rudder as control. Lateral stability, dihedral angle, aileron control.	8

Unit IV Dynamical equations: Euler angles. Body angular velocity and Euler angle rates. Body-fixed axis, wind axis, stability axes. Equations of motion of rigid aircraft in body fixed axes. Stability derivatives. Steady flight and perturbed flight leading to linearized equations of motion.	10
Unit V Aircraft motion modes: Decoupling of longitudinal dynamics and lateral-directional dynamics. Short period and phugoid modes of longitudinal dynamics. Dutch roll, spiral and roll subsidence modes of lateral-directional dynamics. Effect of winds. Flight simulation.	10

Total: 45 Hours

Text Books:

1. Nelson, R. C., Flight Stability and Automatic Control, Mc Graw Hill International, 1990.
2. Etkin, B. and Duffy, L. D., Dynamics of Flight: stability and control, John Wiley, NY 1995.
3. Perkins, C. D. and Hage, R. E., Airplane Performance Stability and Control, Wiley, New York, 1949.
4. Basic Flight Mechanics, Springer, Basel, Switzerland, 2016, by A. Tewari.

Reference Books:

1. Stengel, R. F., Flight Dynamics, Princeton University Press, 2004.
2. Roskam, J., Airplane Flight Dynamics and Automatic Flight Controls, DAR Corporation, 1995.

RTM Nagpur University
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
VI	Principles of Combustion (BTAE604T(E)-3)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objectives
1	To make the student understand the fundamentals of combustion and to teach them combustion in different regions like basic flame to gas turbine engines to rocket engines and finally how it is done in supersonic speeds.

Course Outcomes

After successful completion of this course the student will be able to:

CO1	Explain basic process of combustion.
CO2	Illustration of basics of chemical kinetics and flames.
CO3	Understand the concepts of gas turbine engine.
CO4	Understand and illustration of combustion in solid propellant rocket engines.
CO5	Explain the principle of supersonic combustion.

SYLLABUS

Contents	No. of Hours
Unit I: INTRODUCTION TO COMBUSTION Thermo-chemical equations –Heat of formation –Activation energy -Multi-step reactions - Heat of reaction -first order, second order and third order reactions – Calculation of adiabatic flame temperature.	8
Unit II: BASICS OF CHEMICAL KINETICS AND FLAMES Premixed flames –Diffusion flames –measurement of burning velocity – various methods –Effect of various parameters on burning velocity – flame stability –Deflagration – Detonation – Rankine- Hugoniot curve – Radiation by flames.	9
Unit III: COMBUSTION IN GAS TURBINE ENGINES Combustion in gas turbine combustion chambers -Recirculation – combustion efficiency, Factors affecting combustion efficiency-Fuels used for gas turbine combustion chambers – combustion stability –Flame holder types.	8

Unit IV: COMBUSTION IN ROCKETS Solid propellant grain types – types of solid propellant burning in rocket combustion chambers – basic mechanism of composite propellant combustion – solid propellant burn rate laws – criterion for stable combustion - combustion in liquid rocket engines – single fuel droplet combustion model – combustion in hybrid rockets.	10
Unit V: SUPERSONIC COMBUSTION Introduction – supersonic combustion controlled by diffusion, mixing and heat convection – Analysis of reactions and mixing processes - supersonic burning with detonation shocks.	10

Total: 45 Hours

TEXT BOOKS:

1. Sharma, S.P., and Chandra Mohan, "Fuels and Combustion", Tata Mc. Graw Hill Publishing Co., Ltd., New Delhi, 1987.
2. Fundamentals of Combustion, Prentice Hall of India, New Delhi, revised edition, 2010, by D. P. Mishra.

