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
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Page 2 to 29
Principal

Lokmanya Tilak Jankalyan Shikshan Sanstha's
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1.3.2 Average percentage of courses that include experiential learning through project work/field work/internship during last five years

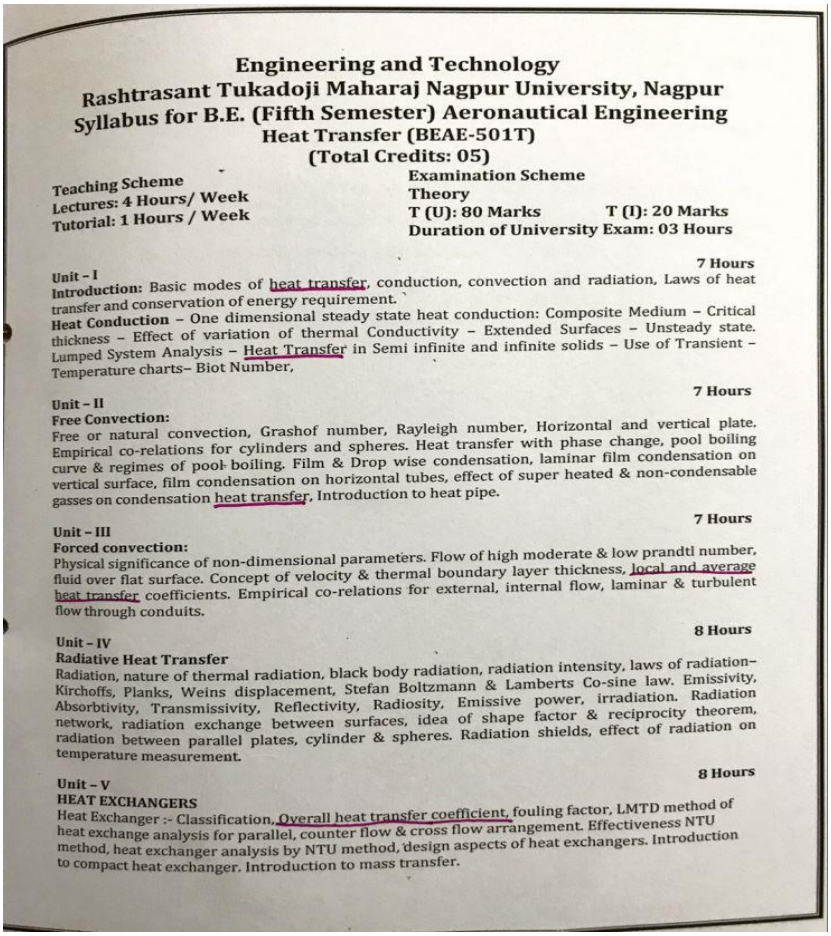
B.E – AERONAUTICAL ENGINEERING (2019-2020)

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**	3-6
2	Propulsion- I	BEAE-505T		
3	Propulsion- II	BEAE-601T&P		
4	Aero- Thermodynamics	BEAE-302T&P	**Aerodynamics**	7-14
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**	15-20
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**	21-26
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**	27-29
30	Elective –I Reliability Centered Maintenance	BEAE-803T		
31	Elective-II-Airframe Maintenance and Repair	BEAE-804T		
32	Applied Mathematics – III	BEAE-301T	**other**	
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

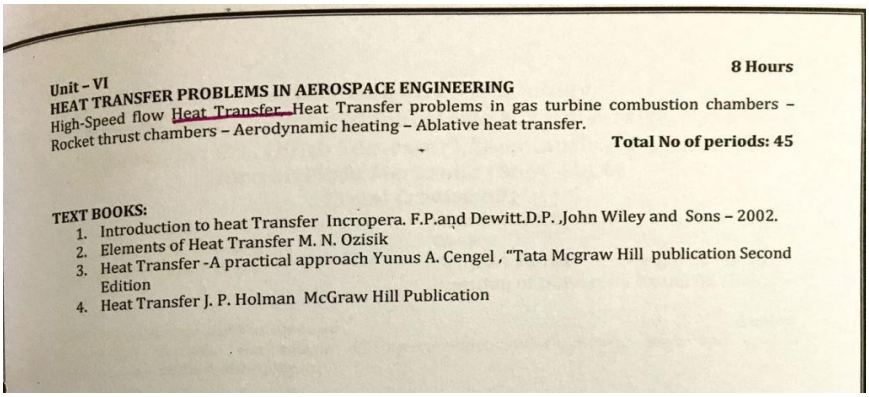
Unit – I **7 Hours**
Introduction: Basic modes of heat transfer, conduction, convection and radiation, Laws of heat transfer and conservation of energy requirement.
Heat Conduction – One dimensional steady state heat conduction: Composite Medium – Critical thickness – Effect of variation of thermal Conductivity – 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.

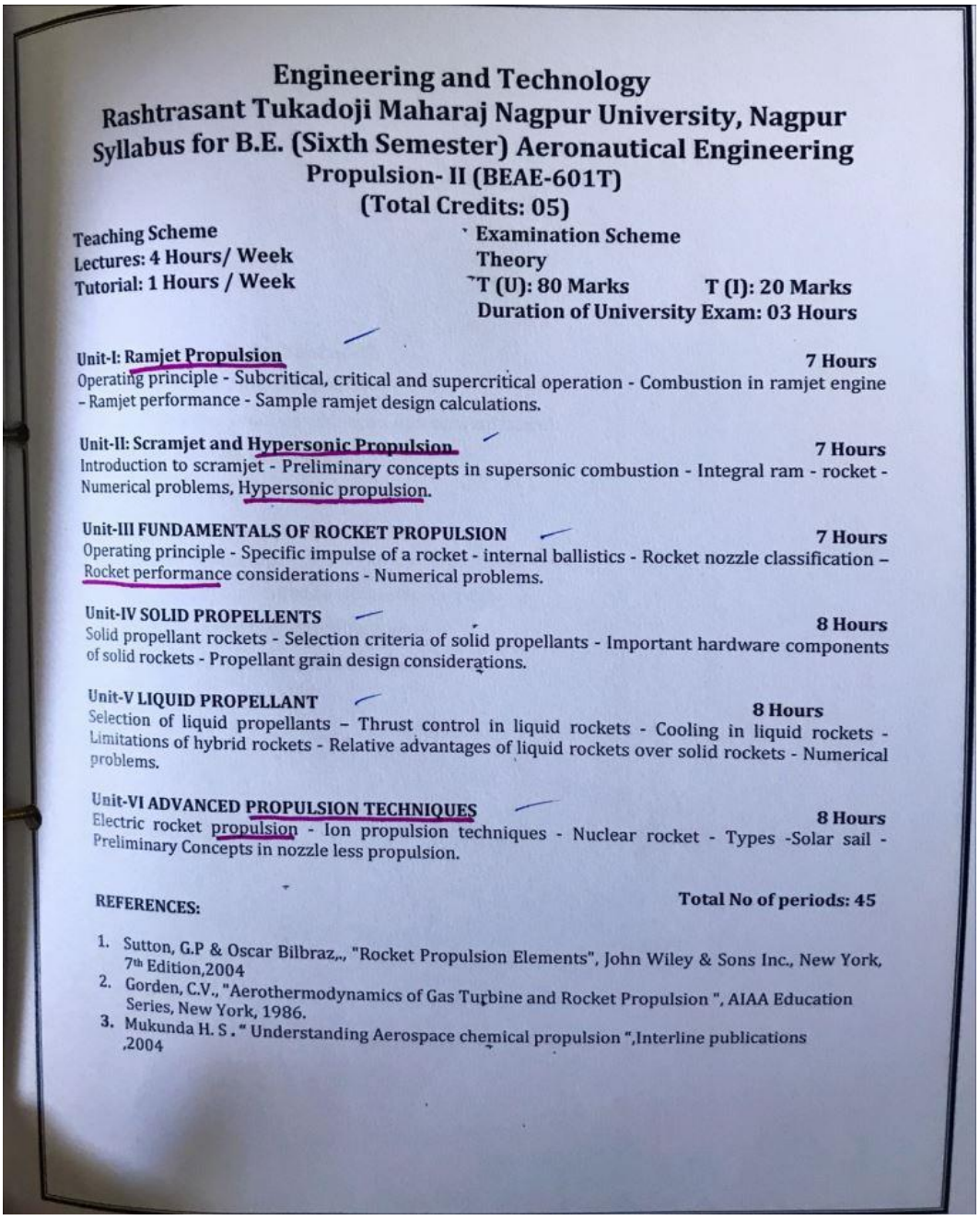
Unit – V **8 Hours**
HEAT EXCHANGERS
Heat Exchanger :- Classification, Overall heat transfer coefficient, fouling factor, LMTD method of heat exchange analysis for parallel, counter flow & cross flow arrangement. Effectiveness NTU method, heat exchanger analysis by NTU method, design aspects of heat 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:

