Lokmanya Tilak Jankalyan Shikshan Sanstha's
PRIYADARSHINI COLLEGE OF ENGINEERING
(Recognised by A.I.C.T.E., New Delhi & Govt. of Maharashtra, Affiliated to R.T.M.Nagpur University)
Near CRPF Campus, Hingna Road, Nagpur-440 019, Maharashtra (India)
Phone : 07104 – 236381, 237307, Fax : 07104 – 237681,
email : principal.pce.ngp@gmail.com, www.pcenagpur.edu.in

1.3.2 Average percentage of courses that include experiential learning through project work/field work/internship during last five years

PRIYADARSHINI COLLEGE OF ENGG. NAGPUR
CERTIFIED DOCUMENT
Page 2 to 33
Principal

Lokmanya Tilak Jankalyan Shikshan Sanstha's
PRIYADARSHINI COLLEGE OF ENGINEERING
(Recognised by A.I.C.T.E., New Delhi & Govt. of Maharashtra, Affiliated to R.T.M.Nagpur University)
Near CRPF Campus, Hingna Road, Nagpur-440 019, Maharashtra (India)
Phone : 07104 – 236381, 237307, Fax : 07104 – 237681,
email : principal.pce.ngp@gmail.com, www.pcenagpur.edu.in

1.3.2 Average percentage of courses that include experiential learning through project work/field work/internship during last five years

B.E – AERONAUTICAL ENGINEERING (2020-2021)

Sr. No	Name of the course that include experiential learning through Project work/ Internship	Subject Code	Domain	Page No
1	Heat Transfer	BEAE-501T	Propulsion	3-8
2	Propulsion- I	BEAE-505T		
3	Propulsion- II	BEAE-601T&P		
4	Aero- Thermodynamics	BEAE-302T&P	Aerodynamics	9-15
5	Fluid Mechanics and Machinery	BEAE-303T&P		
6	Elements of Aeronautics	BEAE-305T		
7	Aerodynamics- I	BEAE-405T&P		
8	Aircraft layout and Component drawing	BEAE-406P		
9	Aircraft Flight Mechanics	BEAE-502T		
10	Aerodynamics- II	BEAE-503T		
11	Aircraft Design	BEAE-605T		
12	Space Flight Mechanics	BEAE-703T		
13	Elective-III-CFD	BEAE-805T		
14	Mechanics of Machine	BEAE-401T	Structure	16-20
15	Aircraft Materials	BEAE-403T		
16	Aircraft Structure- I	BEAE-404T&P		
17	Aircraft Structure- II	BEAE-504T&P		
18	Non Destructive Inspection	BEAE-506P		
19	CAD/ CAM	BEAE-507P		
20	Design of Machine Elements	BEAE-702T		
21	Vibration and Aero- elasticity	BEAE-802T		
22	System Modeling and Simulation	BEAE-603T	Avionics	21-24
23	Applied Electronics	BEAE-604T&P		
24	Aircraft Systems and Instrumentation	BEAE-701T		
25	Control Engineering	BEAE-704T		
26	Aircraft Design Project	BEAE-706P		
27	Aircraft System	BEAE-707P		
28	Air Transportation	BEAE-801T		
29	Aircraft General Engineering and Maintenance Practices	BEAE-705T	Maintenance	25-27
30	Elective –I Reliability Centered Maintenance	BEAE-803T		
31	Elective-II-Airframe Maintenance and Repair	BEAE-804T		
32	Applied Mathematics – III	BEAE-301T	other	28-33
33	Computer Programming	BEAE-304T		
34	Seminar	BEAE-606P		
35	Environmental Studies	BEAE-407T		
37	Project Work Phase- I	BEAE708P		

38	Project Work Phase- II	BEAE-806P		
39	Manufacturing Process- I	BEAE-402T		
40	Manufacturing Process- II	BEAE-602T		

Domain 1: Propulsion

Sr. No	Name of the course that include experiential learning through Project work/ Internship	Subject Code	Domain
1	Heat Transfer	BEAE-501T	**Propulsion**
2	Propulsion- I	BEAE-505T	
3	Propulsion- II	BEAE-601T&P	

Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Fifth Semester) Aeronautical Engineering
Heat Transfer (BEAE-501T)
(Total Credits: 05)

Teaching Scheme
Lectures: 4 Hours/ Week
Tutorial: 1 Hours / Week

Examination Scheme
Theory
T (U): 80 Marks **T (I): 20 Marks**
Duration of University Exam: 03 Hours

Unit – I **7 Hours**
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,

Unit – II **7 Hours**
Free Convection:
Free or natural convection, Grashof 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.

Unit – III **7 Hours**
Forced convection:
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.

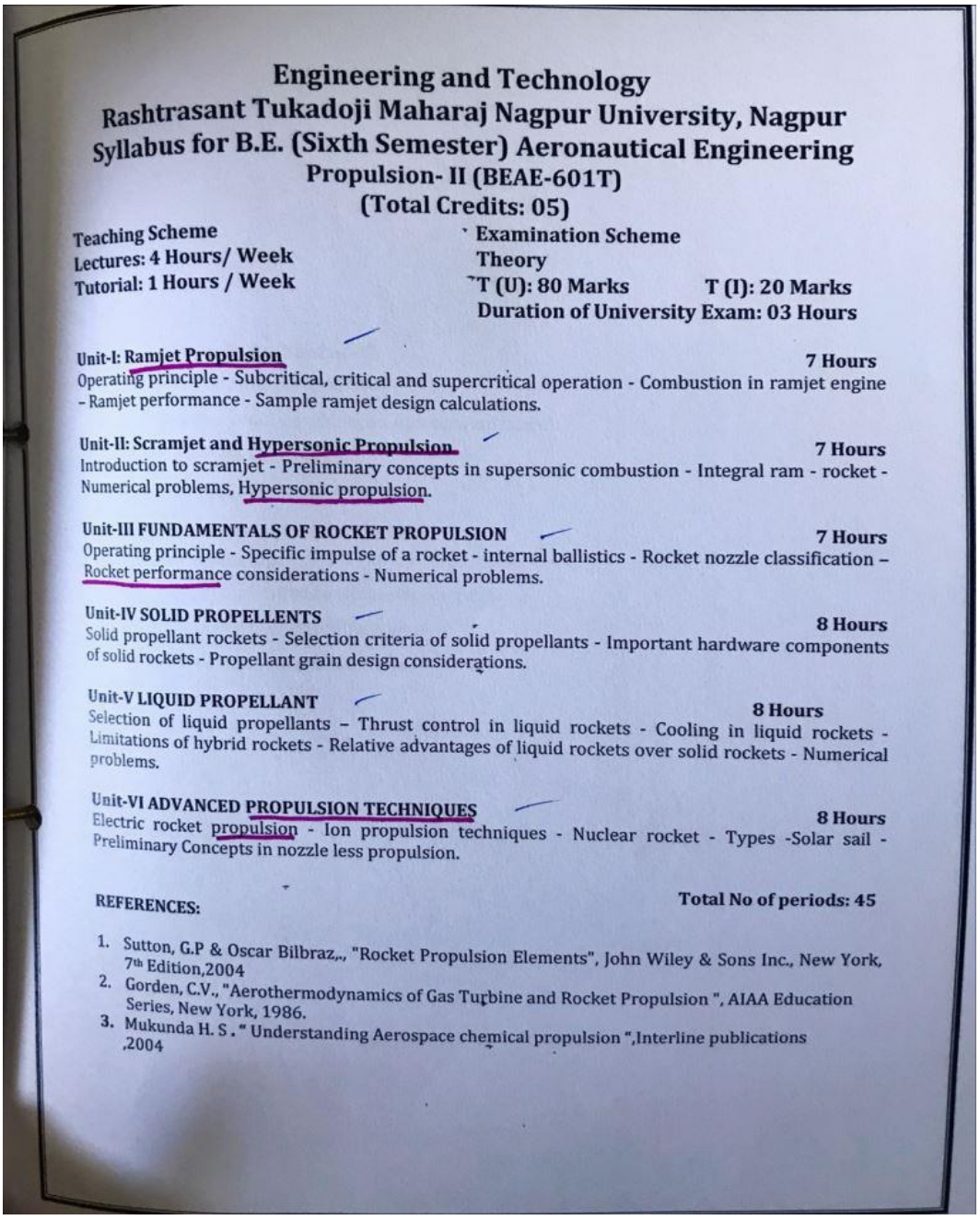
Unit – IV **8 Hours**
Radiative Heat Transfer
Radiation, nature of thermal radiation, black body radiation, radiation intensity, laws of radiation– Kirchoffs, Planks, Weins displacement, Stefan Boltzmann & Lamberts Co-sine law. Emissivity, Absorbtivity, Transmissivity, Reflectivity, Radiosity, Emissive 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.

Unit – V **8 Hours**
HEAT EXCHANGERS
Heat Exchanger :- 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. Introduction to mass transfer.

Unit – VI **8 Hours**
HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING
High-Speed flow Heat Transfer, Heat Transfer problems in gas turbine combustion chambers – Rocket thrust chambers – Aerodynamic heating – Ablative heat transfer.

Total No of periods: 45

TEXT 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 -A practical approach Yunus A. Cengel , "Tata Mcgraw Hill publication Second Edition
4. Heat Transfer J. P. Holman McGraw Hill Publication



Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Sixth Semester) Aeronautical Engineering
Propulsion- II (BEAE-601T)
(Total Credits: 05)

Teaching Scheme
Lectures: 4 Hours/ Week
Tutorial: 1 Hours / Week

Examination Scheme
Theory
T (U): 80 Marks **T (I): 20 Marks**
Duration of University Exam: 03 Hours

Unit-I: Ramjet Propulsion **7 Hours**
Operating principle - Subcritical, critical and supercritical operation - Combustion in ramjet engine - Ramjet performance - Sample ramjet design calculations.

Unit-II: Scramjet and Hypersonic Propulsion **7 Hours**
Introduction to scramjet - Preliminary concepts in supersonic combustion - Integral ram - rocket - Numerical problems, Hypersonic propulsion.

Unit-III FUNDAMENTALS OF ROCKET PROPULSION **7 Hours**
Operating principle - Specific impulse of a rocket - internal ballistics - Rocket nozzle classification – Rocket performance considerations - Numerical problems.

Unit-IV SOLID PROPELLENTS **8 Hours**
Solid propellant rockets - Selection criteria of solid propellants - Important hardware components of solid rockets - Propellant grain design considerations.

Unit-V LIQUID PROPELLANT **8 Hours**
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.

Unit-VI ADVANCED PROPULSION TECHNIQUES **8 Hours**
Electric rocket propulsion - Ion propulsion techniques - Nuclear rocket - Types -Solar sail - Preliminary Concepts in nozzle less propulsion.

REFERENCES: **Total No of periods: 45**

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.
3. Mukunda H. S . " Understanding Aerospace chemical propulsion ",Interline publications ,2004

Project Mapping:

3D IMITATION FABRICATION AND EXPERIMENTAL ANALYSIS OF PROPELLER BLADE FOR OPTIMISING RESULT

This report is submitted to **Rashtrasant Tukdoji Maharaj Nagpur University** in partial fulfilment of the requirement for the award of degree of Bachelor of Engineering in **Aeronautical Engineering** by

RUCHIKA ASHTEKAR
KHUSHBOO GUPTA
PRACHI BHIMTE
SHREYA DHOTKAR

under the guidance of
Prof. Sandeep Patil

DEPARTMENT OF AERONAUTICAL ENGINEERING
Lokmanya Tilak Jankalyan Shikshan Sanstha'

PRIYADARSHINI COLLEGE OF ENGINEERING

(An institution affiliated to Rashtrasant Tukdoji Maharaj Nagpur University)

NAGPUR – 440019

2020-2021

"COMPARATIVE ANALYSIS OF CENTRIFUGAL AND AXIAL COMPRESSOR USING CFD TECHNIQUE"

This report is submitted to Rashtrasant Tukadoji Maharaj Nagpur University in partial fulfillment of the requirement for the award of degree

of

Bachelor of Engineering in Aeronautical Engineering

by

1. Kedar Kulkarni
2. Sharayu Sonkusare
3. Aman Bawaria
4. Yogeshwar Dalal

under the guidance of

Prof. Sandeep Patil

DEPARTMENT OF AERONAUTICAL ENGINEERING
Lokmanya Tilak Jankalyan Shikshan Sanstha's
PRIYADARSHINI COLLEGE OF ENGINEERING
(An institution affiliated to Rashtrasant Tukdoji Maharaj Nagpur University)
NAGPUR – 440019
2020 – 2021
Lokmanya Tilak Jankalyan Shikshan Sanstha's

Lokmanya Tilak Jankalyan Shikshan Sanstha's

PRIYADARSHINI COLLEGE OF ENGINEERING

(Recognised by A.I.C.T.E., New Delhi & Govt. of Maharashtra, Affiliated to R.T.M.Nagpur University)

Near CRPF Campus, Hingna Road, Nagpur-440 019, Maharashtra (India)

Phone : 07104 – 236381, 237307, Fax : 07104 – 237681,

email : principal.pce.ngp@gmail.com, www.pcenagpur.edu.in

"Computational Analysis to find the effect of Winglets on Turbine Blades"

This report is submitted to Rashtrasant Tukdoji

Maharaj Nagpur University in partial

fulfillment of the requirement for the award

of degree of

Bachelor of Engineering in Aeronautical Engineering

by

1. **Affan Momin** 3. **Vikas Dubey**

2. **Kunal Harinkhede** 4. **Yogesh Kedar**

under the guidance of

Prof. Vishal Kaushik

DEPARTMENT OF AERONAUTICAL ENGINEERING

Lokmanya Tilak Jankalyan Shikshan Sanstha's

PRIYADARSHINI COLLEGE OF ENGINEERING

(An institution affiliated to Rashtrasant Tukdoji Maharaj Nagpur University)

NAGPUR – 440019

2020-2021

"JET NOISE REDUCTION"