REFERENCES:

1. Beer, J.M., and Chiierar, N.A. "Combustion Aerodynamics", Applied Science Publishers Ltd., London, 1981.
2. Chowdhury, R., Applied Engineering Thermodynamics, Khanna Publishers, New Delhi, 1986.
3. Loh, W.H.T., "Jet, Rocket, Nuclear, Ion and Electric Propulsion: Theory and Design, Springer Verlag, New York, 1982.
4. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 2nd edition 2014.
5. Sutton,G.P., Rocket Propulsion Elements, John Wiley, 1993.

RTM Nagpur University
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
VI	(Aerodynamic Design of Compressors and Turbine BTAE604T(E)-4)	3	0	0	3	30	70	100	3 Hours

Sr. No.	Course Objectives
1	To impart students detailed understanding of various Rota-dynamic machines.
2	To provide deep analytical skills to students for different types of compressors and turbines.

Course Outcomes

After successful completion of this course the student will be able to:

CO1	Understand in detail Axial flow compressors and Fans. Understand and interpret Radial Equilibrium Equation as applicable to Rota-dynamic machines.
CO2	Understand the physics of Transonic Compressors.
CO3	Understand in detail the Axial flow turbines.
CO4	Illustrate Centrifugal Compressors in detail.
CO5	Explain in detail Radial Turbine.

SYLLABUS

Contents	No. of Hours
Unit I: Axial flow compressors and Fans: Introduction; Aero-Thermodynamics of flow through an Axial flow Compressor stage; Losses in axial flow compressor stage; Losses and Blade performance estimation; Secondary flows (3-D); Tip leakage flow and scrubbing; Simple three dimensional flow analysis; Radial Equilibrium Equation; Design of compressor blades; 2-D blade section design: Airfoil Data; Axial Flow Track Design; Axial compressor characteristics; Multi-staging of compressor characteristics.	10
Unit II: Transonic Compressors; Shock Structure Models in Transonic Blades; Transonic Compressor Characteristics; 3-D Blade shapes of Rotors and Stators; Instability in Axial Compressors; Loss of Pressure Rise; Loss of Stability Margin; Noise problem in Axial Compressors and Fans.	9

Unit III: Axial flow turbines: Introduction; Turbine stage; Turbine Blade 2-D (cascade) analysis Work Done; Degree of Reaction; Losses and Efficiency; Flow Passage; Subsonic, transonic and supersonic turbines, Multi-staging of Turbine; Exit flow conditions; Turbine Cooling; Turbine Blade design – Turbine Profiles : Airfoil Data and Profile construction.	10
Unit IV: Centrifugal Compressors: Introduction; Elements of centrifugal compressor/ fan; Inlet Duct Impeller; Slip factor; Concept of Rothalpy; Modified work done; Incidence and lag angles; Diffuser ; Centrifugal Compressor Characteristics; Surging; Chocking; Rotating stall; Design.	8
Unit V: Radial Turbine: Introduction; Thermodynamics and Aerodynamics of radial turbines; Radial Turbine Characteristics; Losses and efficiency; Design of radial turbine.	8

Total: 45 Hours

Text Books:

1. Aerodynamics of Turbines and Compressors. (HSA-1), Volume 1 by William R. Hawthorne.
2. "Turbines Compressors and Fans" S. M. Yahya, Tata McGraw-Hill Education, 2010

Reference Books:

1. Centrifugal Compressors: A Strategy for Aerodynamic Design and Analysis by Ronald H. Aungier.
2. Axial-Flow Compressors: A Strategy for Aerodynamic Design and Analysis by Ronald H. Aungier.
3. Turbine Aerodynamics: Axial-Flow and Radial-Flow Turbine Design and AnalysisRonald H. Aungier.

RTM Nagpur University
Syllabus (Practical)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
VI	Aero-Design and Simulation Laboratory (BTAE-605P)	0	0	2	1	25	25	50

Sr. No.	Course Objectives
1	After successful completion of this course the student will be able to work on advancement and application of computational engineering for the design, optimization, and control of aerospace and other complex systems.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understanding of basic aspects of CAD software.
CO2	Detail illustration and analysis of different modules in ANSYS.