Design and Analysis of Annular Combustion Chamber For Turbo Jet Engine"

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. **Akshay Belkhode**
2. **Abhishek kapale**
3. **Rohit Gonekar**
4. **Jaspreet Singh**

Under the guidance of

Prof. Akshay Pachpor

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

2019 - 2020

IGNITION SYSTEM:

Igniter used in this micro gas turbine combustor application is electrical spark igniter, which is similar to automotive spark plugs. The igniter needs to be in the combustion zone where the fuel and air are already mixed, but it needs to be far enough upstream so that it is not damaged by the combustion itself. The LPG gas has to be injected into the combustion chamber at a velocity; this velocity of injection of LPG gas can be calculated from the below expression,

$$V_{inj} = \sqrt{\frac{2 \times (\Delta P)}{\rho_{fluid}}}$$

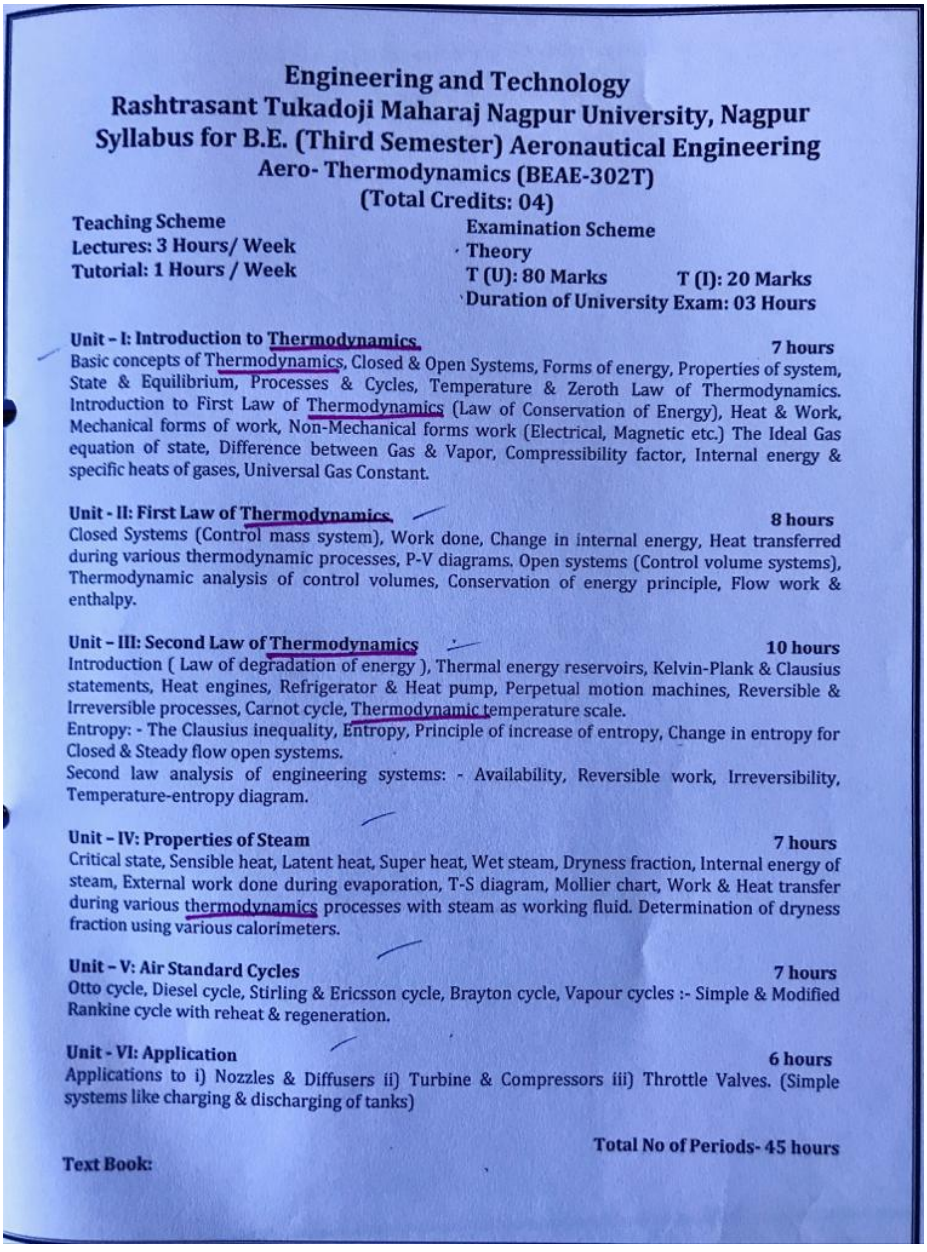
The velocity of injection calculated from the expression is 24.3 m/s. The diameter of the fuel injector is calculated from the below expression

$$\dot{m}_f = \rho_f A_f V_f C_D$$

From the above expression, value of diameter of the fuel injector is calculated as 0.6mm

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.

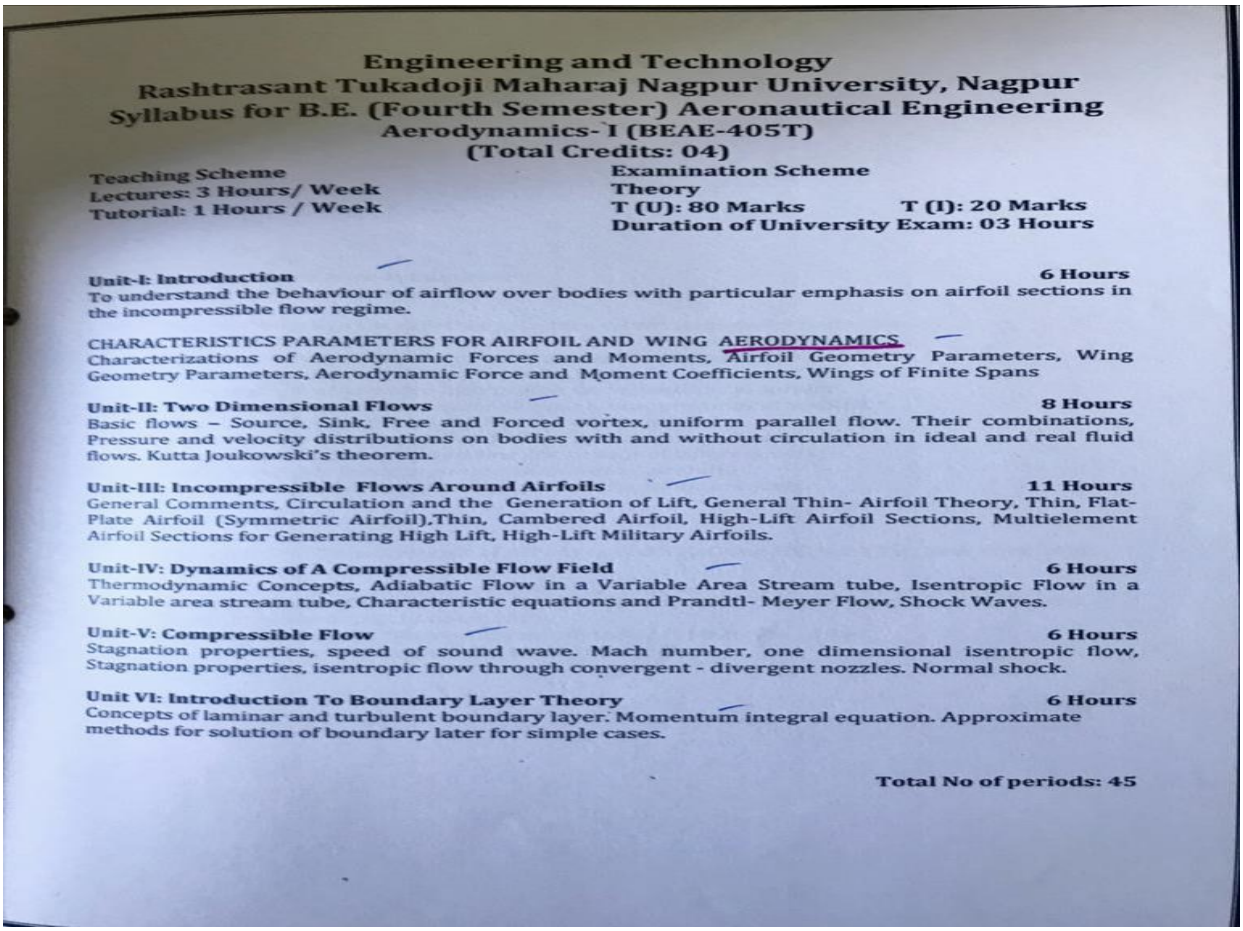
Unit – IV: Properties of Steam **7 hours**
Critical state, Sensible heat, Latent heat, Super heat, Wet steam, Dryness fraction, Internal energy of steam, External work done during evaporation, T-S diagram, Mollier chart, Work & Heat transfer during various thermodynamics processes with steam as working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

