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

Aero- Thermodynamics (BEAE-302T)

(Total Credits: 04)

Teaching Scheme	**Examination Scheme**
Lectures: 3 Hours/ Week	**Theory**

Tutorial: 1 Hours / Week **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:

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

Engineering and Technology

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

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

Aero- Thermodynamics (BEAE-302P)

(Total Credits: 01)

Teaching Scheme	**Examination Scheme**
Practical: 2 Hours/ Week	**Practical**
	T (U): 25 Marks **T (I): 25 Marks**

List of Experiments in Aero- Thermodynamics:

1. Study of steam turbines.
2. Study of internal combustion engines.
3. Study of various types of compressors.
4. Performance and evaluation of Rotary air Compressor.
5. Performance and evaluation of Reciprocating air Compressor.
6. Visit to thermal power plant .(Case study to be prepared by students)

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

Text Books:

1. Fluid Mechanics by Frank M. White
2. Fluid Mechanics & Fluid Power Engineering by D.S.Kumar
3. Fluid Mechanics for Engineers by P.N. Chartterjee
4. Fluid Mechanics by J.F.Douglas, J.M. Gasiorek
5. Fluid Mechanics & hydraulic Machines by R.K.Bansal
6. Mechanics of Fluids by B.S.Massey
7. Fluid Mechanics by A.K.Jain
8. Fluid Mechanics with engineering applications by Daugherty & Franizini

Engineering and Technology

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Syllabus for B.E. (Third Semester) Aeronautical Engineering
Fluid Mechanics and Machinery (BEAE-303P)
(Total Credits: 01)

Teaching Scheme **Examination Scheme**

Practical: 2 Hours/ Week **Practical**

T (U): 25 Marks **T (I): 25 Marks**

List of Experiments in Fluid Mechanics and Machinery:

1. To verify Bernoulli's Theorem
2. To determine the critical velocity of flow by Reynolds's apparatus.
3. Performance characteristics of Pelton Turbine
4. Performance characteristics of Francis Turbine
5. Performance characteristics of Kaplan Turbine
6. To study the Centrifugal Pump
7. To study the Axial Flow Pump
8. To study the Reciprocating Pump

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]

2. Programming with C : K.R.Venugopal & S.R.Prasad [TMH]
3. Let Us C : Yashwant Kanetkar [BPB]

Engineering and Technology

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

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

Computer Programming (BEAE-304P)

(Total Credits: 01)

Teaching Scheme	**Examination Scheme**	
Practical: 2 Hours/ Week	**Practical**	
	T (U): 25 Marks	**T (I): 25 Marks**

List of Experiments in Fluid Computer Programming:

1. Write a programme to perform swapping of two variables without using third variable.
2. Write a programme to calculate the sum of all digit of a five digit number.
3. Write a programme to check whether the year is a leap year or not.
4. Write a programme to print Armstrong number from 1to 500.
5. A menu programme for finding the factorial of a number, prime number & odd number or even number.
6. Write a programme to check whether the entered string of number is paleindrome or not.
7. Write a programme to find the biggest number of three numbers.
8. Write a programme to calculate or demonstrate call by value & call by reference

Engineering and Technology

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

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

Elements of Aeronautics (BEAE-305T)

(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 **5 hours**

To introduce the basic concepts of aerospace engineering early airplanes, biplanes and monoplanes

Unit - II: Development **5 hours**

Developments in aerodynamics, materials, structures and propulsion over the years

Unit -III: Aircraft Configurations **8 hours**

Components of an airplane and their functions, Different types of flight vehicles, classifications. Conventional control, Powered control, Basic instruments for flying, Typical systems for control actuation.

Unit -IV: Introduction to Principles of Flight **9 hours**

Physical properties and structure of the atmosphere, Temperature, pressure and altitude relationships, Evolution of lift, drag and moment. Aerofoil's, Mach number,Maneuvers.

Unit - V: Introduction to Airplane Structures and Materials **9 hours**

General types of construction, Monocoque, semi-monocoque construction, Typical wing and fuselage structure. Metallic and non-metallic materials, Use of aluminium alloy, titanium, stainless steel and composite materials.