This report is submitted to the Rashtrasant Tukadoji Maharaj Nagpur University

in partial fulfilment of the requirement for the award of the degree

of

Bachelor of Engineering in Aerospace Engineering

By

Akanksha Gupta

Rizin Shah

Kaiwalya Vichare

Poonam Jamgade

Under the guidance of

Prof. Sandeep Patil

DEPARTMENT OF AERONAUTICAL ENGINEERING

Lokmanya Tilak Jankalyan Shikshan Sanstha's

PRIYADARSHINI COLLEGE OF ENGINEERING

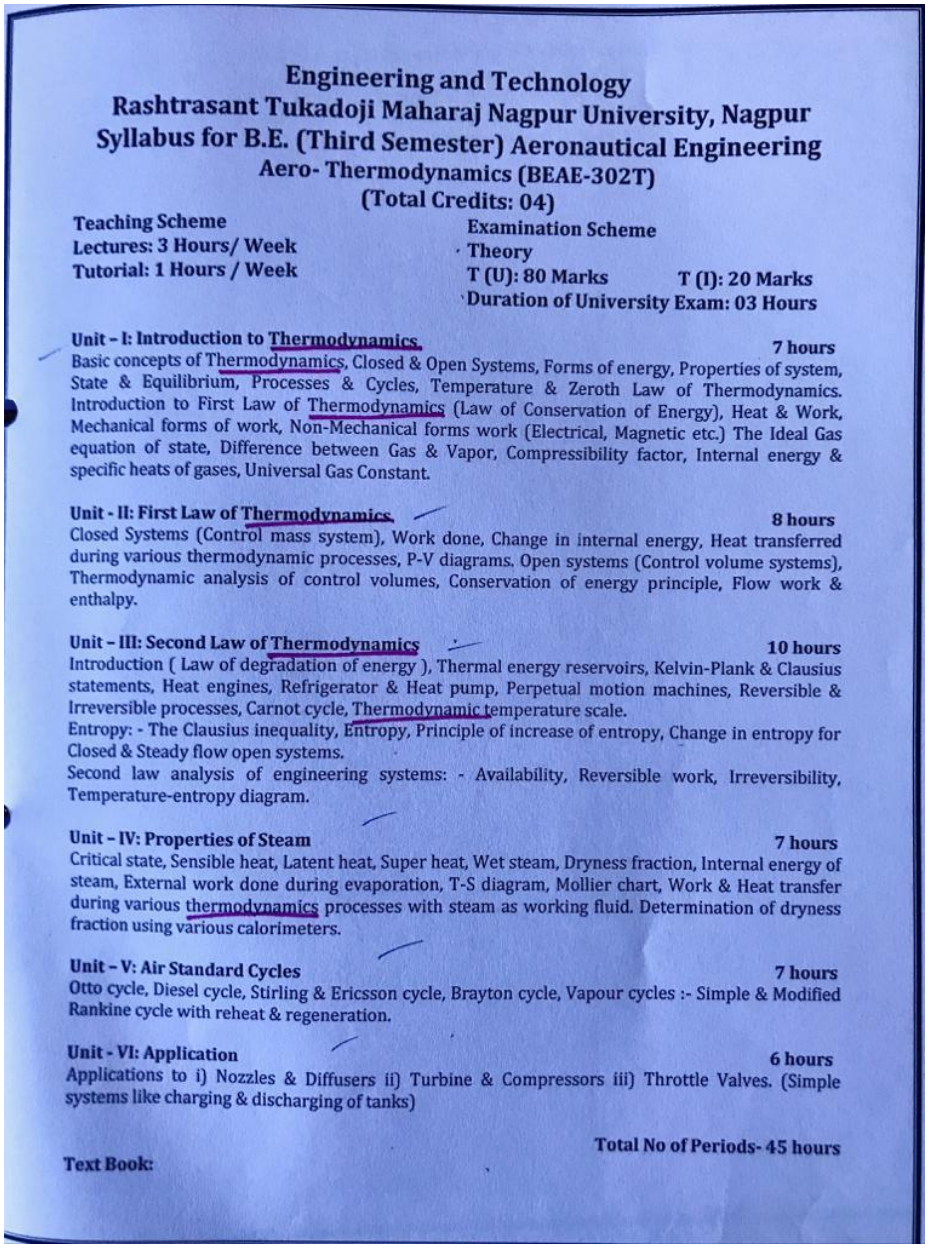
(An institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

NAGPUR – 440019

2020 - 2021

Domain 2: Aerodynamics

Sr. No	Name of the course that include experiential learning through Project work/ Internship	Subject Code	Domain
1	Aero- Thermodynamics	BEAE-302T&P	Aerodynamics
2	Fluid Mechanics and Machinery	BEAE-303T&P	
3	Elements of Aeronautics	BEAE-305T	
4	Aerodynamics- I	BEAE-405T&P	
5	Aircraft layout and Component drawing	BEAE-406P	
6	Aircraft Flight Mechanics	BEAE-502T	
7	Aerodynamics- II	BEAE-503T	
8	Aircraft Design	BEAE-605T	
9	Space Flight Mechanics	BEAE-703T	
10	Elective-III-CFD	BEAE-805T	



Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Third Semester) Aeronautical Engineering
Aero- Thermodynamics (BEAE-302T)
(Total Credits: 04)

Teaching Scheme
Lectures: 3 Hours/ Week
Tutorial: 1 Hours / Week

Examination Scheme
Theory
T (U): 80 Marks **T (I): 20 Marks**
Duration of University Exam: 03 Hours

Unit – I: Introduction to Thermodynamics **7 hours**
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.

Unit - II: First Law of Thermodynamics **8 hours**
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.

Unit – III: Second Law of Thermodynamics **10 hours**
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.

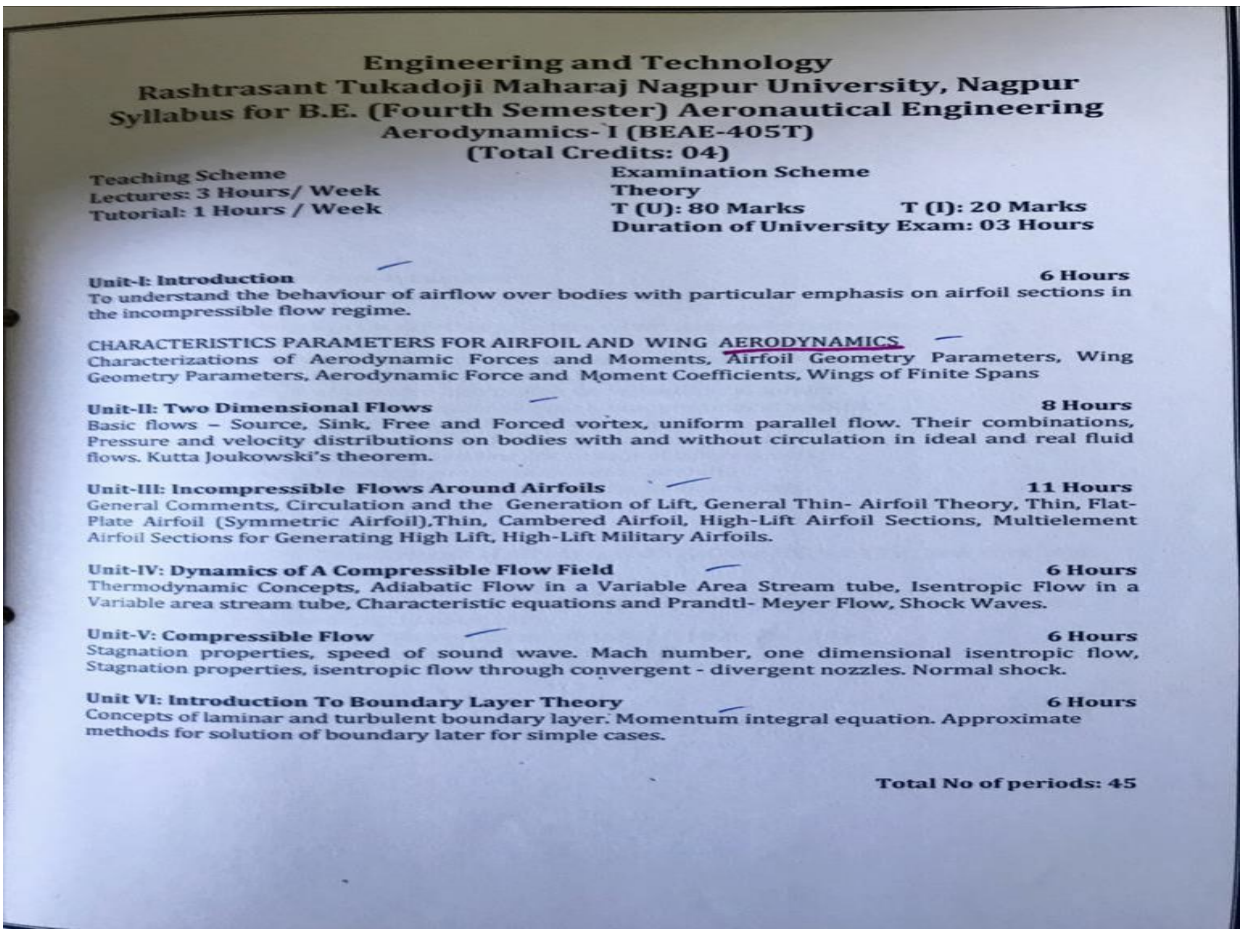
Unit – IV: Properties of Steam **7 hours**
Critical state, Sensible heat, Latent heat, Super heat, Wet steam, Dryness fraction, Internal energy of steam, External work done during evaporation, T-S diagram, Mollier chart, Work & Heat transfer during various thermodynamics processes with steam as working fluid. Determination of dryness fraction using various calorimeters.

Unit – V: Air Standard Cycles **7 hours**
Otto cycle, Diesel cycle, Stirling & Ericsson cycle, Brayton cycle, Vapour cycles :- Simple & Modified Rankine cycle with reheat & regeneration.

Unit - VI: Application **6 hours**
Applications to i) Nozzles & Diffusers ii) Turbine & Compressors iii) Throttle Valves. (Simple systems like charging & discharging of tanks)

Total No of Periods- 45 hours

Text Book:



Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Fourth Semester) Aeronautical Engineering
Aerodynamics- I (BEAE-405T)
(Total Credits: 04)

Teaching Scheme
Lectures: 3 Hours/ Week
Tutorial: 1 Hours / Week

Examination Scheme
Theory
T (U): 80 Marks T (I): 20 Marks
Duration of University Exam: 03 Hours

Unit-I: Introduction 6 Hours
To understand the behaviour of airflow over bodies with particular emphasis on airfoil sections in the incompressible flow regime.

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

Unit-II: Two Dimensional Flows 8 Hours
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.

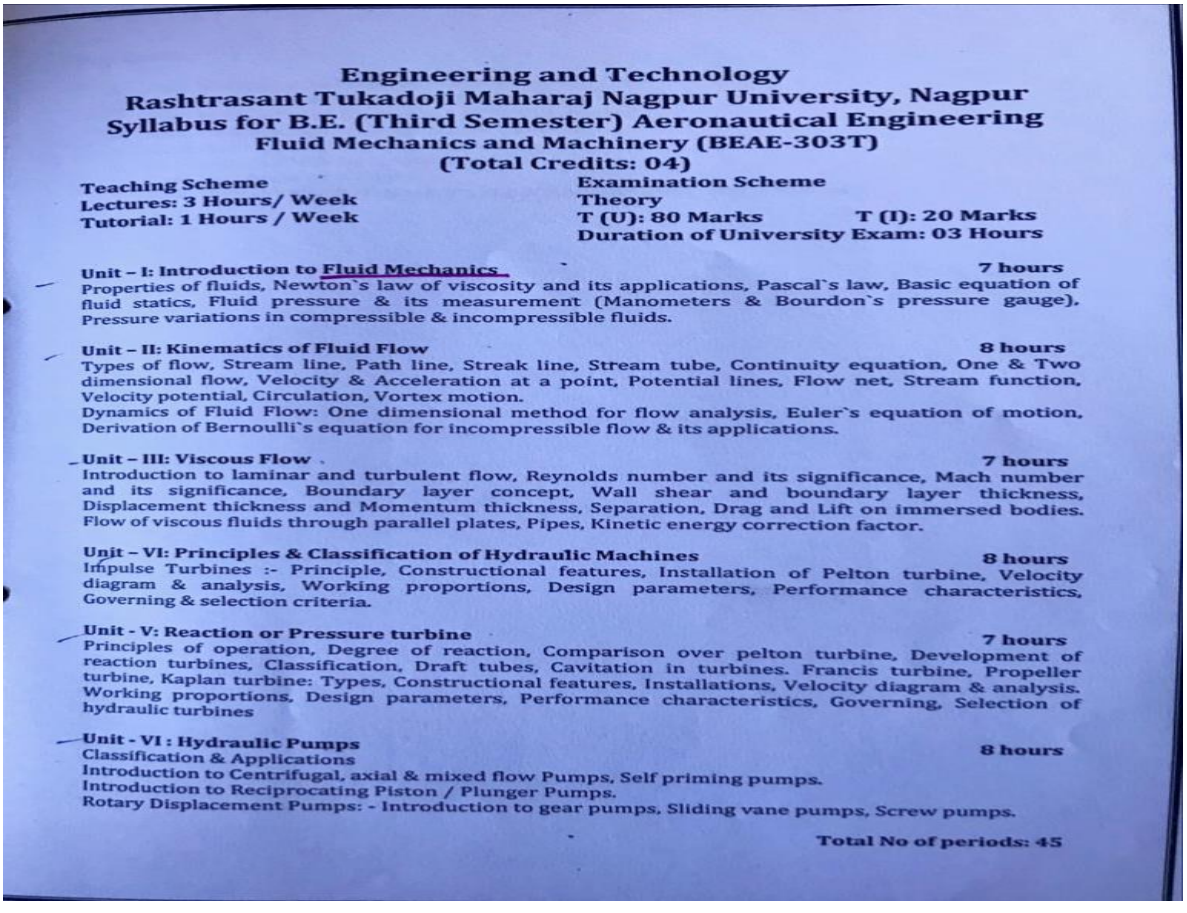
Unit-III: Incompressible Flows Around Airfoils 11 Hours
General Comments, Circulation and the Generation of Lift, General Thin- Airfoil Theory, Thin, Flat-Plate Airfoil (Symmetric Airfoil),Thin, Cambered Airfoil, High-Lift Airfoil Sections, Multielement Airfoil Sections for Generating High Lift, High-Lift Military Airfoils.