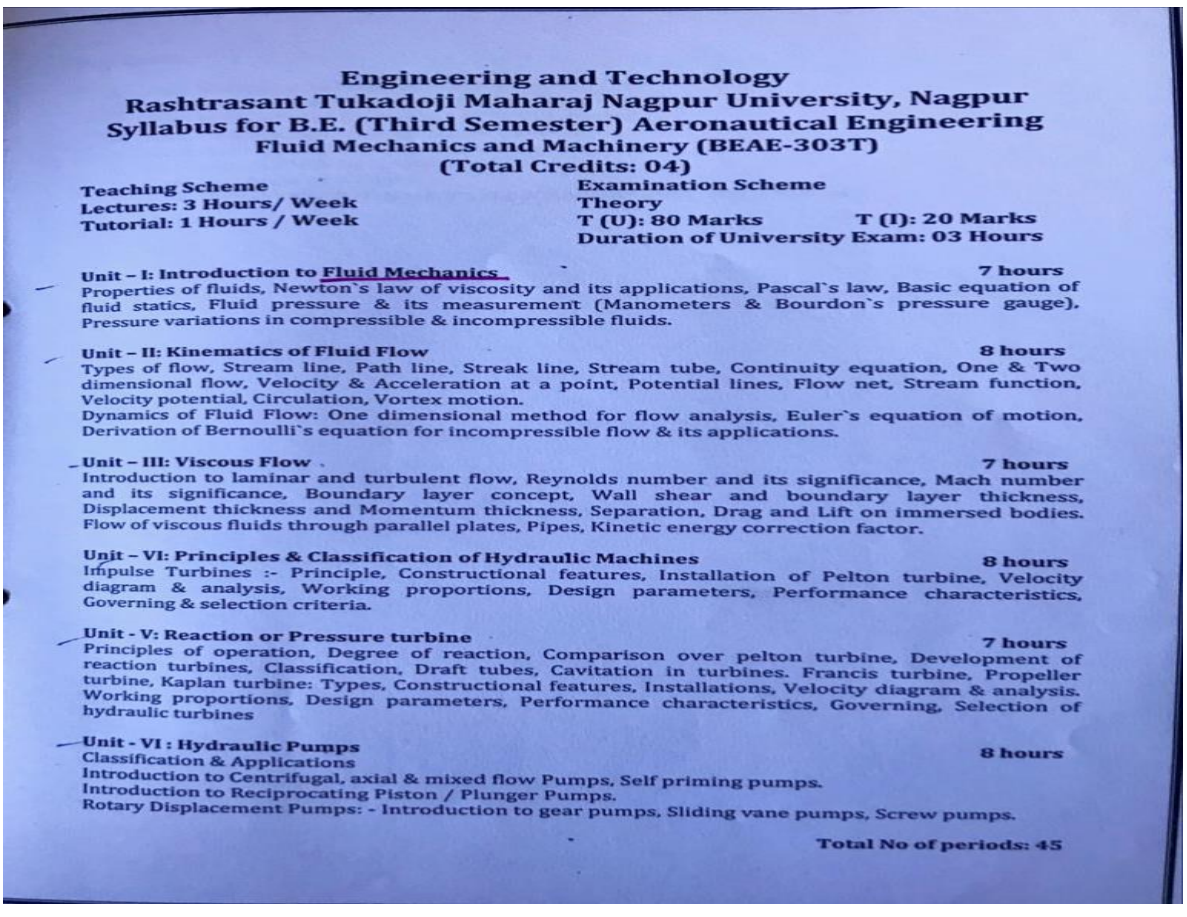
Unit-III: Incompressible Flows Around Airfoils **11 Hours**
General Comments, Circulation and the Generation of Lift, General Thin- Airfoil Theory, Thin, Flat-Plate Airfoil (Symmetric Airfoil),Thin, Cambered Airfoil, High-Lift Airfoil Sections, Multielement Airfoil Sections for Generating High Lift,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

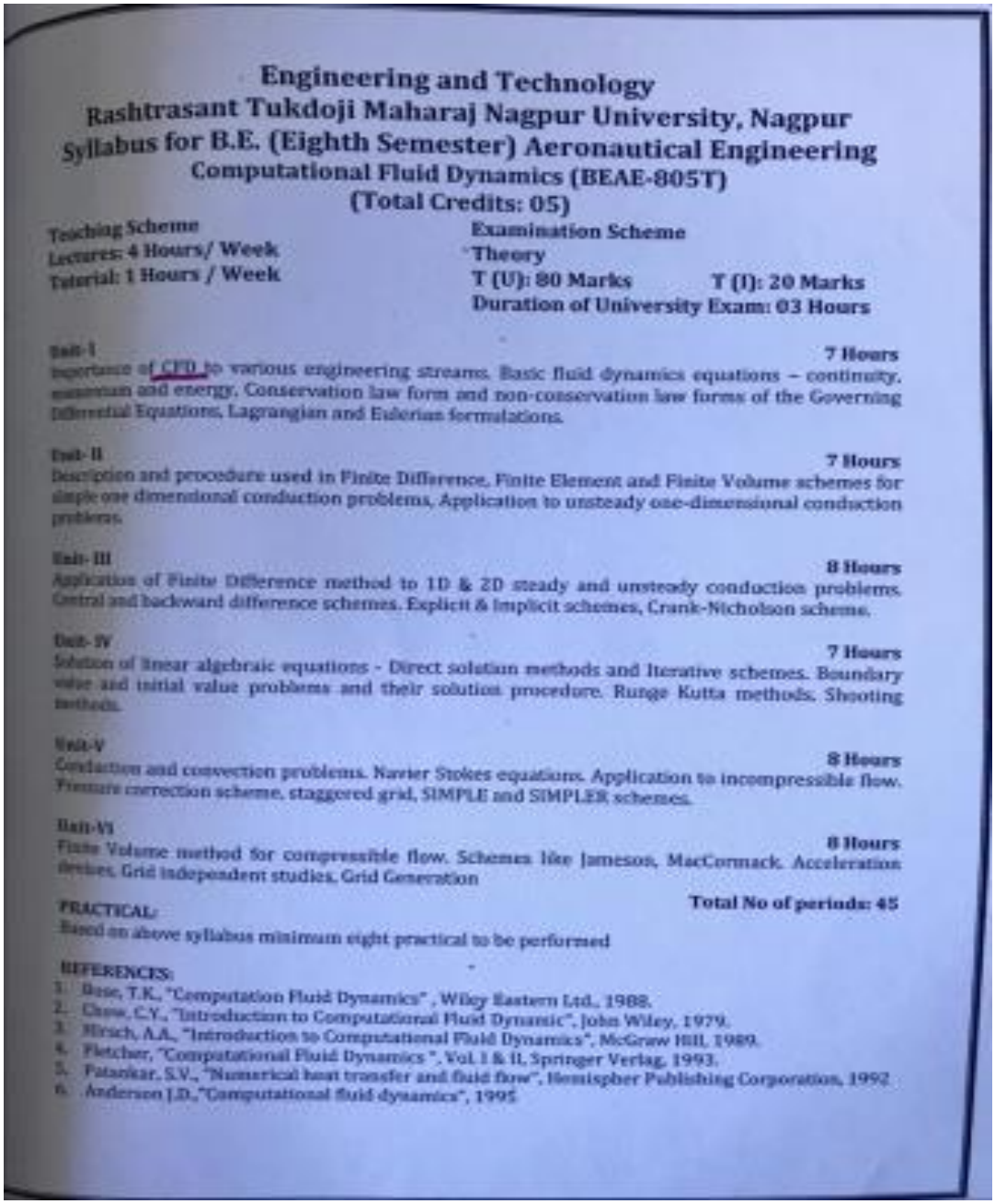
AIRCRAFT PERFORMANCE
Unit-III **8 Hours**
Performance of airplane in level flight - Maximum speed in level flight - Conditions for minimum drag and power required - Range and endurance, - Climbing flight (Maximum rate of climb and steepest angle of climb,) Service and absolute ceiling

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. Rose, 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:

"STUDY AND ESTIMATION OF RCS VALUES OF A STEALTH AIRCRAFT"

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

1. Darshan Hudekar
2. Pratiksha Meshram
3. Prabhat Phondekar
4. Shubham Dusane

under the guidance of

Prof. Akshay Pachpore

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

2019-2020

1

CHAPTER 7: COMPUTATIONAL ANALYSIS

Test over different nozzles are carried out in a commercial software to analyze flow pattern and compare them with theoretical results to choose the best suited nozzle for the mission. The models are analyzed with velocity, pressure, energy and enthalpy contours.