Unit -VI: Power Plants Used In Airplanes **9 hours**

Basic ideas about piston, turboprop and jet engines, Use of propeller and jets for thrust production. Comparative merits, Principles of operation of rocket, types of rockets and typical applications, Exploration into space.

Total No of periods: 45

Text Books:

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

Reference Book:

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

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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

TEXT BOOKS:

1. Theory of mechanisms & machines by Shigley J. E.
2. Theory of mechanisms & machines by Ghosh & Mallik
3. Mechanism & Machine Theory by J. S. Rao & Dukki Patti
4. Theory of Machine by Ratan

REFERENCE BOOKS:-

1. Theory of Machines by Thoman Beven CBS publication
2. Theory of Machines by Sandor & Erdman.
3. Mechanical Vibrations by Grover

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.

Total No of periods: 45

TEXT BOOKS:

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

REFERENCE BOOKS:-

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

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**

Iron base, Nickel base and Cobalt base super alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, embrittlement, solidification of single crystals, Intermetallics, high temperature ceramics.

Total No of periods: 45

TEXT BOOKS AND REFERENCE BOOKS:

1. Material Science and Technology – Vol 13 – Composites by Cahn – VCH, West Germany Composite Materials – K.K.Chawla
2. Calcote, L R. "The Analysis of laminated Composite Structures", Von – Noastrand Reinhold Company, New York 1998.
3. Jones, R.M., "Mechanics of Composite Materials", McGraw-Hill, Kogakusha Ltd., Tokyo, 1985.
4. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites", John Wiley and sons. Inc., New York, 1995.
5. Lubin, G., "Handbook on Advanced Plastics and Fibre Glass", Von Nostrand Reinhold Co., New
   York, 1989.
6. Raj. R., "Flow and Fracture at Elevated Temperatures", American Society for Metals, USA, 1985.
7. Hertzberg R. W., "Deformation and Fracture Mechanics of Engineering materials", 4th Edition,
   John Wiley, USA, 1996.
8. Courtney T.H, "Mechanical Behavior of Materials", McGraw-Hill, USA, 1990.
9. Boyle J.T, Spencer J, "Stress Analysis for Creep", Butterworths, UK, 1983.
10. Bressers. J., "Creep and Fatigue in High Temperature Alloys", Applied Science, 1981.
11. McLean D., "Directionally Solidified Materials for High Temperature Service", The Metals
    Society, USA, 1985.

Engineering and Technology

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

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

Aircraft Structure- I (BEAE-404T)

(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: Concept of simple stresses & strains **8 hours**

Concept of simple stresses & strains :- Introduction, stress, strain, types of stresses, stresses & strains with uni-axial loading, stress-strain diagram for brittle & ductile material, elastic limit, Hooks law, Poisson`s ratio, bulk modulus, relation between Young`s modulus & Shear modulus.

Torsion of circular shafts :- Derivation of torsion equation with the assumptions made in it. Torsion, shear stress induced in the shaft, when it is subjected to torque. Strength & rigidity criterion for design of shaft. Torque transmitted by solid & hollow circular shaft.

Thin cylinders and spherical shells subjected to internal pressure

Unit – II: Shear force & bending moment 11 hour

Shear force & bending moment: - Types of beams (cantilever beam, simply supported beam, overhung beam etc.) Types of loads (Concentrated & UDL), Shear force & bending moment diagrams for different types of beams subjected to different types of loads, Sign. Conventions for bending moment & shear force, shear force & bending moment diagrams for beams subjected to couple, Relation between load, shear force & bending moment.

Stresses in beams:- Pure bending, theory of simple bending with assumptions & expressions for bending stress, derivation of bending equation, bending stresses in symmetrical sections, section modulus for various shapes of beam sections.

Deflection of beams :- Derivation of differential equation of elastic curve with the assumptions made in it. Deflection & slope of cantilever, simply supported, overhung beams subjected to concentrated load, UDL, Relation between slope, deflection & radius of curvature. Macaulay`s method, area moment method to determining deflection of beams.