Unit-IV: Dynamics of A Compressible Flow Field 6 Hours
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.

Unit-V: Compressible Flow 6 Hours
Stagnation properties, speed of sound wave. Mach number, one dimensional isentropic flow, Stagnation properties, isentropic flow through convergent - divergent nozzles. Normal shock.

Unit VI: Introduction To Boundary Layer Theory 6 Hours
Concepts of laminar and turbulent boundary layer. Momentum integral equation. Approximate methods for solution of boundary later for simple cases.

Total No of periods: 45



Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Third Semester) Aeronautical Engineering
Fluid Mechanics and Machinery (BEAE-303T)
(Total Credits: 04)

Teaching Scheme
Lectures: 3 Hours/ Week
Tutorial: 1 Hours / Week

Examination Scheme
Theory
T (U): 80 Marks T (I): 20 Marks
Duration of University Exam: 03 Hours

Unit – I: Introduction to Fluid Mechanics 7 hours
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 & incompressible fluids.

Unit – II: Kinematics of Fluid Flow 8 hours
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.

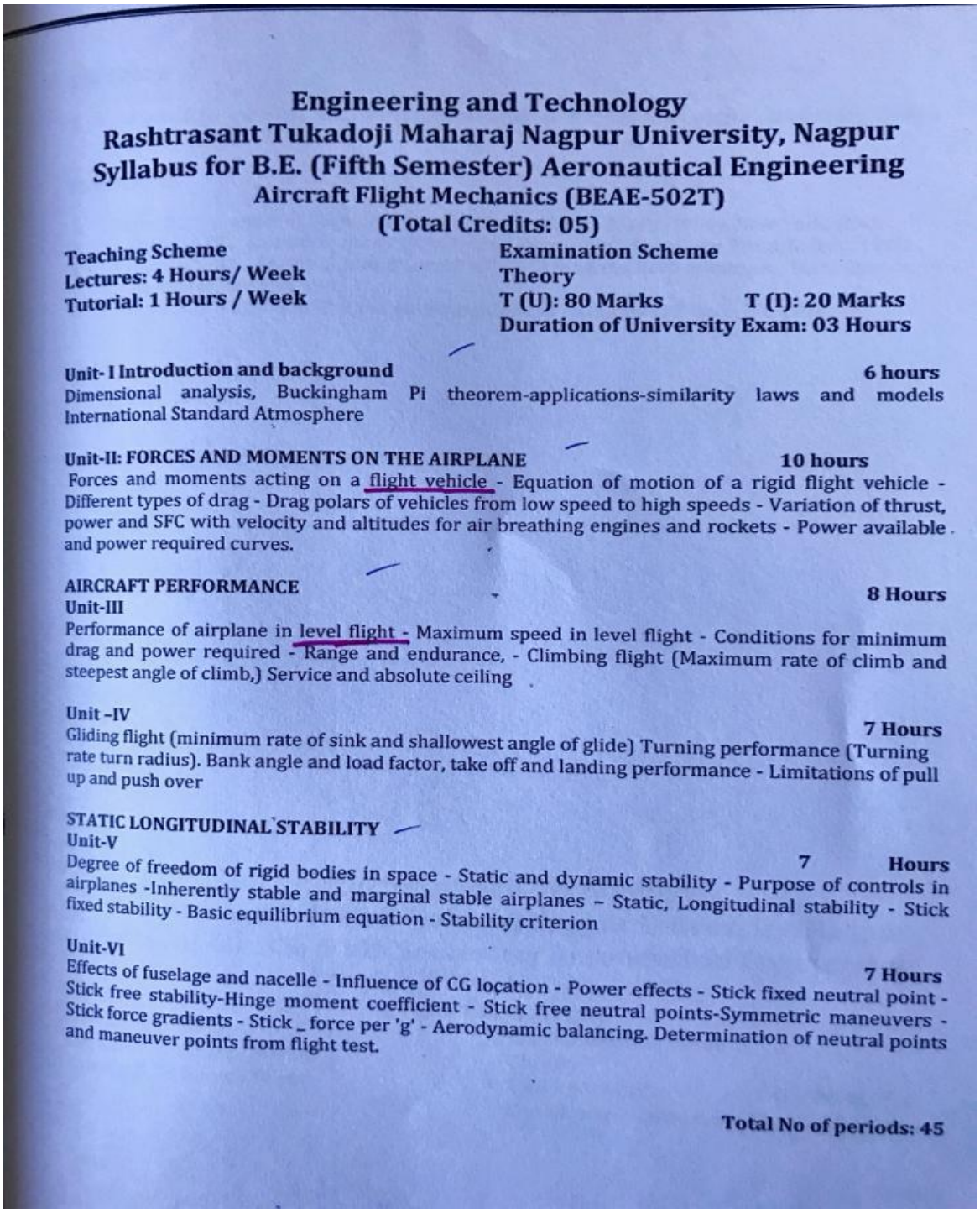
Unit – III: Viscous Flow 7 hours
Introduction to laminar and turbulent flow, Reynolds number and its significance, Mach number and its significance, Boundary layer concept, Wall shear and boundary layer thickness, Displacement thickness and Momentum thickness, Separation, Drag and Lift on immersed bodies. Flow of viscous fluids through parallel plates, Pipes, Kinetic energy correction factor.

Unit – VI: Principles & Classification of Hydraulic Machines 8 hours
Impulse Turbines :- Principle, Constructional features, Installation of Pelton turbine, Velocity diagram & analysis, Working proportions, Design parameters, Performance characteristics, Governing & selection criteria.

Unit - V: Reaction or Pressure turbine 7 hours
Principles 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

Unit - VI : Hydraulic Pumps 8 hours
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.

Total No of periods: 45



Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Fifth Semester) Aeronautical Engineering
Aircraft Flight Mechanics (BEAE-502T)
(Total Credits: 05)

Teaching Scheme
Lectures: 4 Hours/ Week
Tutorial: 1 Hours / Week

Examination Scheme
Theory
T (U): 80 Marks **T (I): 20 Marks**
Duration of University Exam: 03 Hours

Unit- I Introduction and background **6 hours**
Dimensional analysis, Buckingham Pi theorem-applications-similarity laws and models International Standard Atmosphere

Unit-II: FORCES AND MOMENTS ON THE AIRPLANE **10 hours**
Forces and moments acting on a flight vehicle - Equation of motion of a rigid flight vehicle - Different types of drag - Drag polars 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.

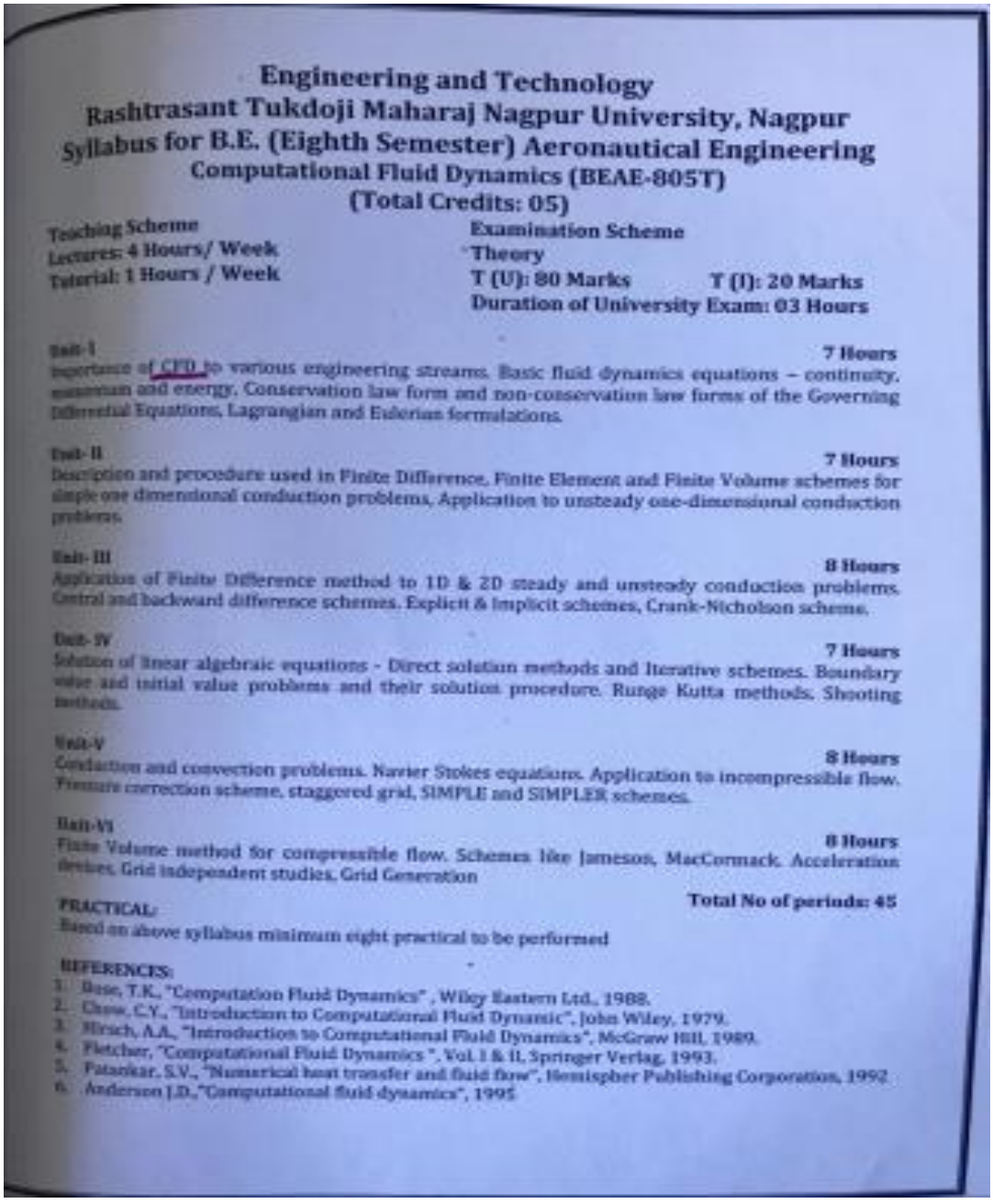
AIRCRAFT PERFORMANCE
Unit-III **8 Hours**
Performance of airplane in level flight - Maximum speed in level flight - Conditions for minimum drag and power required - Range and endurance, - Climbing flight (Maximum rate of climb and steepest angle of climb,) Service and absolute ceiling

Unit –IV **7 Hours**
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

STATIC LONGITUDINAL STABILITY
Unit-V **7 Hours**
Degree of freedom of rigid bodies in space - 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

Unit-VI **7 Hours**
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.

Total No of periods: 45



Engineering and Technology
Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Eighth Semester) Aeronautical Engineering
Computational Fluid Dynamics (BEAE-805T)
(Total Credits: 05)

Teaching Scheme
Lectures: 4 Hours/ Week
Tutorial: 1 Hours / Week

Examination Scheme
Theory
T (U): 80 Marks T (I): 20 Marks
Duration of University Exam: 03 Hours

Unit-I 7 Hours
Importance of CFD to various engineering streams. Basic fluid dynamics equations – continuity, momentum and energy. Conservation law form and non-conservation law forms of the Governing Differential Equations, Lagrangian and Eulerian formulations.

Unit- II 7 Hours
Description and procedure used in Finite Difference, Finite Element and Finite Volume schemes for simple one dimensional conduction problems, Application to unsteady one-dimensional conduction problems.

Unit- III 8 Hours
Application of Finite Difference method to 1D & 2D steady and unsteady conduction problems. Central and backward difference schemes. Explicit & Implicit schemes, Crank-Nicholson scheme.

Unit- IV 7 Hours
Solution of linear algebraic equations - Direct solution methods and Iterative schemes. Boundary value and initial value problems and their solution procedure. Runge Kutta methods, Shooting methods.

Unit-V 8 Hours
Conduction and convection problems. Navier Stokes equations. Application to incompressible flow. Pressure correction scheme, staggered grid, SIMPLE and SIMPLER schemes.

Unit-VI 8 Hours
Finite Volume method for compressible flow. Schemes like Jamesos, MacCormack. Acceleration devices. Grid independent studies. Grid Generation

Total No of periods: 45

PRACTICAL:
Based on above syllabus minimum eight practical to be performed

REFERENCES:
1. Bose, T.K., "Computation Fluid Dynamics" , Wiley Eastern Ltd., 1988.
2. Chow, C.Y., "Introduction to Computational Fluid Dynamic", John Wiley, 1979.
3. Hirsch, A.A., "Introduction to Computational Fluid Dynamics", McGraw Hill, 1989.
4. Fletcher, "Computational Fluid Dynamics ", Vol. I & II, Springer Verlag, 1993.
5. Patankar, S.V., "Numerical heat transfer and fluid flow", Hemispher Publishing Corporation, 1992
6. Anderson J.D.,"Computational fluid dynamics", 1995

Project Mapping:

"2D SIMULATION TO STUDY THE EFFECT OF FLAPS ON /VARIOUS AIRFOILS"

This report is submitted to Rashtrasant Tukdoji Maharaj Nagpur University in partial fulfillment of the requirement for the award of degree of

Bachelor of Engineering in Aeronautical Engineering

By

1. **Ashwini Wandile**
2. **Chetna Khadse**
3. **Vaibhav Girade**

under the guidance of

Prof. Vishal Kaushik

DEPARTMENT OF AERONAUTICAL ENGINEERING

Lokmanya Tilak Jankalyan Shikshan Sanstha's

PRIYADARSHINI COLLEGE OF ENGINEERING

(An institution affiliated to Rashtrasant Tukdoji Maharaj Nagpur University)

NAGPUR – 440019

2020 – 2021

INTRODUCTION

Drones or Unmanned Aerial Systems (UAV - Unmanned Aerial Vehicle or UAS - Unmanned Aerial Systems) are aircraft, which can fly without a pilot and passengers on board. Drone Controlling is performed remotely by radio waves or autonomously (with a predetermined route). Drones do not have a specific size or type of drive. They are often equipped with accessories used for surveillance and monitoring, in the form of optoelectronic heads.