The basic step is to create a model in commercial CAD software and save it in the. is file format and then import the same geometry in the pre-processing software to generate the mesh. After importing the geometry, check for multiple edges and curves since they will generate errors while creating faces on the geometry. Once the multiple edges and curves are deleted, split the curve of the domain and body to obtain multiple faces. Nodes must be generated on the edges, adjust the nodes amount while adjusting nodes we have to provide high concentration where we want to catch boundary layer and another minute parameter. Concentration of nodes depends upon the model length. While creating the mesh on the different faces, the number of elements on the opposite face must be equal to generate the proper mesh. For starting the iterations, set all the values that is required including the material, inlet and outlet conditions' CFD studies on combustor are being carried out using the commercially available CFD code. Combustor configuration is analyzed and the results have been validated with actual combustor test. Based on the experience, a modified combustor configuration for which no experimental results are yet available has also been analyzed. This approach would save substantial developmental time. 3-D, structured, Body Fitted Co-ordinate grid having a density of about 1 million cells has been generated using PHOENICS. Figure 2 shows a typical velocity vector plot across a plane passing through the atomizer. Figure 3 shows a typical temperature contour plot across the same plane. The high temperature zone extends almost up to the dilution zone. It can be seen that the temperatures close to the walls in inner and outer (in the primary and secondary zones) are very high.

Lokmanya Tilak Jankalyan Shikshan Sanstha's
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Phone : 07104 – 236381, 237307, Fax : 07104 – 237681,
email : principal.pce.ngp@gmail.com, www.pcenagpur.edu.in

A

PROJECT REPORT ON

"IMPLEMENTATION OF NATURAL FIBRE COMPOSITE IN AIRCRAFT"

This report is submitted to **Rashtrasant Tukadoji Maharaj Nagpur University**

In partial fulfilment of the requirement

For the award of the degree

of

Bachelor of Engineering in Aeronautical Engineering

Submitted by

1. Rajat D. Tayde
2. Nilesh K. Vairagade
2. Vaibhao P. Badole
4.Mayur S. Jambhulkar

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 Tukadoji Maharaj Nagpur University, Nagpur)

NAGPUR-440019

2019-2020

1

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)

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"RENDEZEVOUS: GUIDANCE TRAJECTORY PLANNING FOR ROBOTIC INTERCEPTION"

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

of

Bachelor of Engineering in Aeronautical Engineering

by

1. Kartik Poojari **2. Piyush More** **3. Suraj Neharkar**

under the guidance of

Prof. Sandeep Patil

DEPARTMENT OF AERONAUTICAL ENGINEERING

Lokmanya Tilak Jankalyan Shikshan Sanstha's

PRIYADARSHINI COLLEGE OF ENGINEERING

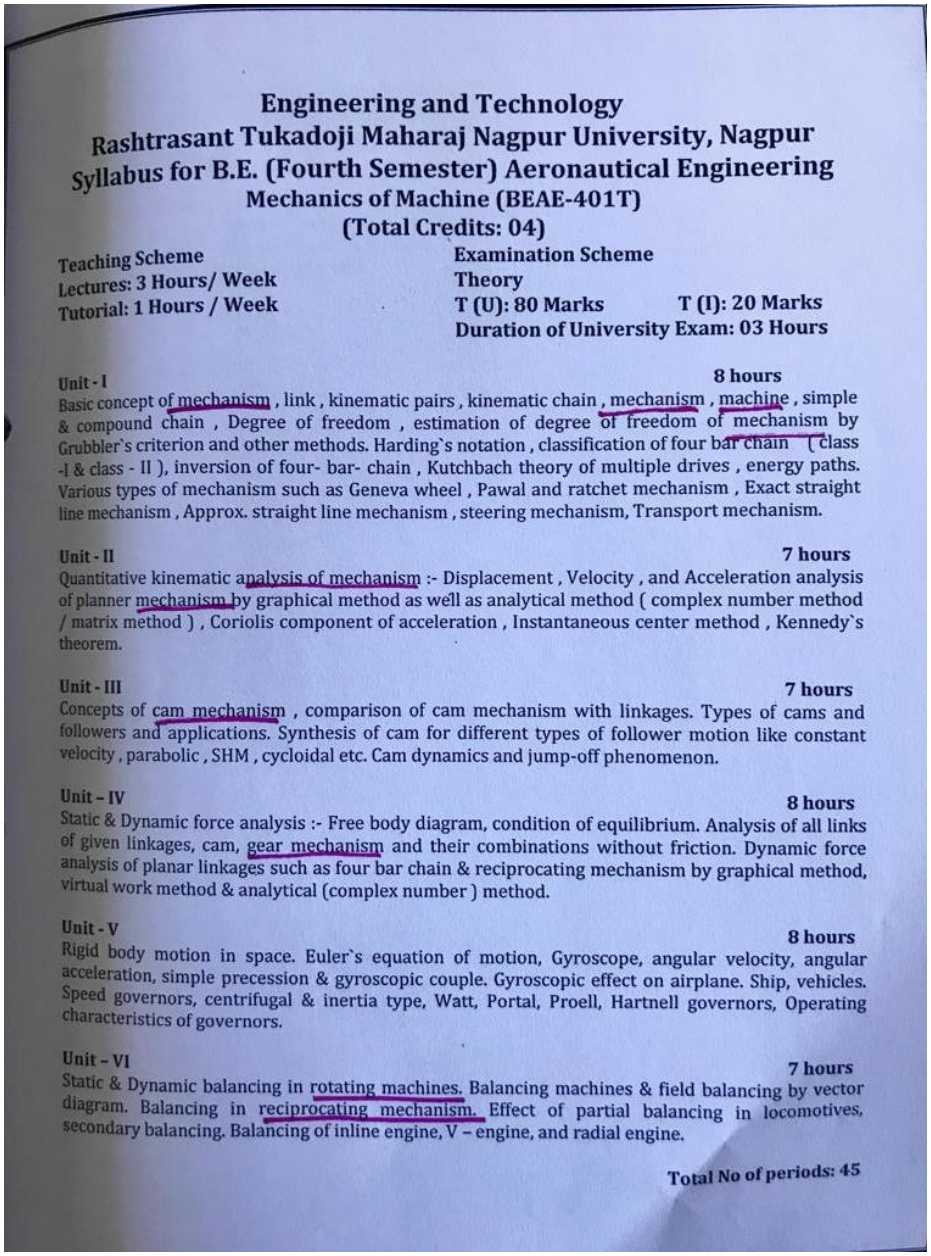
(An institution affiliated to Rashtrasant Tukdoji Maharaj Nagpur University)

NAGPUR – 440019

2019 - 2020

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.