Minimum Eight out of the following shall be performed:

Sr. No.	List of Practical's
01	Introduction to CAD software
02	Introduction to ANSYS
03	Modeling and Simulation Procedure in ANSYS
04	Simulation of flow through a converging-diverging nozzle
05	Simulation of flow through an axial flow compressor blade passage
06	Simulation of flow over an airfoil at different angles
07	Hot flow simulation through an axial flow turbine blade passage
08	Simulation of flow through subsonic and supersonic diffusers
09	Structural analysis of a tapered wing
10	Structural analysis of a fuselage structure
11	Structural analysis of a landing gear
12	Thermos-structural analysis of a composite laminate structure

References:

1. CATIA V5-6R2014 For Beginners, CD folks.
2. Working with ANSYS A Tutorial Approach: Divya Zindani, Apurba Kumar Roy, Kaushik Kumar, Wiley.

RTM Nagpur University
Syllabus (Practical)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
VI	Non Destructive Inspection Lab (BTAE-606P)	0	0	2	1	25	25	50

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand various non-destructive techniques such as ultrasonic, radiography, dye penetration etc. for determination of defects/damage in structural component for maintenance.
CO2	Perform various non-destructive techniques such as ultrasonic, radiography, dye penetration etc.

Minimum Eight out of the following shall be performed:

Sr. No.	List of Practical's
01	Experiment/Study on Simple optical inspection.
02	Experiment/Study on Borescope.
03	Experiment/Study on Ultrasonic flaw detection.
04	Experiment/Study on Ultrasonic thickness measurement.
05	Experiment/Study on Dye Penetration testing.
06	Experiment/Study on Eddy current testing.
07	Experiment/Study on Magnetic particle testing.
08	Experiment/Study on Radiography testing.
09	Experiment/Study on weld inspection.
10	Experiment/Study on Metallurgical Microscope.

References:

1. Basics of Non-Destructive Testing by Luri & Kumar, S.K. Kataria & Sons; 2013 Edition.
2. "Non - destructive testing" by Mr. T. Raja Santhosh Kumar, Dr. A. Anderson, dr. S. Ramachandran, Airwalk Publications; First Edition (2017).

RTM Nagpur University
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
VI	Effective Technical Communication (BTAE-607T)	2	0	0	2	15	35	50	2 Hours

Sr. No.	Course Objectives
1	At the end of the semester, students will have enough confidence to face competitive examinations (IELTES/ TOEFL/CAT/ MAT/ XAT/SNAP/GMAT/GATE etc.) to pursue master's degree.
2	They will also acquire language skills required to write their Reviews/Projects/Reports. They will be able to organize their thoughts in English and hence face job interviews more confidently

Course Outcomes

After successful completion of this course the student will be able to:

CO1	Acquire knowledge of structure of language.
CO2	Build vocabulary and face interview process and can become employable.
CO3	Develop business writing skills
CO4	Understand technical and scientific writing skills.

SYLLABUS

Contents	No. of Hours
UNIT I: FUNCTIONAL GRAMMAR Common errors, Transformation of Sentences (Change the voice, Change the narration, transformation of Simple, Compound, Complex sentences), Use of Phrases, Idioms & Proverbs.	6
UNIT II: ENGLISH FOR COMPETITIVE EXAMS & INTERVIEW TECHNIQUES Prefix, Suffix, Word building processes, English words /phrases derived from other languages, Technical Jargons, Synonyms/Antonyms, Verbal Analogies, Give one word for, Types & Techniques of Interview	6
UNIT III: FORMAL CORRESPONDENCE AND ANALYTICAL COMPREHENSION Job applications and Resume Writing, Business Letters, (Enquiry, Quotation, Orders, Complaints), Writing Memorandum, Circulars, notices, e-mail etiquettes, Unseen Comprehension passages	6

UNIT IV: TECHNICAL & SCIENTIFIC WRITING	
Features of Technical Writing, Technical Report writing, Writing Manuals, Writing Project and research Proposals, Writing Research papers.	6

Total: 24 Hours

Text Books:

1. Effective technical Communication by Barun K. Mitra, Oxford University Press.
2. Technical Communication-Principles and Practice by Meenakshi Raman & Sharma, Oxford University Press, 2011, ISBN-13-978-0-19-806529.
3. How to Prepare a Research Proposal: Guidelines for Funding and Dissertations in the Social and Behavioral Sciences by Krathwohl & R David.