The most important feature of drones is that they do not need any additional infrastructure to quickly register and monitor a designated area or object. A significant advantage is the extremely short reaction time when it comes to commissioning and preparing the unit for a flight. The precursors of UAVs are aircraft used primarily in the uniformed services - the army and the police. The first countries that started researches on UAVs were the United States, the United Kingdom, Russia, Germany, and Israel.

The first time an unmanned flying vehicle was used by the Austrians in August of 1849. At the time there were used the balloons (filled with explosives) which have been known for almost 150 years and were being used as bombs. One of the first creators of drones was Charles Kettering, who in collaboration with Elmer Sperry, Orville Wright, and Robert Millikan created in 1915, the aircraft named "Kettering Bug". It was a primitive automatic plane, which based on sensors defined its height (by using a barometer), the distance traveled (based on the number of engine spins) and the position. In contrast, the first civilian aircraft was produced only in the 80s of the twentieth century in Japan at the request of the Minister of Agriculture, Forests, and Fisheries. Public drones differ from the military in size and drive. They are smaller and they are driven by an electric motor (military are driven by an internal combustion engine). They are mainly used for photographing and filming.

This project consists of flying wing swept back vertical take-off and landing. It will be Hexacopters – six engines drone. In addition, VTOL systems must be used to operate as a helicopter in the required tasks such as hovering. However, if endurance is a priority, then a fixed-wing type will most likely be preferred due to the efficiency of the cruise flight. If both of these features are demanded in a single operation then a fixed-wing vertical and take-off landing (VTOL-FW) with level flight capability becomes the best option.

To combine the advantages of fixed-wing aircraft and multi-rotor UAVs, a hybrid UAV can be generated which is categorized into two main types:

Lokmanya Tilak Jankalyan Shikshan Sanstha's
PRIYADARSHINI COLLEGE OF ENGINEERING
(Recognised by A.I.C.T.E., New Delhi & Govt. of Maharashtra, Affiliated to R.T.M.Nagpur University)
Near CRPF Campus, Hingna Road, Nagpur-440 019, Maharashtra (India)
Phone : 07104 – 236381, 237307, Fax : 07104 – 237681,
email : principal.pce.ngp@gmail.com, www.pcenagpur.edu.in

"CFD ANALYSIS OF WINGLETS"

This report is submitted to Rashtrasant Tukdoji Maharaj Nagpur University in partial fulfillment of the requirement for the award of degree

of

Bachelor of Engineering in Aeronautical Engineering

by

ANSHUL GIRI

under the coordination and guidance of

Prof. SANDEEP PATIL and Prof.Ashish Meshram

DEPARTMENT OF AERONAUTICAL ENGINEERING

Lokmanya Tilak Jankalyan Shikshan Sanstha's

PRIYADARSHINI COLLEGE OF ENGINEERING

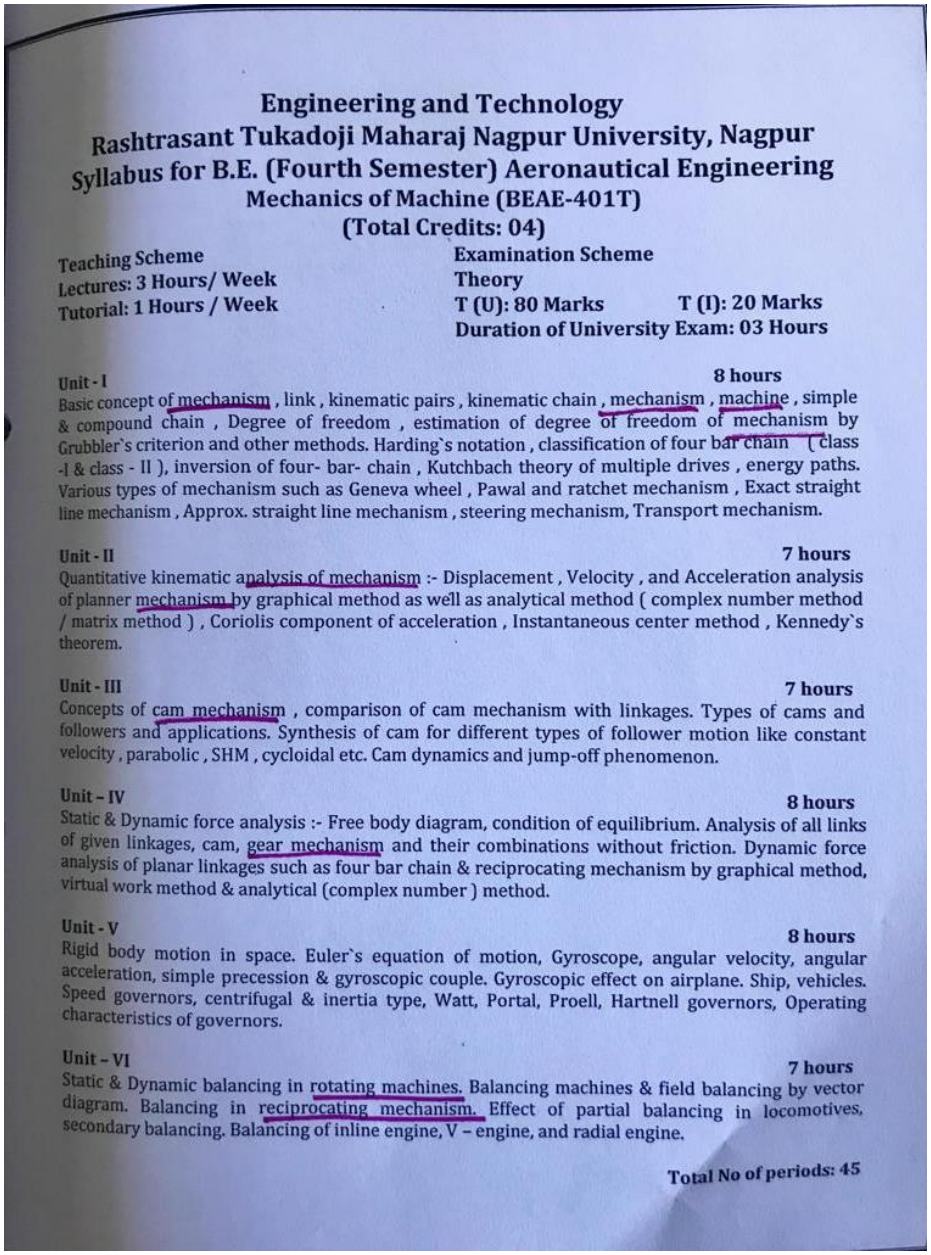
(An institution affiliated to Rashtrasant Tukdoji Maharaj Nagpur University)

NAGPUR – 440019

2020 – 2021

Domain 3: Structure

Sr. No	Name of the course that include experiential learning through Project work/ Internship	Subject Code	Domain
1	Mechanics of Machine	BEAE-401T	Structure
2	Aircraft Materials	BEAE-403T	
3	Aircraft Structure- I	BEAE-404T&P	
4	Aircraft Structure- II	BEAE-504T&P	
5	Non Destructive Inspection	BEAE-506P	
6	CAD/ CAM	BEAE-507P	
7	Design of Machine Elements	BEAE-702T	
8	Vibration and Aero- elasticity	BEAE-802T	



Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Fourth Semester) Aeronautical Engineering
Mechanics of Machine (BEAE-401T)
(Total Credits: 04)

Teaching Scheme
Lectures: 3 Hours/ Week
Tutorial: 1 Hours / Week

Examination Scheme
Theory
T (U): 80 Marks **T (I): 20 Marks**
Duration of University Exam: 03 Hours

Unit - I **8 hours**
Basic concept of mechanism , link , kinematic pairs , kinematic chain , mechanism , machine , simple & compound chain , Degree of freedom , estimation of degree of freedom of mechanism by Grubbler's criterion and other methods. Harding's notation , classification of four bar chain (class -I & class - II), inversion of four- bar- chain , Kutchbach theory of multiple drives , energy paths. Various types of mechanism such as Geneva wheel , Pawal and ratchet mechanism , Exact straight line mechanism , Approx. straight line mechanism , steering mechanism, Transport mechanism.

Unit - II **7 hours**
Quantitative kinematic analysis of mechanism :- Displacement , Velocity , and Acceleration analysis of planner mechanism by graphical method as well as analytical method (complex number method / matrix method) , Coriolis component of acceleration , Instantaneous center method , Kennedy's theorem.

Unit - III **7 hours**
Concepts of cam mechanism , comparison of cam mechanism with linkages. Types of cams and followers and applications. Synthesis of cam for different types of follower motion like constant velocity , parabolic , SHM , cycloidal etc. Cam dynamics and jump-off phenomenon.

Unit – IV **8 hours**
Static & Dynamic force analysis :- Free body diagram, condition of equilibrium. Analysis of all links of given linkages, cam, gear mechanism and their combinations without friction. Dynamic force analysis of planar linkages such as four bar chain & reciprocating mechanism by graphical method, virtual work method & analytical (complex number) method.

Unit - V **8 hours**
Rigid body motion in space. Euler's equation of motion, Gyroscope, angular velocity, angular acceleration, simple precession & gyroscopic couple. Gyroscopic effect on airplane. Ship, vehicles. Speed governors, centrifugal & inertia type, Watt, Portal, Proell, Hartnell governors, Operating characteristics of governors.

Unit – VI **7 hours**
Static & Dynamic balancing in rotating machines. Balancing machines & field balancing by vector diagram. Balancing in reciprocating mechanism. Effect of partial balancing in locomotives, secondary balancing. Balancing of inline engine, V – engine, and radial engine.

Total No of periods: 45

Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Fourth Semester) Aeronautical Engineering
Aircraft Materials (BEAE-403T)
(Total Credits: 04)

Teaching Scheme
Lectures: 4 Hours/ Week

Examination Scheme
Theory
T (U): 80 Marks **T (I): 20 Marks**
Duration of University Exam: 03 Hours

Unit – I: Introduction to aerospace materials; **10 hours**
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.

Unit – II: Introduction to composite materials **8 hours**
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.

Unit – III: Manufacturing Of Advanced Composites **7 hours**
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.

Unit – IV: Creep **5 hours**
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.

Unit – V: Fracture **8 hours**
Various types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture, ductile fracture due to micro void coalescence-diffusion controlled void growth; fracture maps for different alloys and oxides, Fatigue of aircraft materials

Oxidation and Hot Corrosion
Oxidation, Pilling, Bedworth ratio, kinetic laws of oxidation- defect structure and control of oxidation by alloy additions, hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion, interaction of hot corrosion and creep, methods of combat hot corrosion.

Unit –VI: Super alloys and Other Materials **6 hours**

Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Fourth Semester) Aeronautical Engineering
Aircraft Structure- I (BEAE-404P)
(Total Credits: 01)

Teaching Scheme
Practical: 2 Hours/ Week

Examination Scheme
Practical
T (U): 25 Marks **T (I): 25 Marks**

List of Experiments in Aircraft Structure- I (Minimum any Ten Experiments)

1. Study of strain measuring instruments mechanical, electrical types.
2. Tension test on metals.
3. Hardness test on metals.
4. Torsion test on metals.
5. Impact test metals.
6. Transverse test on beams including deflections.
7. Notch Bar Test for toughness of metals.
8. Measurement of static strains using electrical resistance gauges.
9. Verification of S.T. in beams.
10. Deflection of springs.
11. Aircraft structure material: Absorption Test, Dimension Test, Crushing strength

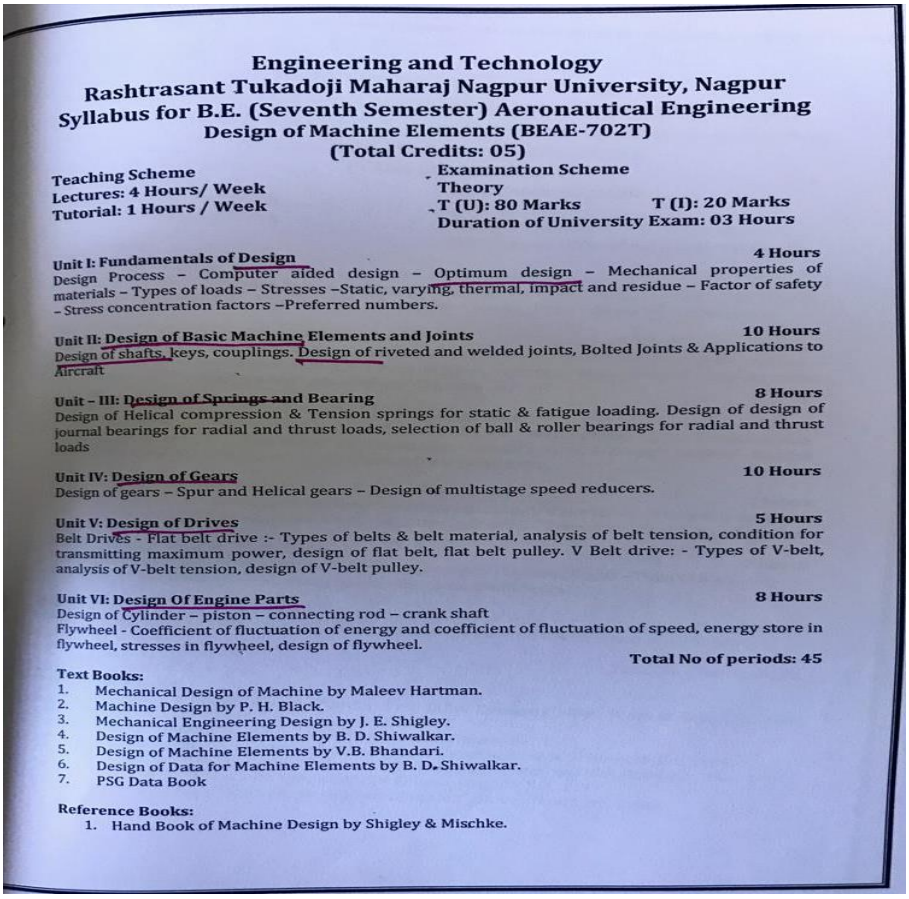
Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Fifth Semester) Aeronautical Engineering
Non Destructive Inspection (BEAE-506P)
(Total Credits: 02)

Teaching Scheme
Practical: 2 Hours/ Week

Examination Scheme
Practical
T (U): 25 Marks **T (I): 25 Marks**

Objective:
The training will have a focus on creating awareness of various non destructive techniques such as ultrasonic, radiography, dye penetration etc. for determination of defects / damage in structural component for maintenance.