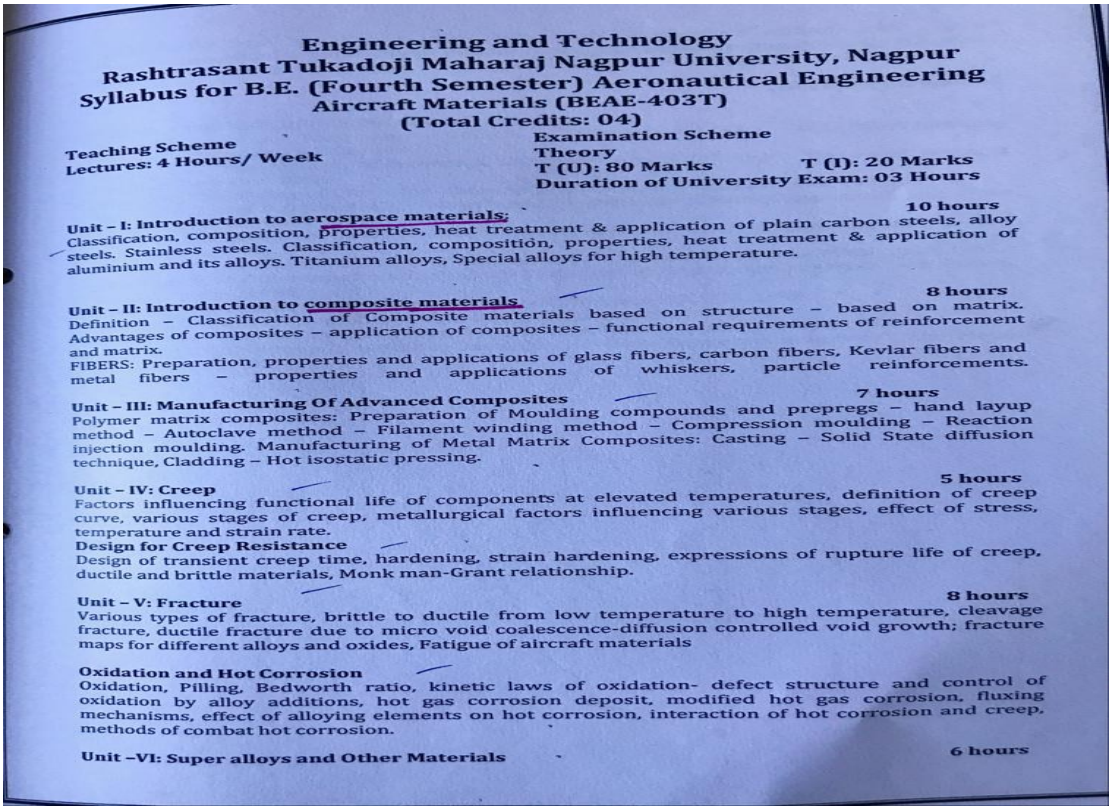
Unit - III **7 hours**
Concepts of cam mechanism , comparison of cam mechanism with linkages. Types of cams and followers and applications. Synthesis of cam for different types of follower motion like constant velocity , parabolic , SHM , cycloidal etc. Cam dynamics and jump-off phenomenon.

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.

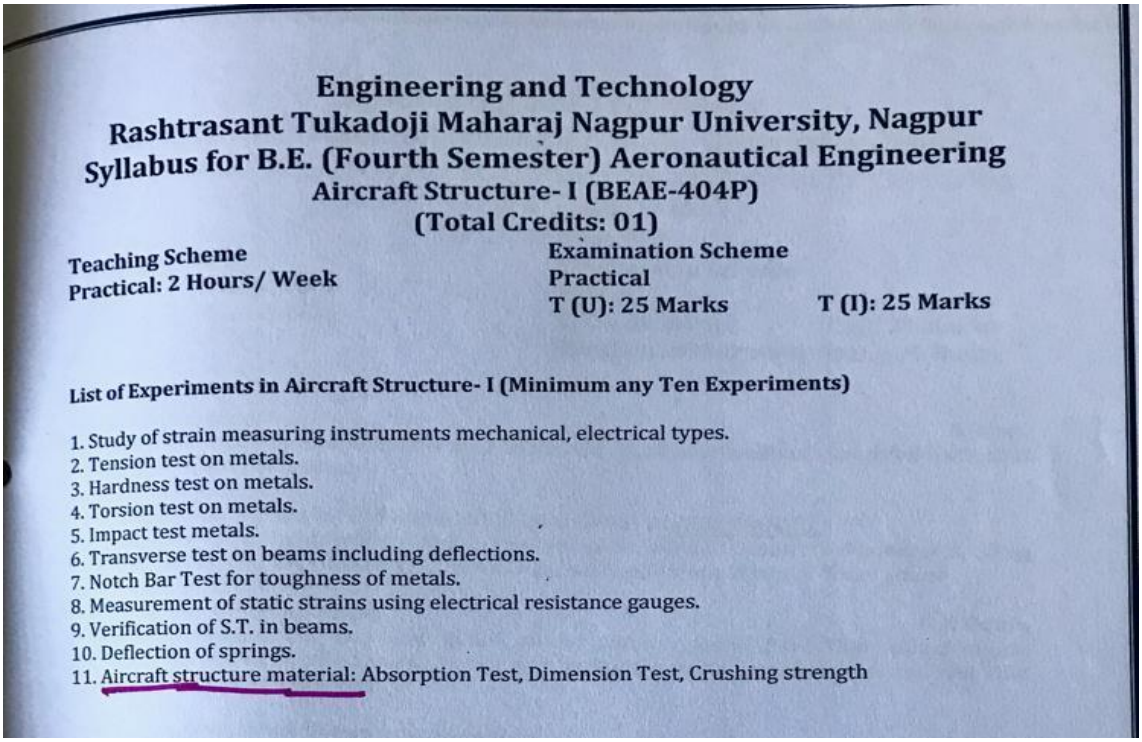
Unit – III: Manufacturing Of Advanced Composites **7 hours**
Polymer matrix composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Manufacturing of Metal Matrix Composites: Casting – 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**



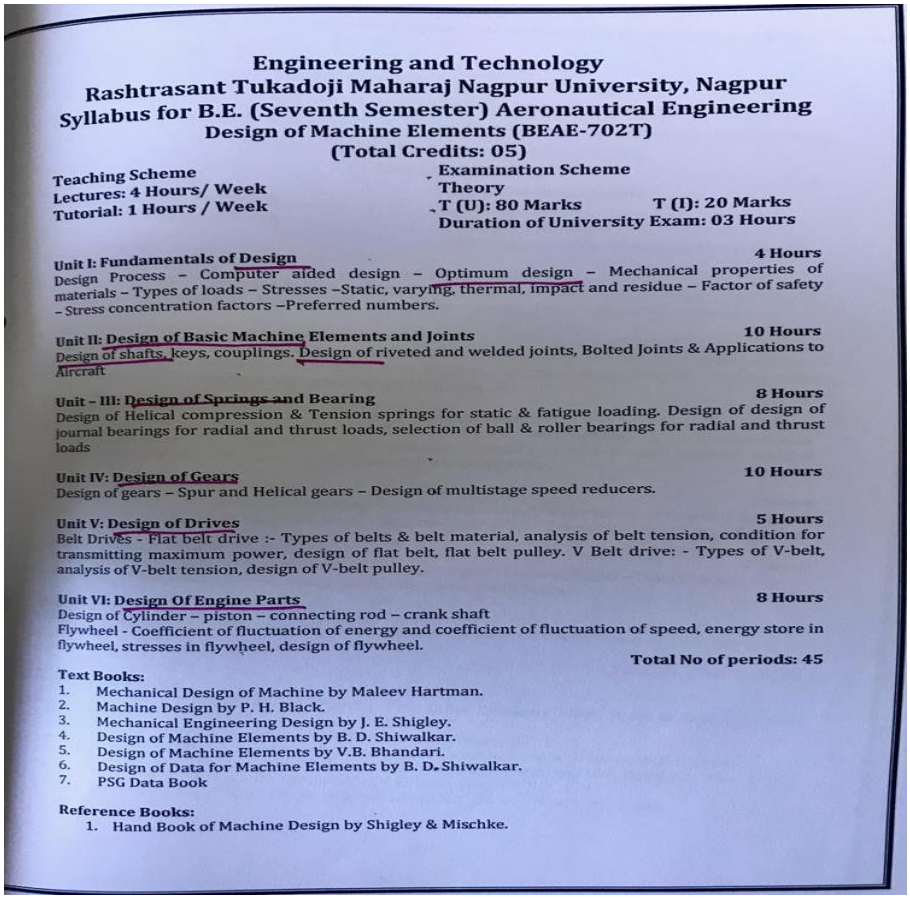
Engineering and Technology
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Fourth Semester) Aeronautical Engineering
Aircraft Structure- I (BEAE-404P)
(Total Credits: 01)

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. (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.