Reference Books :

1. Technical Writing- Process and Product by Sharon J. Gerson & Steven M. Gerson, 3rd edition, Pearson Education Asia, 2000.
2. Developing Communication skills by Krishna Mohan & Meera Banerjee.
3. Functional English by Dr. P. Mahato and Dr. Dora Thompson, Himalaya Publications.

RTM Nagpur University
Syllabus (Practical)

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
VI	Mini Project-II:{Internship/Case Study/Seminar} (BTAE-608P)	0	0	6	3	50	50	100

Course Outcomes	
After successful completion of this course the student will be able :	
CO1	To create an Industrial environment and culture within the institution.
CO2	To standardize laboratories to industrial standard, thereby giving exposure to industrial housekeeping standards.
CO3	To provide students hands on experience on, troubleshooting, maintenance, fabrication, innovation, record keeping, documentation etc. thereby enhancing the skill and competency part of technical education.

Sr. No.	**The mini project-II can be organized based on the recommendations and evaluation criteria listed below.**
01	Standardization of Laboratories: This phase of the mini project can be clubbed with laboratory hours of the semester. Before the commencement of cycle of experiments for the semester, the students should be given instructions on 5S method of industrial housekeeping. Video resources available in the internet can be utilized for the purpose. After the initial summarizing, students should be grouped into batches of 5 and should be entrusted with activities of implementing or maintaining 5S standardization of the laboratory. This ensures that all experiments of the laboratory are performed as per industrial standard.The case can suitably be adopted for any departments as standardization concept is the same for all industry, whether it is manufacturing, service or hospitality.
02	Case study: Based on area of interest related to aerospace industry allotted to students group.
03	The evaluation should be made as group performance in implementing the standardization and individual contribution in setting work place clean and tidy. Evaluations by way of surprise visits made by the Head of Department and Guide during laboratory hours at least twice the semester contribute to the part of total marks.
04	Seminar Presentation and report submission.

With intent to get some exposure on Aerospace and related industries institution should arrange:

• Industry Visits to some of the Industries in Aerospace like HAL (Hindustan Aeronautics Limited), NAL (National Aerospace Limited), ISRO (Indian Space Research Organization).

(OR)

• Visits to Aerospace Museums.

(OR)

• Building miniature models of Aircraft /Gliders etc. as hands on exercises conducted as competitions.

References:

Innovative ideas of commercial values should be encouraged to be continued as project for the forth coming semester.

1. Evaluation Standardization (30%), Group (15%) and Individual (15%).
2. Problem identification and solving (50%) or collaborative work (50%) or involvement in production center (50%).
3. Documentation (20%).

RTM Nagpur University Aeronautical Engineering –VI Sem. SPORTS
Course Code BTAE-609P

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
VI	SPORTS (BTAE-609P)	0	0	3		0	0	0	0

Sr. No.	COURSE OBJECTIVE
1	Through sports, students should able to build a wide range of abilities and skills such as leadership, confidence, teamwork, patience, self-reliance, trust, and many more which facilitate the overall development of an individual.
2	Students should learn to manage time between their lectures, sports, and personal life.

EXPECTATION FROM INSTITUTES

1. Provide sports facilities.
2. Provide platforms for participation in events.
3. Develop interest for sports amongst students.
4. Conduct regular events (every month) in college for all indoor and outdoor sports.