List of Experiments for Non Destructive Inspection:
1. Simple optical inspection
2. Borescope
3. Ultrasonic flaw detection
4. Ultrasonic thickness measurement
5. Dye Penetration testing
6. Eddy current testing
7. Magnetic particle testing
8. Radiography
9. Weld inspection
10. Metallurgical Microscope



Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Seventh Semester) Aeronautical Engineering
Design of Machine Elements (BEAE-702T)
(Total Credits: 05)

Teaching Scheme
Lectures: 4 Hours/ Week
Tutorial: 1 Hours / Week

Examination Scheme
Theory
T (U): 80 Marks **T (I): 20 Marks**
Duration of University Exam: 03 Hours

Unit I: Fundamentals of Design **4 Hours**
Design Process – Computer aided design – Optimum design – Mechanical properties of materials – Types of loads – Stresses –Static, varying, thermal, impact and residue – Factor of safety – Stress concentration factors –Preferred numbers.

Unit II: Design of Basic Machine Elements and Joints **10 Hours**
Design of shafts, keys, couplings. Design of riveted and welded joints, Bolted Joints & Applications to Aircraft

Unit – III: Design of Springs and Bearing **8 Hours**
Design of Helical compression & Tension springs for static & fatigue loading. Design of design of journal bearings for radial and thrust loads, selection of ball & roller bearings for radial and thrust loads

Unit IV: Design of Gears **10 Hours**
Design of gears – Spur and Helical gears – Design of multistage speed reducers.

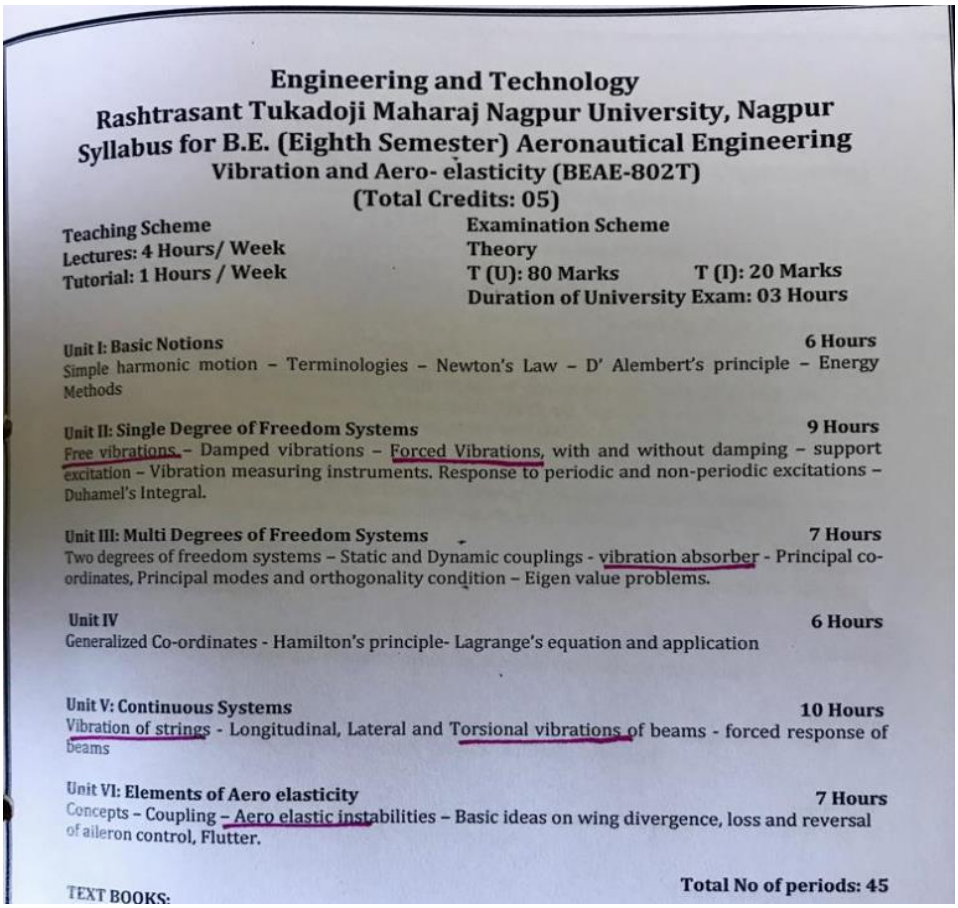
Unit V: Design of Drives **5 Hours**
Belt Drives - Flat belt drive :- Types of belts & belt material, analysis of belt tension, condition for transmitting maximum power, design of flat belt, flat belt pulley. V Belt drive: - Types of V-belt, analysis of V-belt tension, design of V-belt pulley.

Unit VI: Design Of Engine Parts **8 Hours**
Design of cylinder – piston – connecting rod – crank shaft
Flywheel - Coefficient of fluctuation of energy and coefficient of fluctuation of speed, energy store in flywheel, stresses in flywheel, design of flywheel.

Total No of periods: 45

Text Books:
1. Mechanical Design of Machine by Maleev Hartman.
2. Machine Design by P. H. Black.
3. Mechanical Engineering Design by J. E. Shigley.
4. Design of Machine Elements by B. D. Shiwalkar.
5. Design of Machine Elements by V.B. Bhandari.
6. Design of Data for Machine Elements by B. D. Shiwalkar.
7. PSG Data Book

Reference Books:
1. Hand Book of Machine Design by Shigley & Mischke.



Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Eighth Semester) Aeronautical Engineering
Vibration and Aero- elasticity (BEAE-802T)
(Total Credits: 05)

Teaching Scheme
Lectures: 4 Hours/ Week
Tutorial: 1 Hours / Week

Examination Scheme
Theory
T (U): 80 Marks **T (I): 20 Marks**
Duration of University Exam: 03 Hours

Unit I: Basic Notions **6 Hours**
Simple harmonic motion – Terminologies – Newton's Law – D' Alembert's principle – Energy Methods

Unit II: Single Degree of Freedom Systems **9 Hours**
Free vibrations – Damped vibrations – Forced Vibrations, with and without damping – support excitation – Vibration measuring instruments. Response to periodic and non-periodic excitations – Duhamel's Integral.

Unit III: Multi Degrees of Freedom Systems **7 Hours**
Two degrees of freedom systems – Static and Dynamic couplings - vibration absorber - Principal co-ordinates, Principal modes and orthogonality condition – Eigen value problems.

Unit IV **6 Hours**
Generalized Co-ordinates - Hamilton's principle- Lagrange's equation and application

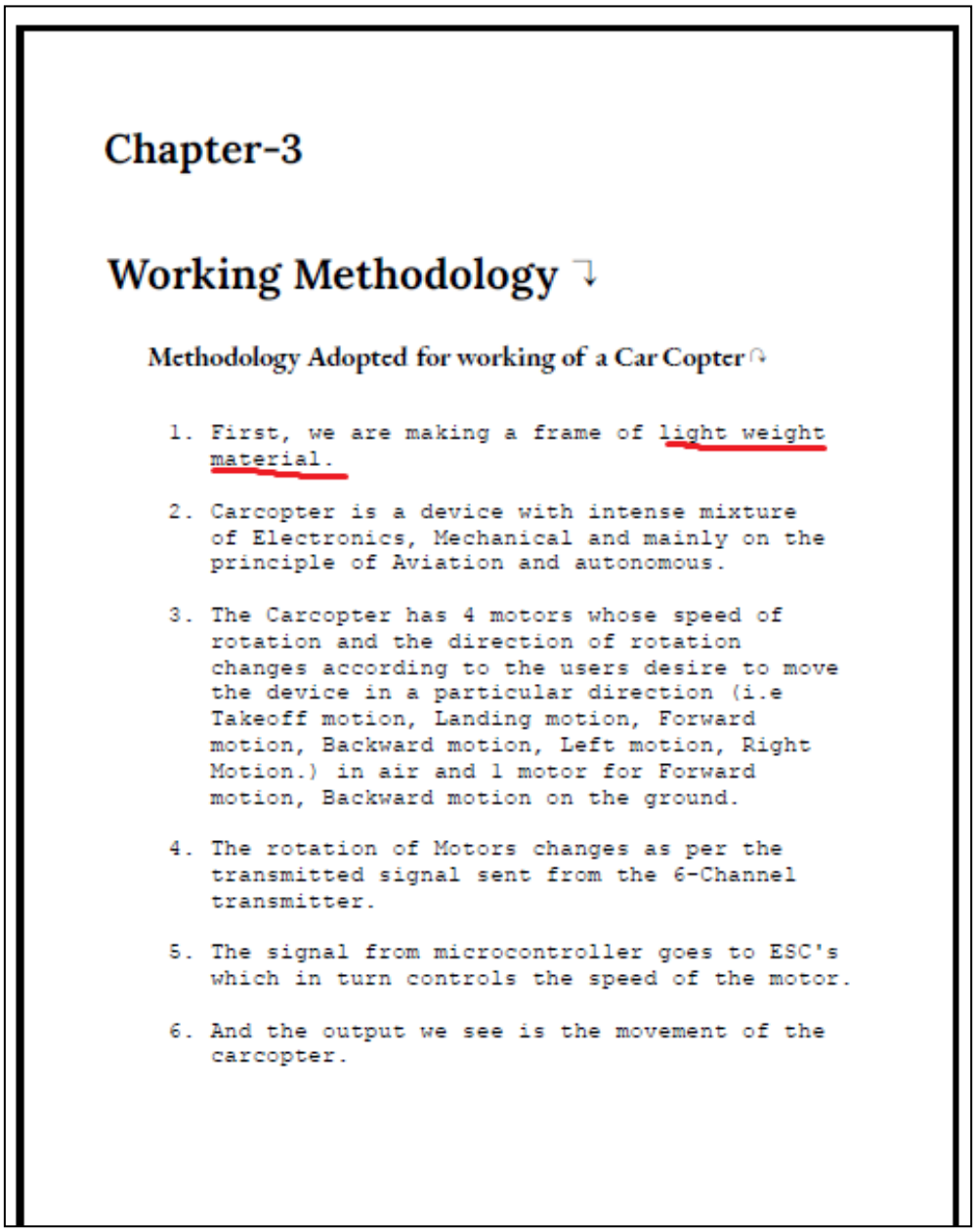
Unit V: Continuous Systems **10 Hours**
Vibration of strings - Longitudinal, Lateral and Torsional vibrations of beams - forced response of beams

Unit VI: Elements of Aero elasticity **7 Hours**
Concepts – Coupling – Aero elastic instabilities – Basic ideas on wing divergence, loss and reversal of aileron control, Flutter.

Total No of periods: 45

TEXT BOOKS:

Project Mapping:



Chapter-3

Working Methodology

Methodology Adopted for working of a Car Copter

1. First, we are making a frame of light weight material.
2. Carcopter is a device with intense mixture of Electronics, Mechanical and mainly on the principle of Aviation and autonomous.
3. The Carcopter has 4 motors whose speed of rotation and the direction of rotation changes according to the users desire to move the device in a particular direction (i.e Takeoff motion, Landing motion, Forward motion, Backward motion, Left motion, Right Motion.) in air and 1 motor for Forward motion, Backward motion on the ground.
4. The rotation of Motors changes as per the transmitted signal sent from the 6-Channel transmitter.
5. The signal from microcontroller goes to ESC's which in turn controls the speed of the motor.
6. And the output we see is the movement of the carcopter.