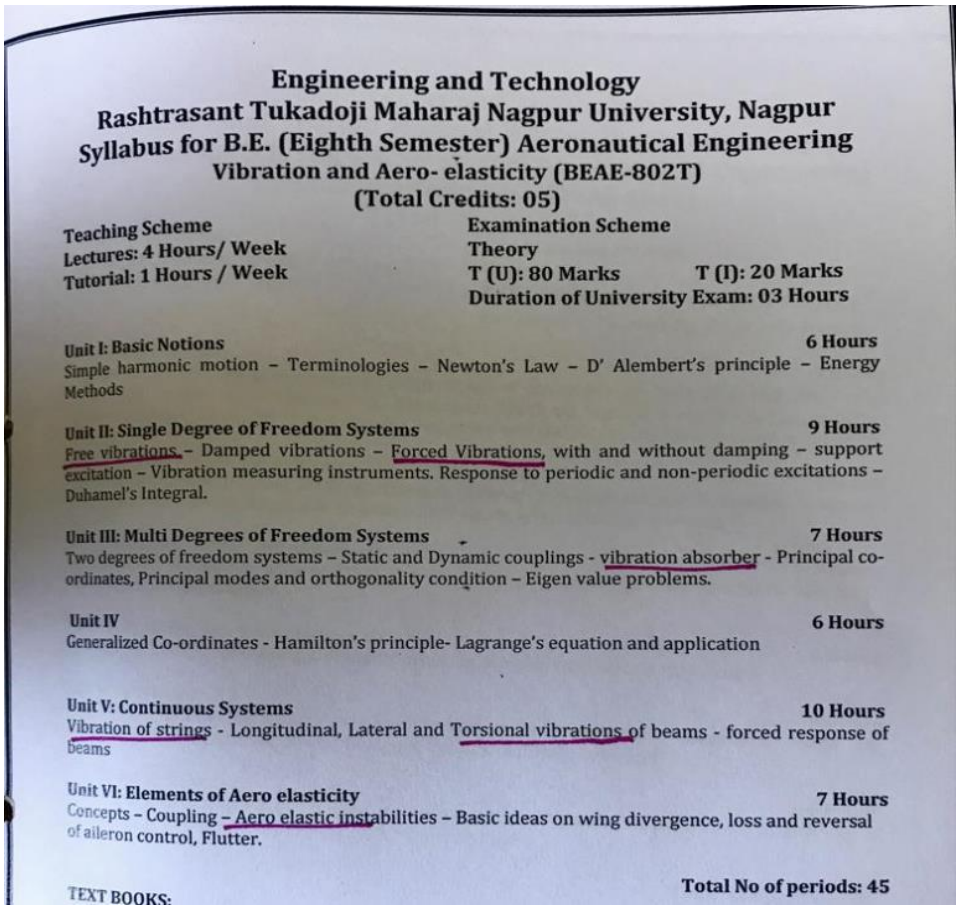
Unit V: Design of Drives **5 Hours**
Belt Drives - Flat belt drive :- Types of belts & belt material, analysis of belt tension, condition for transmitting maximum power, design of flat belt, flat belt pulley. V Belt drive: - Types of V-belt, analysis of V-belt tension, design of V-belt pulley.

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:

ABSTRACT

During the last decades, stealth technology has proven to be one of the most effective approaches as far as the endeavor to hide from radar systems is concerned. Especially for military aircraft, "stealth" or "low observable" technology has become ubiquitous: all new aircraft types are designed taking into account low observable principles and techniques, while existing jet fighters are considered for modification in order to reduce their radar signature. Low radar signature for a target means that it is detected and tracked at a shorter distance from a radar.

However, low observable does not mean no observable, i.e., complete disappearance from the radar screens. Furthermore, stealthiness comes at a price. Apart from the development cost, stealth aircraft have higher flyaway cost and important maintenance costs, while they have significant operational limitations due to the specific aircraft shape imposed and materials used, and also due to the limited fuel and weapons, which have to be carried internally. Any pylon, tank, missile or pod carried externally increases the radar signature.

Having realized the capabilities of stealth aircraft, many countries have been developing anti-stealth technologies. The following systems have been reported to be potential counter-stealth approaches: passive / multistatic radars, very low frequency radars, over-the-horizon radars and sensitive IR sensor systems. It is commonly accepted that the U.S. exhibit an important advantage on the stealth domain, while Russia and China are leading the anti-stealth effort, followed by other countries.

Evading the enemy radars plays a crucial role in today's warfare. All weapon systems are designed with the aim of minimising their radar signature or Radar Cross Section (RCS). It would also be desirable to know the RCS of any potential target. However, RCS values are not publicly available. This paper examines the concept of estimating the RCS of a complex object, such as an aircraft, on the basis of available photos and videos. Initially, a basic 3D model is created, which is further refined, taking into account details shown in photos, with the help of CAD software. Consequently, a computational approach, based on Physical Optics, is employed to calculate the RCS of the final 3D model. The proposed method is applied to F-35 jet fighters yielding plausible results.

This paper will begin by a brief history of the development of stealth aircraft and a short presentation of the most important stealth fighters of today. It will continue by exploring the basic concepts of low observable principles, mainly

CHAPTER 2: Basic radar principles

Radar – history (RADAR -RAdio Detection And Ranging) – was invented during the Second World War (WWII). In the beginning radars were very large installations based stationary on land, but were rapidly further developed to fit into different combat platforms such as ships and airplanes.

The principle, which radar is working by, was discovered much earlier than WWII. As early as 1896 Mr. Heinrich Hertz experimented with Maxwell's theories. He discovered and demonstrated the similarity between radio- and light waves. Hertz showed that radio-waves reflect onto metallic or dielectric bodies.

In 1903 the German Engineer, Holsmeyer, experimented with radio-waves that were reflected onto the hull of a ship. He succeeded in making a device called "the obstacle detector" or the "ships navigation apparatus" that he, in 1904, patented in several countries.

The famous Marconi himself experimented with the basic theories, but his goal was to be able to achieve wireless transfer of energy, wireless, over great distances. The phenomena that were supposed to be used is called "tropospheric scatter". These scatters reflect short wavelengths of radio waves beyond the horizon. Several followers developed the techniques even further, to mention some of them A.H. Taylor, L.C. Young, Breit, Tuve and L.A. Hyland.

At first Continuous Wave (CW) Radar was used. As technology proceeded the pulsed Doppler Radars started to be used. These latter devices increased the range over which the equipment could be used.

Today the size the transmitter/receiver of surveillance radar for a fighter aircraft can be made to fit in a palm. One example is the Swedish PS-05 (Pulse Doppler) radar for the Swedish Air force fighter-attack and reconnaissance aircraft, JAS 39 Griffin. The possibility with so called solid state technology has opened for these small devices to be manufactured.