RTM Nagpur University Aeronautical Engineering –VI Sem. YOGA
Course Code BTAE-609P

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
VI	YOGA (BTAE-609P)	0	0	3		0	0	0	0

Sr. No.	COURSE OBJECTIVE
1	To introduce basic wellness principles and practices of Yoga to students
2	To bring awareness of the fundamentals of Yoga for wellness in their daily lives
3	To bring peace and harmony in the society at large by introducing the Yogic way of life.

EXPECTATION FROM TRAINERS

1. Brief to origin of Yoga,
2. History and Development of Yoga: Vedic Period, Classical Period, Post classical period, Modern Period.
3. Etymology and Definitions of Yoga in classical Yoga texts
4. Meaning, Aim and Objectives of Yoga,
5. Misconceptions about Yoga;
6. True Nature of Yoga;
7. Principles of Yoga;
8. Basis of Yoga.

RTM Nagpur University
Aeronautical Engineering –VI Sem.
National Cadet Corps (NCC)
Course Code BTAE-609P

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
VI	National Cadet Corps (NCC) (BTAE-609P)	0	0	3		0	0	0	0

ABOUT NCC

1. NCC is the Indian military cadet corps wing of the Indian armed forces.
2. NCC offers training to the students of schools and colleges.
3. This is not compulsory training for all students.

Sr. No.	OUTCOMES EXPECTED
1	During the training of NCC, candidates should get the basic military training. This training should be conducted to develop the interest of young students in all three forces; the army, the navy and the air force of India. Students should be able to check their abilities to join the Indian Defense Services.

Sr. No.	AIM
1	To create an organized, trained and motivated youth, create soldiers for the nation, develop the leadership skills in the youth.

EXPECTATION FROM INSTITUTES

- Create awareness amongst students about NCC
- Make understand the students about the importance of NCC
- Conduct regular Drills and Training exercises
- Conduct Regular exams
- Arrange for Training Camps

RTM Nagpur University
Aeronautical Engineering –VI Sem.
National Service Scheme (NSS)
Course Code BTAE-609P

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III & IV	National Service Scheme (NSS) (BTAE-609P)	0	0	3		0	0	0	0

Sr. No.	COURSE OBJECTIVE
1	1. Understand the community in which they work. 2. Understand themselves in relation to their community. 3. Identify the needs and problems of the community and involve them in problem- solving. 4. Develop among them a sense of social and civic responsibility. 5. Utilize their knowledge in finding practice solutions to individual and community problems. 6. Develop competence required for group-living and sharing of responsibilities. 7. Gain skills in mobilizing community participation. 8. Acquire leadership qualities and democratic attitudes 9. Develop capacity to meet emergencies and natural disasters. 10. Practice national integration and social harmony

EXPECTATION FROM TRAINERS

1. To assist and guide the NSS unit for implementation of NSS programs at college level.
2. To advise in organizing camps, training and orientation programs for the NSS volunteers.
3. To visit the NSS units for monitoring and evaluation.
4. To ensure implementation of NSS regular activities and special camping programs.

RTM Nagpur University
Aeronautical Engineering –VI Sem.
National Cadet Corps (NCC)
Course Code BTAE-609P

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
VI	National Cadet Corps (NCC) (BTAE-609P)	0	0	3		0	0	0	0

ABOUT NCC

1. NCC is the Indian military cadet corps wing of the Indian armed forces.
2. NCC offers training to the students of schools and colleges.
3. This is not compulsory training for all students.

Sr. No.	OUTCOMES EXPECTED
1	During the training of NCC, candidates should get the basic military training. This training should be conducted to develop the interest of young students in all three forces; the army, the navy and the air force of India. Students should be able to check their abilities to join the Indian Defense Services.

Sr. No.	AIM
1	To create an organized, trained and motivated youth, create soldiers for the nation, develop the leadership skills in the youth.

EXPECTATION FROM INSTITUTES

- Create awareness amongst students about NCC
- Make understand the students about the importance of NCC
- Conduct regular Drills and Training exercises
- Conduct Regular exams
- Arrange for Training Camps