"COMPARATIVE ANALYSIS OF CENTRIFUGAL AND AXIAL COMPRESSOR USING CFD TECHNIQUE"

This report is submitted to Rashtrasant Tukadoji Maharaj Nagpur University in partial fulfillment of the requirement for the award of degree

of

Bachelor of Engineering in Aeronautical Engineering

by

1. Kedar Kulkarni
2. Sharayu Sonkusare
3. Aman Bawaria
4. Yogeshwar Dalal

under the guidance of

Prof. Sandeep Patil

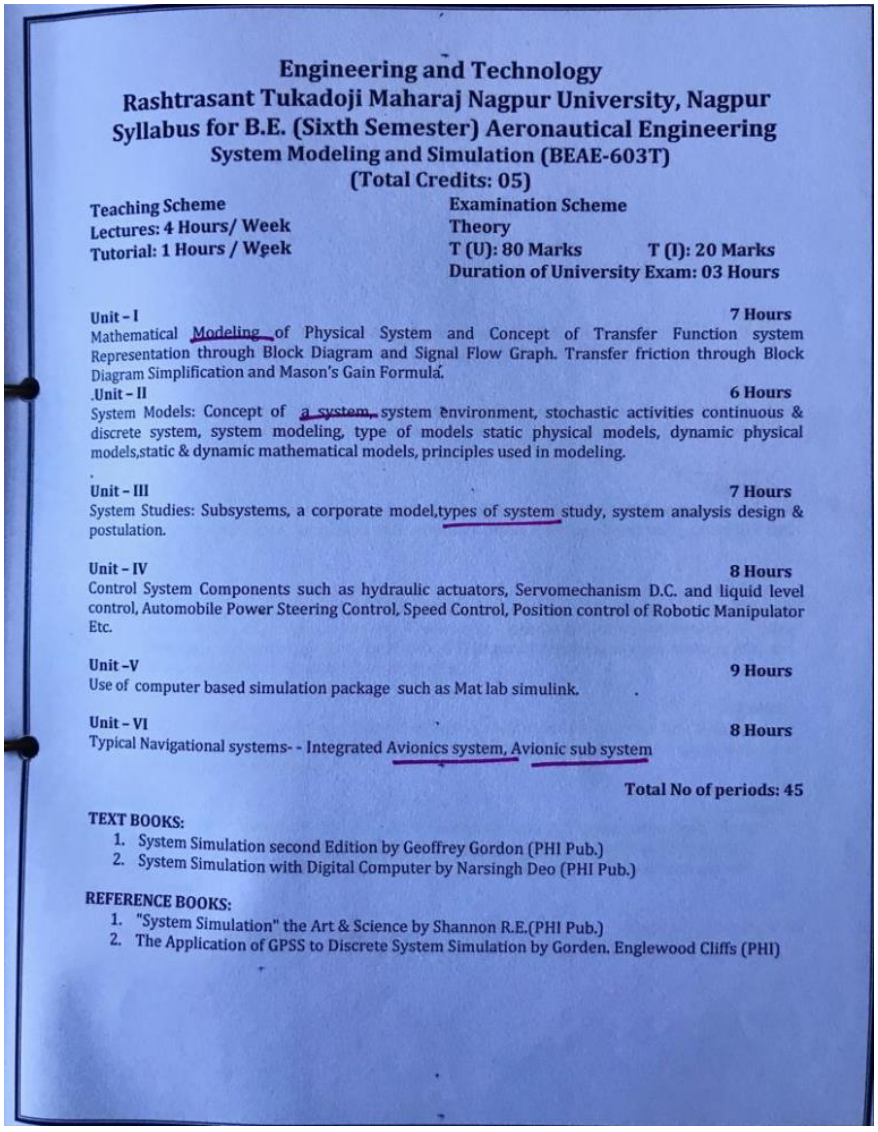
DEPARTMENT OF AERONAUTICAL ENGINEERING
Lokmanya Tilak Jankalyan Shikshan Sanstha's
PRIYADARSHINI COLLEGE OF ENGINEERING
(An institution affiliated to Rashtrasant Tukdoji Maharaj Nagpur University)
NAGPUR – 440019

2020 - 2021

Lokmanya Tilak Jankalyan Shikshan Sanstha's

Domain 4: Avionics

Sr. No	Name of the course that include experiential learning through Project work/ Internship	Subject Code	Domain
1	System Modeling and Simulation	BEAE-603T	Avionics
2	Applied Electronics	BEAE-604T&P	
3	Aircraft Systems and Instrumentation	BEAE-701T	
4	Control Engineering	BEAE-704T	
5	Aircraft Design Project	BEAE-706P	
6	Aircraft System	BEAE-707P	
7	Air Transportation	BEAE-801T	



Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Sixth Semester) Aeronautical Engineering
System Modeling and Simulation (BEAE-603T)
(Total Credits: 05)

Teaching Scheme
Lectures: 4 Hours/ Week
Tutorial: 1 Hours / Week

Examination Scheme
Theory
T (U): 80 Marks **T (I): 20 Marks**
Duration of University Exam: 03 Hours

Unit – I **7 Hours**
Mathematical Modeling of Physical System and Concept of Transfer Function system Representation through Block Diagram and Signal Flow Graph. Transfer friction through Block Diagram Simplification and Mason's Gain Formula.

Unit – II **6 Hours**
System Models: Concept of a system, system environment, stochastic activities continuous & discrete system, system modeling, type of models static physical models, dynamic physical models,static & dynamic mathematical models, principles used in modeling.

Unit – III **7 Hours**
System Studies: Subsystems, a corporate model,types of system study, system analysis design & postulation.

Unit – IV **8 Hours**
Control System Components such as hydraulic actuators, Servomechanism D.C. and liquid level control, Automobile Power Steering Control, Speed Control, Position control of Robotic Manipulator Etc.

Unit –V **9 Hours**
Use of computer based simulation package such as Mat lab simulink.

Unit – VI **8 Hours**
Typical Navigational systems- - Integrated Avionics system, Avionic sub system

Total No of periods: 45

TEXT BOOKS:
1. System Simulation second Edition by Geoffrey Gordon (PHI Pub.)
2. System Simulation with Digital Computer by Narsingh Deo (PHI Pub.)

REFERENCE BOOKS:
1. "System Simulation" the Art & Science by Shannon R.E.(PHI Pub.)
2. The Application of GPSS to Discrete System Simulation by Gorden. Englewood Cliffs (PHI)

Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Sixth Semester) Aeronautical Engineering
Applied Electronics (BEAE-604T)
(Total Credits: 05)

Teaching Scheme
Lectures: 4 Hours/ Week
Tutorial: 1 Hours / Week

Examination Scheme
Theory
T (U): 80 Marks **T (I): 20 Marks**
Duration of University Exam: 03 Hours

Unit I **6 Hours**
Digital Computers, Memory Classification, Architecture of 8085 Microprocessor, Interfacing of memories/latches/buffers /leds/7-segment display/pushbutton/switches.

Unit II **9 Hours**
Addressing Modes, Instruction Set Classification, Simple Instructions with programs for data transfer, arithmetic, logical , branching and machine control ,Stacks and subroutines , simple and nested calls and return.

Unit III **10 Hours**
Code conversion ,BC D arithmetic and 16 bit data handling instructions and programs, Formats of data transfer, Interrupts (hardware and software). Serial data communication using SID and SOD pins.

Unit IV **8 hours**
Programmable peripheral interface(PPI) 8255, architecture, interfacing and different modes,Interfacing of keyboards/leds/7-segment display/pushbutton/switches using 8255, Interfacing of matrix keyboard, multiplexed 7- segment displays, stepper motors, ADC and DAC.Bus contention and slow memories interfacing

Unit V **6 Hours**
Introduction: Importance and role of avionics, avionic environment. Displays and man-machine interaction: Head up displays, intelligent displays management, Displays technology, control and data entry, instrument placement .

Unit VI **6 Hours**
Onboard communications: Microphones, Digital communications, Transmission lines, Digital data bus systems ARINC 426, MIL STD 1553, Commercial standard digital bus, Fiber optic communication Avionics system integration: Data bus systems, integrated modular avionic

Total No of periods: 45

Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Seventh Semester) Aeronautical Engineering
Aircraft Design Project (BEAE-706P)
(Total Credits: 02)

Teaching Scheme
Practical: 2 Hours/ Week

Examination Scheme
Practical
T (U): 25 Marks **T (I): 25 Marks**

OBJECTIVE
To enhance the knowledge in continuation of the design project given in project–I. To introduce and develop the basic concept of aircraft design. Each student is assigned with the design of an Airplane for given preliminary specifications. The following are the assignments to be carried out:

Task list for the project
1. Comparative configuration study of similar airplanes
2. Selection of main parameters for the design
3. Preliminary weight estimations
4. Power plant selection, Aerofoil selection, Wing tail and control surfaces
5. Preparation of layouts of balance diagram and three view drawings
6. Estimation of various Drag components.
7. Performance calculations and stability estimates
8. V-n diagram for the design study
9. Load estimation of wings
10. Load estimation of fuselage.
11. Balancing and Maneuvering loads on tail plane, Aileron and Rudder loads.
12. Preliminary structural design of wing/fuselage
13. Preparation of a detailed design report

Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Eighth Semester) Aeronautical Engineering
Air Transportation (BEAE-801T)
(Total Credits: 05)

Teaching Scheme
Lectures: 4 Hours/ Week
Tutorial: 1 Hours / Week

Examination Scheme
Theory
T (U): 80 Marks **T (I): 20 Marks**
Duration of University Exam: 03 Hours

Unit I: Introduction **8 Hours**
Development of air transportation, comparison with other modes of transport - Role of IATA, ICAO – The general aviation industry airline - Factors affecting general aviation, use of aircraft, airport: airline management and organisation - levels of management, functions of management, Principles of organisation planning the organisation - chart, staff departments & line departments.

Unit II: Airline Economics **7 Hours**
Forecasting - Fleet size, Fleet planning, the aircraft selection process, operating cost, passenger capacity, load factor etc. - Passenger fare and tariffs - Influence of geographical, economic & political factors on routes and route selection.

Unit III: Fleet Planning **8 Hours**
The aircraft selection process - Fleet commonality, factors affecting choice of fleet, route selection and Capitol acquisition - Valuation & Depreciation - Budgeting, Cost planning - Aircrew evaluation - Route analysis - Aircraft evaluation.

Unit IV Principles of Airlines Scheduling **7 Hours**
Equipment maintenance, Flight operations and crew scheduling, Ground operations and facility limitations equipments and types of schedule - hub & spoke scheduling, advantages / disadvantages & preparing flight plans- Aircraft scheduling in line with aircraft maintenance practices.

Unit IV: Aircraft Reliability **8 Hours**
Aircraft reliability - The maintenance schedule & its determinations - Condition monitoring maintenance - Extended range operations (EROPS) & ETOPS - Ageing aircraft maintenance production.

Unit VI: Technology in Aircraft Maintenance **7 Hours**
Airlines scheduling (with reference to engineering) - Product support and spares - Maintenance sharing - Equipments and tools for aircraft maintenance - Aircraft weight control - Budgetary control. On board maintenance systems - Engine monitoring - Turbine engine oil maintenance - Turbine engine vibration monitoring in aircraft - Life usage monitoring - Current capabilities of NDT - Helicopter maintenance -Future of aircraft maintenance.

Total No of periods: 45

Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Seventh Semester) Aeronautical Engineering
Aircraft System (BEAE-707P)
(Total Credits: 02)

Teaching Scheme
Practical: 2 Hours/ Week

Examination Scheme
Practical
T (U): 25 Marks **T (I): 25 Marks**

OBJECTIVE
To train the students "ON HAND" experience in maintenance of various air frame systems in aircraft and rectification of common snags.

List of Experiment for Aircraft Systems and Instrumentation

1. Aircraft "Jacking Up" procedure
2. Aircraft "Levelling" procedure
3. Control System "Rigging check" procedure
4. Aircraft "Symmetry Check" procedure
5. "Flow test" to assess of filter element clogging
6. "Pressure Test" To assess hydraulic External/Internal Leakage
7. "Functional Test" to adjust operating pressure
8. "Pressure Test" procedure on fuel system components
9. "Brake Torque Load Test" on wheel brake units
10. Maintenance and rectification of snags in hydraulic and fuel systems.

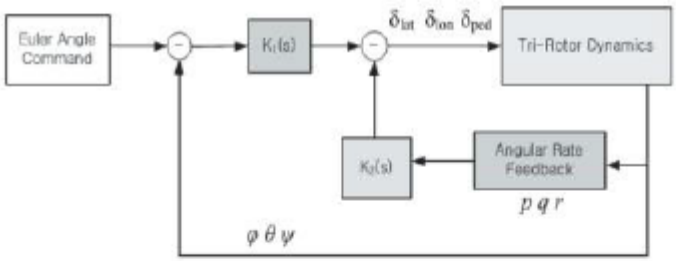
Project Mapping:

the two signals from the gyros and accelerometer [88]. This allows for the FCS to have a much faster awareness of what its orientation is

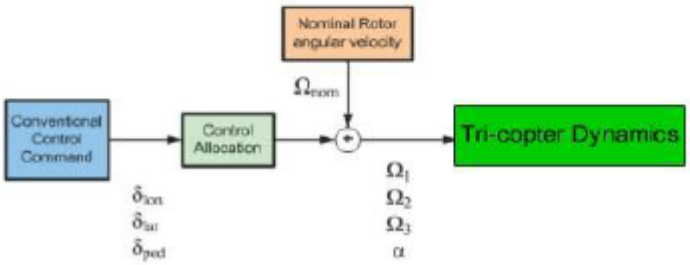
The microcontroller can have a GPS/Compass module connected via an inter-integrated-circuit (I2C) connection adding additional sensing functionality to the Microcontroller. Being based on the Arduino Mega means the APM also has analog and digital pin inputs and outputs.

On the analog pin's devices such as the Sonar and Airspeed sensor are connected as they provide analog data such as pressure difference and sound delay to produce digital information used by the control.

A control scheme can be made specifically to the tri-copter aspect of the UAV. The normal inputs, in this case, are longitudinal (δ-long), lateral (δ-lat) and yaw (δ-yaw) [57]. We can develop a block diagram as shown in Figure 90.