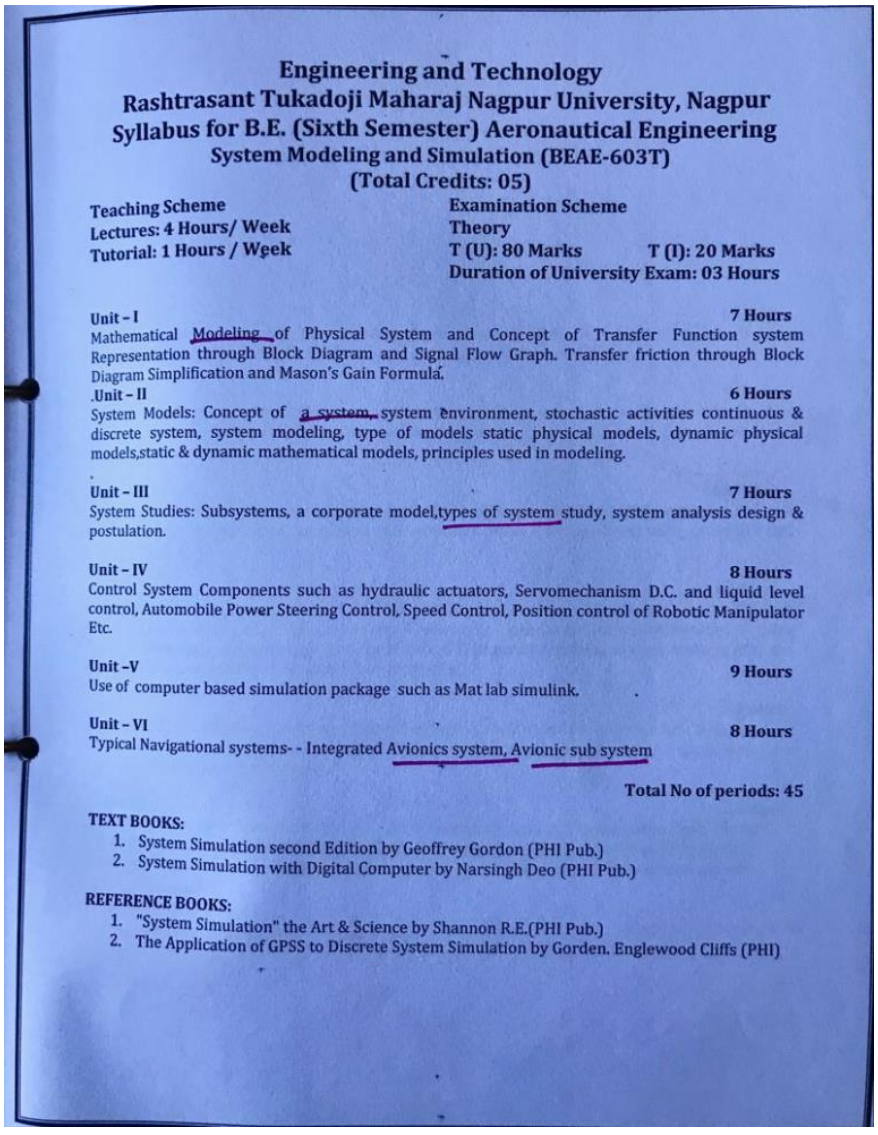
CHAPTER 7: COMPUTATIONAL ANALYSIS

Test over different nozzles are carried out in a commercial software to analyze flow pattern and compare them with theoretical results to choose the best suited nozzle for the mission. The models are analyzed with velocity, pressure, energy and enthalpy contours.

The basic step is to create a model in commercial CAD software and save it in the. is file format and then import the same geometry in the pre-processing software to generate the mesh. After importing the geometry, check for multiple edges and curves since they will generate errors while creating faces on the geometry. Once the multiple edges and curves are deleted, split the curve of the domain and body to obtain multiple faces. Nodes must be generated on the edges, adjust the nodes amount while adjusting nodes we have to provide high concentration where we want to catch boundary layer and another minute parameter. Concentration of nodes depends upon the model length. While creating the mesh on the different faces, the number of elements on the opposite face must be equal to generate the proper mesh. For starting the iterations, set all the values that is required including the material, inlet and outlet conditions' CFD studies on combustor are being carried out using the commercially available CFD code. Combustor configuration is analyzed and the results have been validated with actual combustor test. Based on the experience, a modified combustor configuration for which no experimental results are yet available has also been analyzed. This approach would save substantial developmental time. 3-D, structured, Body Fitted Co-ordinate grid having a density of about 1 million cells has been generated using PHOENICS. Figure 2 shows a typical velocity vector plot across a plane passing through the atomizer. Figure 3 shows a typical temperature contour plot across the same plane. The high temperature zone extends almost up to the dilution zone. It can be seen that the temperatures close to the walls in inner and outer (in the primary and secondary zones) are very high.

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:

ABSTRACT

During the last decades, stealth technology has proven to be one of the most effective approaches as far as the endeavor to hide from radar systems is concerned. Especially for military aircraft, "stealth" or "low observable" technology has become ubiquitous: all new aircraft types are designed taking into account low observable principles and techniques, while existing jet fighters are considered for modification in order to reduce their radar signature. Low radar signature for a target means that it is detected and tracked at a shorter distance from a radar.

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Evading the enemy radars plays a crucial role in today's warfare. All weapon systems are designed with the aim of minimising their radar signature or Radar Cross Section (RCS). It would also be desirable to know the RCS of any potential target. However, RCS values are not publicly available. This paper examines the concept of estimating the RCS of a complex object, such as an aircraft, on the basis of available photos and videos. Initially, a basic 3D model is created, which is further refined, taking into account details shown in photos, with the help of CAD software. Consequently, a computational approach, based on Physical Optics, is employed to calculate the RCS of the final 3D model. The proposed method is applied to F-35 jet fighters yielding plausible results.

This paper will begin by a brief history of the development of stealth aircraft and a short presentation of the most important stealth fighters of today. It will continue by exploring the basic concepts of low observable principles, mainly

Abstract

The natural fibres composites are getting attention because of their eco-friendly nature, sustainability, renewable, recyclable and biodegradable. The availability of natural fibres is abundance in nature so it would be more beneficial to replace glass fibre as reinforcement.

The reason behind using natural fibres composite because of their valuable properties like reduce weight, increasing specific stiffness and extend fatigue life. They have high specific properties such as stiffness, flexibility, low density, high toughness, reduction in tool wear, low cost, impact resistance and modulus.

The fibre reinforced polymer are using in airplanes from last three decades. The carbon filler and glass fibres are synthetic and inorganic in nature and they produce residues with toxic by product during manufacturing process. To avoid the problem of environment pollution the natural fibres should be used instead of synthetic fibres.

The composites made by natural fibres are more environment friendly are used in military applications, building and construction industries (ceiling and panelling), aircraft interior structures and transportation.

6

"Development of Emergency Landing System"

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

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under the guidance of

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DEPARTMENT OF AERONAUTICAL ENGINEERING

Lokmanya Tilak Jankalyan Shikshan Sanstha's

PRIYADARSHINI COLLEGE OF ENGINEERING

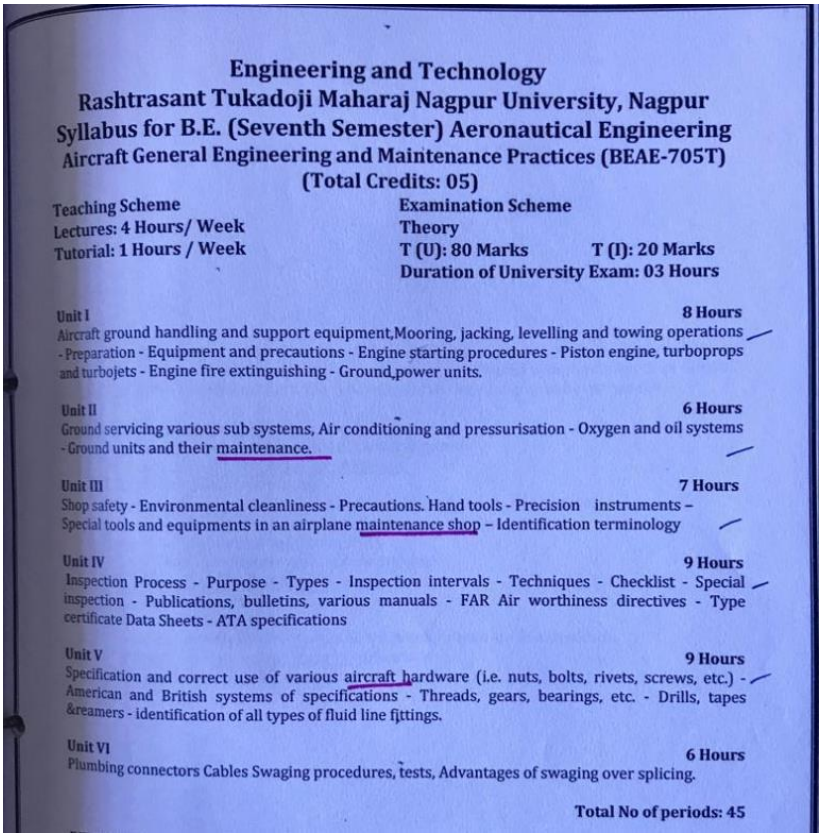
(An institution affiliated to Rashtrasant Tukdoji Maharaj Nagpur University)

NAGPUR – 440019

2019 - 2020

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.

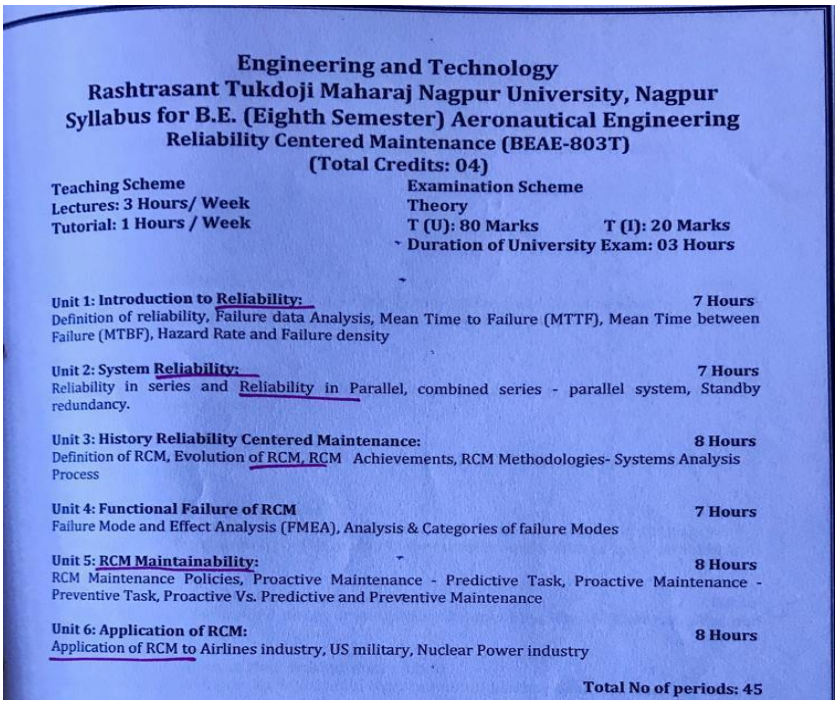
Unit III **7 Hours**
Shop safety - Environmental cleanliness - Precautions. Hand tools - Precision instruments – Special tools and equipments in an airplane maintenance shop – Identification terminology

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.