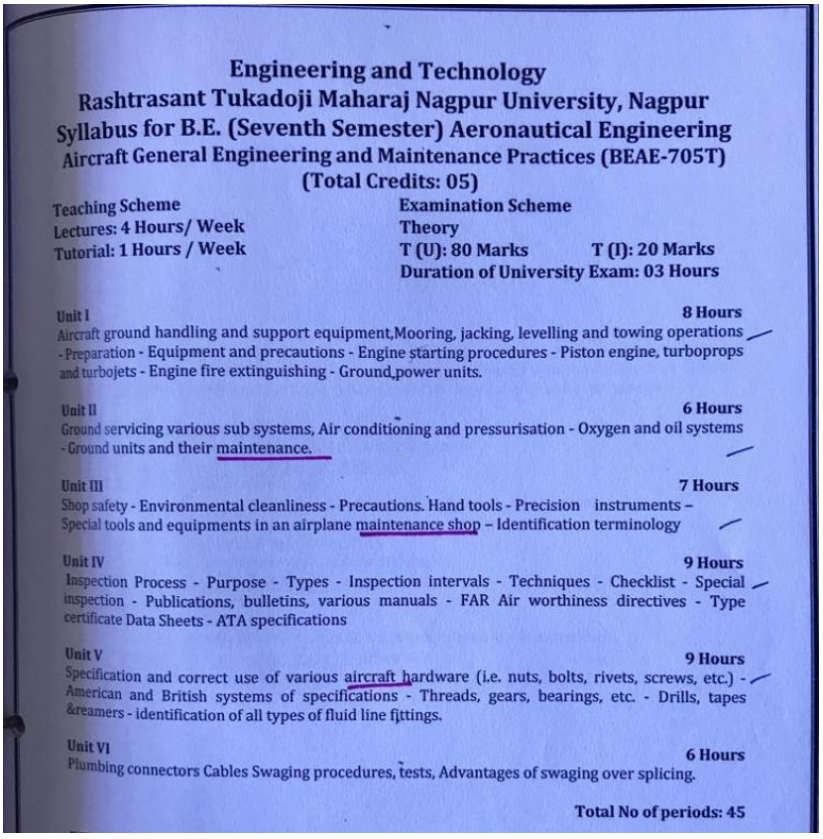


Once the longitudinal (δ-long), lateral (δ-lat), and yaw (δ-yaw) are read the controller can interpret them into angular velocities of the rotors and the angle of attack necessary the UAV needs in yaw this is shown in Figure 91.



Domain 5: Maintenance

Sr. No	Name of the course that include experiential learning through Project work/ Internship	Subject Code	Domain
1	Aircraft General Engineering and Maintenance Practices	BEAE-705T	Maintenance
2	Elective –I Reliability Centered Maintenance	BEAE-803T	
3	Elective-II- Airframe Maintenance and Repair	BEAE-804T	



Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Seventh Semester) Aeronautical Engineering
Aircraft General Engineering and Maintenance Practices (BEAE-705T)
(Total Credits: 05)

Teaching Scheme
Lectures: 4 Hours/ Week
Tutorial: 1 Hours / Week

Examination Scheme
Theory
T (U): 80 Marks **T (I): 20 Marks**
Duration of University Exam: 03 Hours

Unit I **8 Hours**
Aircraft ground handling and support equipment,Mooring, jacking, levelling and towing operations - Preparation - Equipment and precautions - Engine starting procedures - Piston engine, turboprops and turbojets - Engine fire extinguishing - Ground,power units.

Unit II **6 Hours**
Ground servicing various sub systems, Air conditioning and pressurisation - Oxygen and oil systems - Ground units and their maintenance.

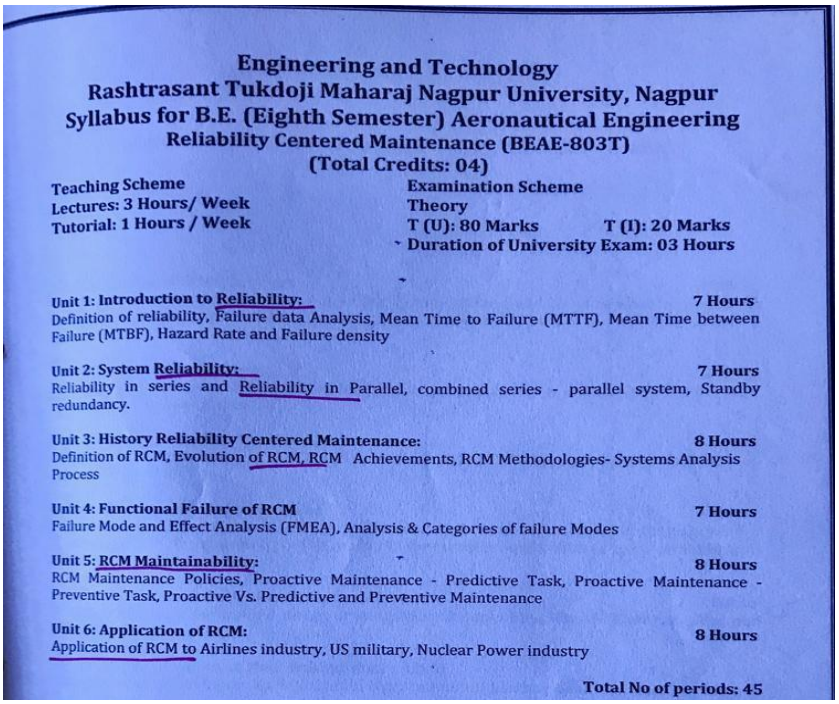
Unit III **7 Hours**
Shop safety - Environmental cleanliness - Precautions. Hand tools - Precision instruments – Special tools and equipments in an airplane maintenance shop – Identification terminology

Unit IV **9 Hours**
Inspection Process - Purpose - Types - Inspection intervals - Techniques - Checklist - Special inspection - Publications, bulletins, various manuals - FAR Air worthiness directives - Type certificate Data Sheets - ATA specifications

Unit V **9 Hours**
Specification and correct use of various aircraft hardware (i.e. nuts, bolts, rivets, screws, etc.) - American and British systems of specifications - Threads, gears, bearings, etc. - Drills, tapes &reamers - identification of all types of fluid line fittings.

Unit VI **6 Hours**
Plumbing connectors Cables Swaging procedures, tests, Advantages of swaging over splicing.

Total No of periods: 45



Engineering and Technology
Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Eighth Semester) Aeronautical Engineering
Reliability Centered Maintenance (BEAE-803T)
(Total Credits: 04)

Teaching Scheme
Lectures: 3 Hours/ Week
Tutorial: 1 Hours / Week

Examination Scheme
Theory
T (U): 80 Marks **T (I): 20 Marks**
Duration of University Exam: 03 Hours

Unit 1: Introduction to Reliability: **7 Hours**
Definition of reliability, Failure data Analysis, Mean Time to Failure (MTTF), Mean Time between Failure (MTBF), Hazard Rate and Failure density

Unit 2: System Reliability: **7 Hours**
Reliability in series and Reliability in Parallel, combined series - parallel system, Standby redundancy.

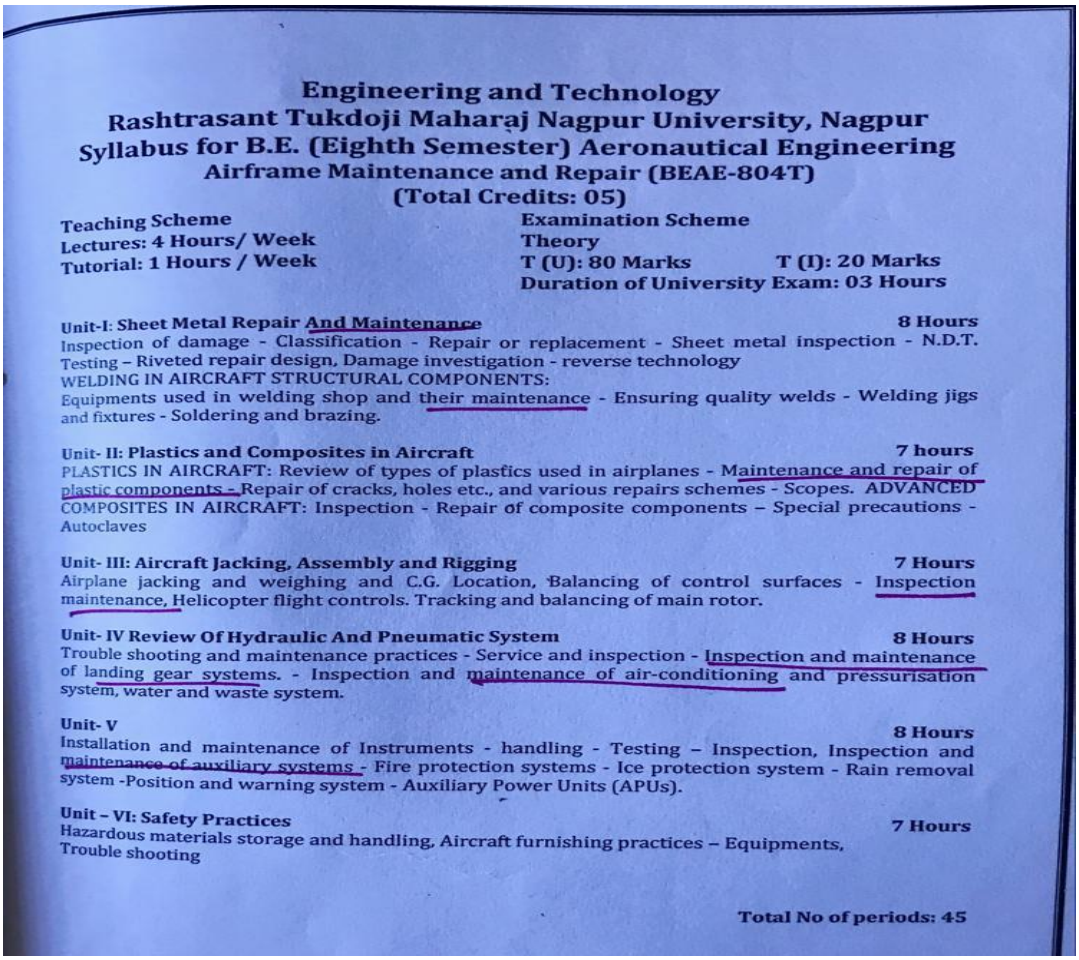
Unit 3: History Reliability Centered Maintenance: **8 Hours**
Definition of RCM, Evolution of RCM, RCM Achievements, RCM Methodologies- Systems Analysis Process

Unit 4: Functional Failure of RCM **7 Hours**
Failure Mode and Effect Analysis (FMEA), Analysis & Categories of failure Modes

Unit 5: RCM Maintainability: **8 Hours**
RCM Maintenance Policies, Proactive Maintenance - Predictive Task, Proactive Maintenance - Preventive Task, Proactive Vs. Predictive and Preventive Maintenance

Unit 6: Application of RCM: **8 Hours**
Application of RCM to Airlines industry, US military, Nuclear Power industry

Total No of periods: 45



Engineering and Technology
Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Eighth Semester) Aeronautical Engineering
Airframe Maintenance and Repair (BEAE-804T)
(Total Credits: 05)

Teaching Scheme
Lectures: 4 Hours/ Week
Tutorial: 1 Hours / Week

Examination Scheme
Theory
T (U): 80 Marks **T (I): 20 Marks**
Duration of University Exam: 03 Hours

Unit-I: Sheet Metal Repair And Maintenance **8 Hours**
Inspection of damage - Classification - Repair or replacement - Sheet metal inspection - N.D.T. Testing – Riveted repair design, Damage investigation - reverse technology
WELDING IN AIRCRAFT STRUCTURAL COMPONENTS:
Equipments used in welding shop and their maintenance - Ensuring quality welds - Welding jigs and fixtures - Soldering and brazing.

Unit- II: Plastics and Composites in Aircraft **7 hours**
PLASTICS IN AIRCRAFT: Review of types of plastics used in airplanes - Maintenance and repair of plastic components - Repair of cracks, holes etc., and various repairs schemes - Scopes. ADVANCED COMPOSITES IN AIRCRAFT: Inspection - Repair of composite components – Special precautions - Autoclaves

Unit- III: Aircraft Jacking, Assembly and Rigging **7 Hours**
Airplane jacking and weighing and C.G. Location, Balancing of control surfaces - Inspection maintenance, Helicopter flight controls. Tracking and balancing of main rotor.

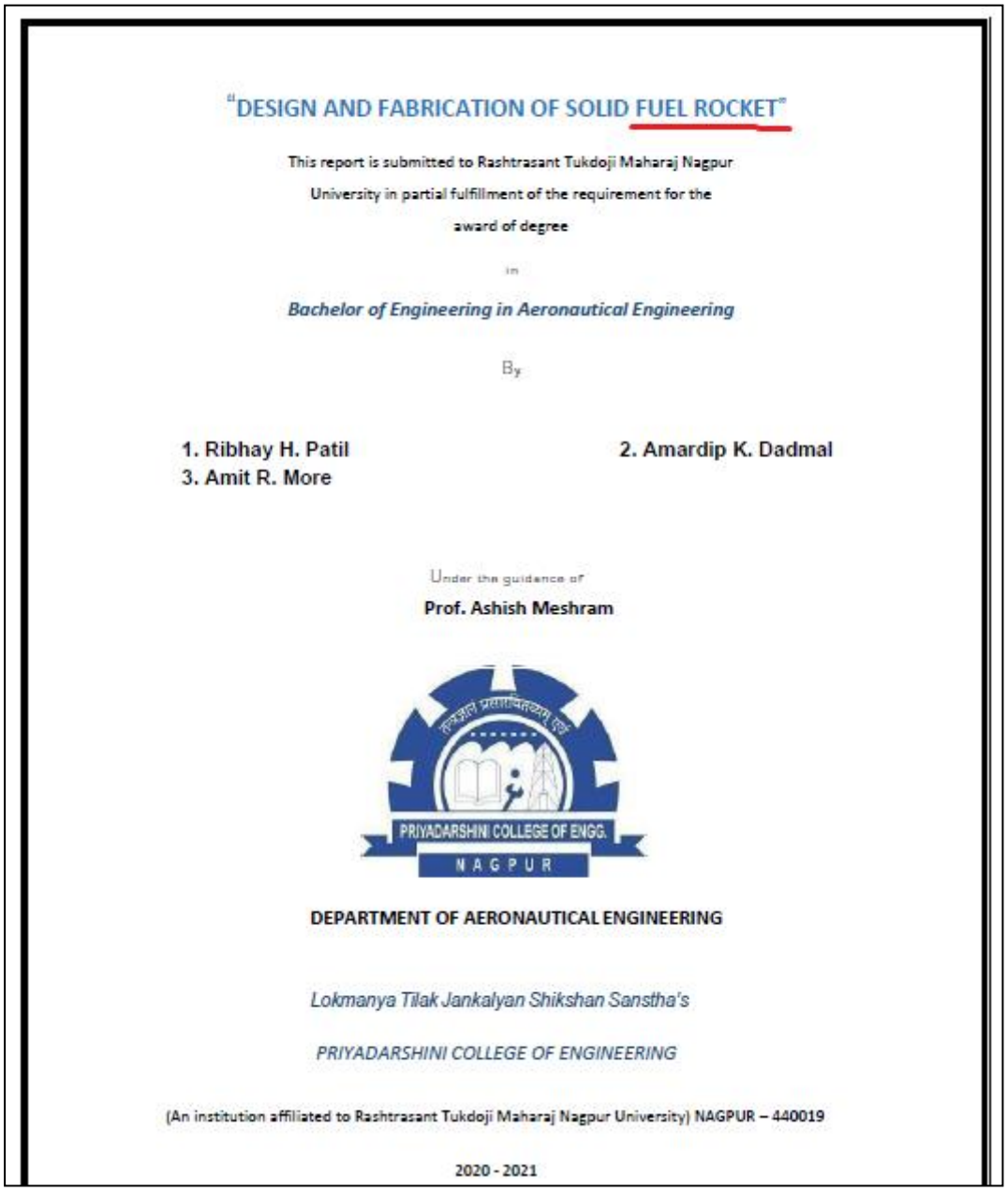
Unit- IV Review Of Hydraulic And Pneumatic System **8 Hours**
Trouble shooting and maintenance practices - Service and inspection - Inspection and maintenance of landing gear systems. - Inspection and maintenance of air-conditioning and pressurisation system, water and waste system.

Unit- V **8 Hours**
Installation and maintenance of Instruments - handling - Testing – Inspection, Inspection and maintenance of auxiliary systems - Fire protection systems - Ice protection system - Rain removal system -Position and warning system - Auxiliary Power Units (APUs).

Unit – VI: Safety Practices **7 Hours**
Hazardous materials storage and handling, Aircraft furnishing practices – Equipments, Trouble shooting

Total No of periods: 45

Project Mapping:



"DESIGN AND FABRICATION OF SOLID FUEL ROCKET"

This report is submitted to Rashtrasant Tukdoji Maharaj Nagpur University in partial fulfillment of the requirement for the award of degree

in

Bachelor of Engineering in Aeronautical Engineering

By

1. Ribhay H. Patil
2. Amardip K. Dadmal
3. Amit R. More

Under the guidance of

Prof. Ashish Meshram

DEPARTMENT OF AERONAUTICAL ENGINEERING

Lokmanya Tilak Jankalyan Shikshan Sanstha's

PRIYADARSHINI COLLEGE OF ENGINEERING

(An institution affiliated to Rashtrasant Tukdoji Maharaj Nagpur University) NAGPUR – 440019

2020 - 2021

Domain 6: Other

Sr. No	Name of the course that include experiential learning through Project work/ Internship	Subject Code	Domain
1	Applied Mathematics – III	BEAE-301T	Other
2	Computer Programming	BEAE-304T	
3	Seminar	BEAE-606P	
4	Environmental Studies	BEAE-407T	
5	Project Work Phase- I	BEAE708P	
6	Project Work Phase- II	BEAE-806P	
7	Manufacturing Process- I	BEAE-402T	
8	Manufacturing Process- II	BEAE-602T	

Syllabus:

Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Third Semester) Aeronautical Engineering
Applied Mathematics – III (BEAE-301T)
(Total Credits: 05)

Teaching Scheme — **Examination Scheme**
Lectures: 4 Hours / Week — **Theory**
Tutorial: 1 Hours / Week — **T (U): 80 Marks** **T (I): 20 Marks**
Duration of University Exam: 03 Hours

UNIT - I: Laplace Transform **12 Hours**
Definition, Properties, Laplace Transform of Derivatives and Integrals, Evaluation of integrals by Laplace Transform, Inverse Laplace Transform and its Properties, Convolution theorem(Statement only), Laplace Transform of Periodic Functions(Statement only), Unit Step Function and Unit Impulse Function, Applications of Laplace Transform to solve Ordinary Differential Equations, Simultaneous Differential Equations, Integral Equations & Integro-Differential Equations.

UNIT – II: Fourier Transform **04 Hours**
Definition and Properties (excluding FFT), Fourier Integral Theorem, Relation with Laplace Transform, Applications of Fourier Transform to Solve Integral Equation.

UNIT- III: Functions Of Complex Variable **12 Hours**
Analytic function, Cauchy- Riemann conditions, Harmonic Functions, Milne-Thomson Method,
Singularities, Cauchy Integral Theorem & Integral Formula (Statement only), Taylor's & Laurent's theorem (Statement only), Residue Theorem (Statement only), Evaluation of Real Definite Integrals by Contour Integration (around unit circle & semi- circle), Conformal mapping, Mapping by Linear and Inverse Transformation.

UNIT - IV: Partial Differential Equations. **10 Hours**
Partial Differential Equations of First Order First Degree i.e. Lagrange's Form, Linear Homogeneous
Partial Differential Equations of Higher Order with Constant Coefficients. Method of Separation of Variables, Applications to One- dimensional Heat Flow Equations. Two-dimensional Heat Flow Equations (only steady state). Applications of Laplace Transform to Solve Partial Differential Equations.

UNIT –V: Matrices: **12 Hours**
Linear and Orthogonal Transformations, Linear Dependence of Vectors, Characteristics Equation, Eigen Values and Eigen Vectors, Statement and Verification of Cayley- Hamilton Theorem [without proof], Reduction to Diagonal Form, Reduction of Quadratic Form to Canonical Form by Orthogonal
Transformation, Sylvester's Theorem [without proof], Solution of Second Order Linear Differential
Equations with Constant Coefficients by Matrix method. Largest Eigen Value and Eigen Vector by Iteration Method.

UNIT – VI: Numerical Methods: **10 Hours**
Error Analysis, Solution of Algebraic and Transcendental Equation by False Position Method, Newton –Raphson Method, Newton- Raphson Method for Multiple Roots, Solution of

System of Simultaneous Linear Equations: Gauss Elimination Method, Gauss- Seidel Method, Crout's Method, Solution of Ordinary Differential equations by Taylor's Series method, Runge-Kutta 4th
Order Method, Euler's Modified Method. Milne 's Predictor- Corrector Method.

Total No of Periods- 60 hours

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,

Reference Books

1. A Text Book of applied Mathematics, Volume I & 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

Engineering and Technology

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Third Semester) Aeronautical Engineering
Computer Programming (BEAE-304T)
(Total Credits: 04)

Teaching Scheme
Lectures: 3 Hours/ Week
Tutorial: 1 Hours / Week

Examination Scheme
Theory
T (U): 80 Marks **T (I): 20 Marks**
Duration of University Exam: 03 Hours

Unit - I: Introduction **8 hours**
Introduction to programming, programming languages, algorithms, flowcharts. C: Data types, Identifiers, Storage class, Constant, Operators, expression, Statements, console I/O statements, Selection statements: if-else, switch,Iteration Statements: for, while, do-while, Jump statements:return, go to, break, continue, comments.

Unit - II: Functions **8 hours**
Function, Call by value, Call by reference, calling functions with arrays, arguments to main (), return statements, recursion, function prototypes, inline keyword, preprocessor directives. Pointers: pointer variables, pointer operator, pointer expression, array of pointers, multiple indirection, pointers to functions, dynamic allocation functions.

Unit - III: Arrays **7 hours**
Arrays: single dimensional arrays, two dimensional arrays, multidimensional arrays, variable length arrays. Strings, array of strings.

Unit - IV: Structures **8 hours**
Structures: array of structures, passing structure to function, structure pointers, structure within structures. Unions, bit-fields, enumerations, sizeof, type def.

Unit - V: File I/O **7 hours**
File I/O: Streams and files, file system basics, fread, fwrite, fseek, random access I/O, fprintf(), fscanf(), standard streams.

Unit – VI: Advanced Concept in C **7 hours**
Advanced Concepts in C: Different types of pointers, ROM-BIOS functions, Elementary TSRs

Total No of Periods- 45 hours

Text Books:

1. The Complete Reference C (4th Edition) : Herbert Schildt [TMH]
2. C How to Program, 4th Edition by H. M. Deitel & P. J. Deitel, Pearson Education.
3. Writing TSRs through C : Yashwant Kanetkar (BPB)

Reference Books:

1. The C Programming Language : Dennis Ritchie & Brain Kernighan [Pearson]

Definition; Causes, effects and control measures of air, water, soil, marine, noise and thermal pollutions and nuclear hazards. Solid waste management - Causes, effects and contro l measures of urban and industrial waste. Role of individual and institutions in prevention of pollution. Disaster management Floods, Earth quacks, Cyclone and land slides.

UNIT – V **8 Hours**

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.

UNIT – VI **6 Hours**

Human Population and the Environment:

Global population growth, variation among nations, population explosion; Family Welfare Programmers.- methods of. sterilization; Urbanization.

Environment and human health - Climate and health, Infectious diseases, water- related diseases, risk due to chemicals in food, Cancer and environment. Human rights — Equity, Nutrition and health rights,

intellectual property rights (1PRS), Community Biodiversity registers (CBRs) Value education - environmental values, valuing nature, valuing cultures, social justice, human

heritage, equitable use of resources, common property resources, ecological degradation. HIY/AIDS; Women and Child Welfare; Information technology in environment and human health.

Total No of periods: 40

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.

Engineering and Technology

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

Syllabus for B.E. (Seventh Semester) Aeronautical Engineering

Project Work Phase- I(BEAE708P) (Total Credits: 02)

Teaching Scheme	Examination Scheme
Practical: 2 Hours/ Week	Practical
	T (I): 50 Marks

OBJECTIVE

The objective of the phase – I of the students project work is to prepare themselves to undertake lively project which will found end application to the industry / society.

Preparation for the project work involve

1. Form a team of likeminded students (not more than 8 in numbers) to carry out the project.
2. Make a preliminary survey and data collection or literature review of the project proposed in the next semester.
3. Conduct a thorough literature survey and publish or present a paper of the proposed work in any one of the forthcoming National seminars.
4. Plan for necessary supports, facilities, analytical tools and fixation of faculties / supervisors for the final semester project work.

Engineering and Technology

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Fourth Semester) Aeronautical Engineering

Manufacturing Process- I (BEAE-402T)
(Total Credits: 04)

Teaching Scheme
Lectures: 4 Hours/ Week

Examination Scheme
Theory
T (U): 80 Marks **T (I): 20 Marks**

Duration of University Exam: 03 Hours

Unit- I **8 hours**

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

Unit- II **9 hours**

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

Unit - III **7 hours**

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

Unit- IV **8 hours**

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

Unit - V **6 hours**

Powder Metallurgy:- 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

Unit- VI **7 hours**

Processing of Plastics:- Thermoplastic, Thermosetting plastics, General properties & applications of Thermosetting & Thermoplastics. Extrusion, Injection Moulding, Compression Moulding, Transfer Moulding, Blow Moulding, Calendering, Wire Drawing, Embossing.

Engineering and Technology

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Sixth Semester) Aeronautical Engineering

Manufacturing Process- II (BEAE-602T)
(Total Credits: 05)

Teaching Scheme	Examination Scheme
Lectures: 4 Hours/ Week	Theory
Tutorial: 1 Hours / Week	T (U): 80 Marks T (I): 20 Marks
	Duration of University Exam: 03 Hours

Unit – I **6 Hours**

Theory of metal cutting : Mechanics of Metal Cutting, Orthogonal and oblique cutting, Stress, Strain & Cutting Forces, Merchant Circle,

Unit – II **7 Hours**

Cutting Force Calculations, Determination of Torque and Power Required for Turning, Drilling and Milling, Influence of tool angle, Cutting Fluids, Cutting speed, Feed and depth of cut on power requirement, Estimation of tool life.

Unit – III **8 Hours**

Study of construction , working , accessories and operations of (1) Lathes (ii) Drilling (iii) Milling Machines (IV) Capstan & Turret Lathe

Unit – IV **8 Hours**

Press Working : Die cutting operation, classification, types of presses, press terminology, introduction to shaping operations, bending, forming & drawing.
Jigs and Fixtures : Introduction, principles of jigs and fixtures design. Materials, principles of location, methods of location. Clamping requirements, types of clamps, jig bushes, drilling jigs, milling fixtures, classification of fixtures.

Manufacturing process of special interest for Aerospace application

Unit – V **8 Hours**

Joints , Rivets , Non-conventional Machining Processes :- Characteristics, Operation, Applications, Limitations and Selection of Process Parameters of the following Processes. Abrasive Jet Machining, Ultrasonic Machining, Water Jet Machining, EDM, ECM.

Unit – VI **8 Hours**

Advanced Welding Methods :- Introduction to TIG, MIG, Spot Welding, Plasma Arc Welding, Electron Beam Welding, Laser Beam Welding,

Total No of periods: 45

TEXT BOOKS:

1. Production Technology - R.K. Jain,8th Edn, Khanna Pub.

Engineering and Technology

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Eighth Semester) Aeronautical Engineering

Project Work Phase- II
(BEAE-806P)
(Total Credits: 05)

Teaching Scheme	Examination Scheme
Practical: 5 Hours/ Week	Practical
	T (U): 75 Marks T (I): 75 Marks

OBJECTIVE

This should be the extension of the partial work already done in Phase-I in earlier semester

Engineering and Technology
Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Fourth Semester) Aeronautical Engineering

Environmental Studies(BEAE-407T)
(Total Credits: 0)

Teaching Scheme:
Practical: 3 Hours/ Week

Examination Scheme:
Audit Subject
College Assessment :(Grades: O, A, B, C)

Course Objectives and Expected Outcomes:
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 shall alert them to find solutions for sustainable development.

UNIT – I **4 Hours**

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.

UNIT – II **6 Hours 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. 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 **8 Hours**

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. Insitu and Exsitu conservation of biodiversity

UNIT – IV **8 Hours**

Pollution :