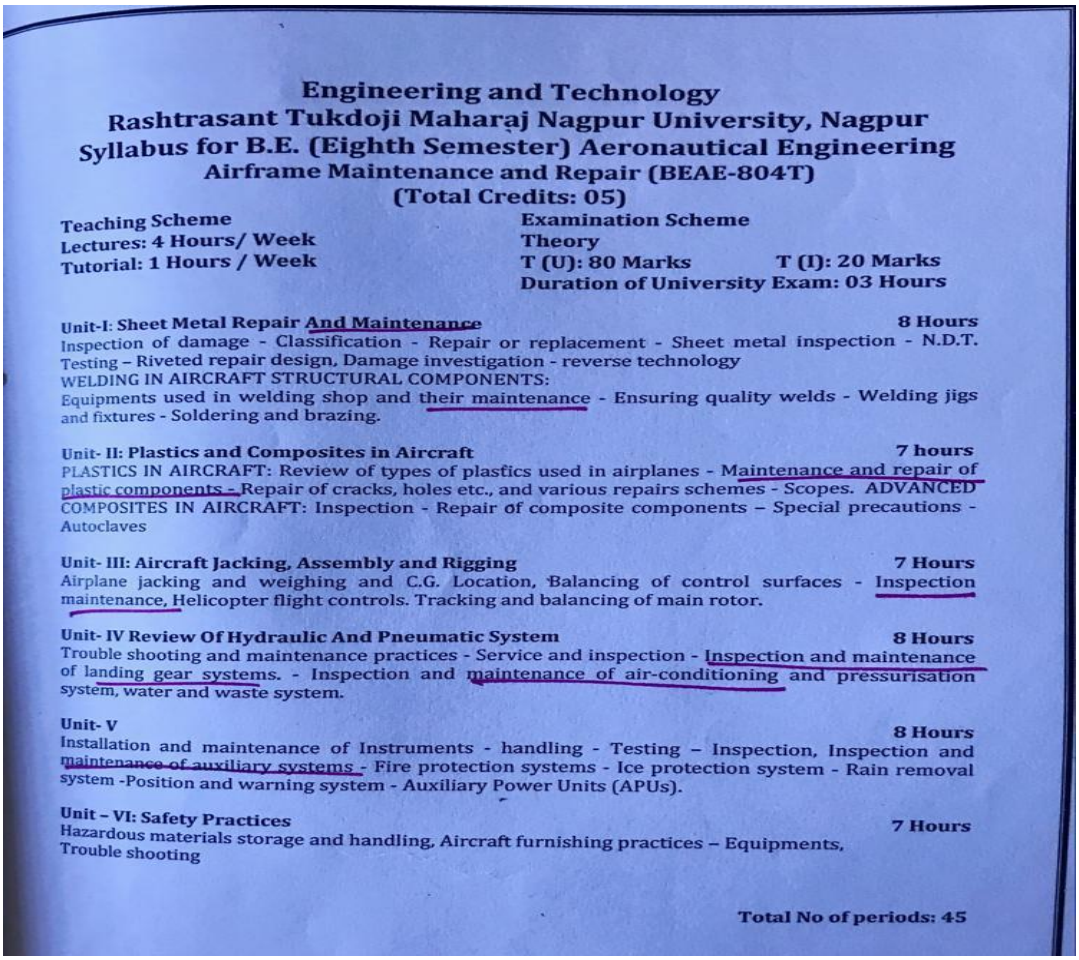
Unit 3: History Reliability Centered Maintenance: **8 Hours**
Definition of RCM, Evolution of RCM, RCM Achievements, RCM Methodologies- Systems Analysis Process

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.

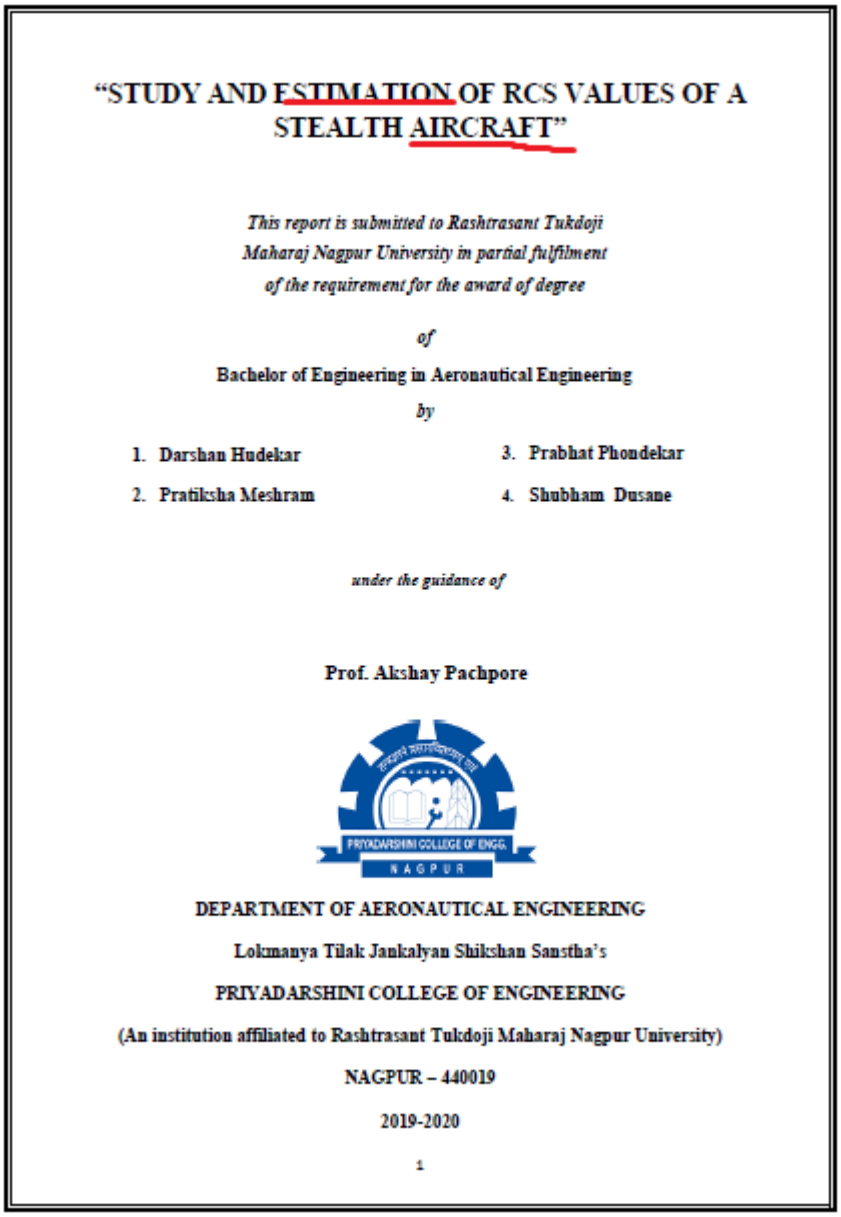
Unit- IV Review Of Hydraulic And Pneumatic System **8 Hours**
Trouble shooting and maintenance practices - Service and inspection - Inspection and maintenance of landing gear systems. - Inspection and maintenance of air-conditioning and pressurisation system, water and waste system.

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:



"STUDY AND ESTIMATION OF RCS VALUES OF A STEALTH AIRCRAFT"

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

1. Darshan Hudekar
2. Pratiksha Meshram
3. Prabhat Phondekar
4. Shubham Dusane

under the guidance of

Prof. Akshay Pachpore

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