Shear stresses in beams :- Concept, derivation of shear stress distribution formula, shear stress
distribution diagram for common symmetrical sections, maximum & average shear stress.

Unit – III: Strain energy & impact loading 8 hour

Strain energy & impact loading :- Definition of strain energy stored in a body when it is subjected to gradually applied load, suddenly applied loads & impact loads. Strain energy under uniaxial tension and compression, bending and torsion. Castingliano`s theorem.

Statically indeterminate beams and frames, Clapeyron's three moment equation method, Moment distribution method.

Unit- IV: Columns 6 hour

Buckling of columns with various end conditions, column curves, Columns with initial curvature, with eccentric loading, South well plot, short column formulae like Rankine's Johnsons, etc. Energy method. Beam Column.

Unit- V: Principal stresses & strains 6 hour

Principal stresses & strains :- Definition of principal planes & principal stresses, analytical method of determining stresses on oblique section when member is subjected to direct stresses in one plane in mutually perpendicular two planes, when member is subjected to shear stress &direct stresses in two mutually perpendicular planes, Mohr`s circle for representation of stresses. Derivation of maximum & minimum principle stresses & maximum shear stresses when the member is subjected to different types of stresses simultaneously (i.e. combined stress)

Unit- VI **6 hour**

Derivation of maximum, minimum principle stresses & maximum shear stress induced in shaft when it is subjected to bending moment, torque & axial load. Theories of failure, modes of failure, compound stresses, eccentric axial loading, variable stresses in machine parts, stress concentration & stress raisers, notch sensitivity, stress concentration factor, methods for reducing stress concentration factor, Factor of safety

Total No of periods: 45

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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. (Fourth Semester) Aeronautical Engineering

Aerodynamics- I (BEAE-405T)

(Total Credits: 04)

Teaching Scheme	**Examination Scheme**
Lectures: 3 Hours/ Week	**Theory**
Tutorial: 1 Hours / Week	**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

TEXT BOOKS

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

REFERENCES

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

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Aerodynamics- I (BEAE405P)
(Total Credits: 01)

Teaching Scheme
Practical: 2 Hours/ Week

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

List of Experiments in Aerodynamics- I

Based on above syllabus minimum eight practical's to be performed.

1. To draw the graph for different velocities verses manometer deflection.

2. Analysis of forces (Lift & Drag) over cambered aerofoil symmetrical.
3. Analysis of forces (Lift & Drag) over cambered aerofoil unsymmetrical.
4. Analysis of forces (Lift & Drag) over flat plate.
5. To draw graph of pressure distribution on a symmetrical aerofoil.
6. To draw graph of pressure distribution on a unsymmetrical aerofoil.
7. To draw graph of pressure distribution on flat plate.
8. To draw graph of pressure distribution on a circular cylinder.
9. To visualize the flow patterns over the surface of different model.
10. To study the side force in yawing motion of an aircraft.
11. To study the boundary layer concept over the various models.

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Aircraft layout and Component drawing
(BEAE-406P) (Total Credits: 02)

Teaching Scheme
Practical: 2 Hours/ Week

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

List of Experiments in Aircraft Layout and Component Drawing:
Study of layout and component parts of different types of aircraft through drawings
Suggested

1. Considerations to be taken while lay outing the cockpit of aircraft.
2. Layout of cockpit of civil aircraft.
3. Layout of cockpit of military aircraft.
4. Considerations to be taken while lay outing the fuselage of aircraft
5. Layout of fuselage of jet transport aircraft.
6. Layout of fuselage of jet commercial aircraft.
7. Layout of fuselage of jet fighter aircraft.
8. Considerations to be taken while designing an aircraft.
9. Three Views drawing of commercial aircraft.
10. Three Views drawing of fighter aircraft.
11. Three Views drawing of jet transport aircraft.
12. Physical models of gliders using balsa.

REFERENCES

1. Janes all the World's Aircraft
2. Drawings available from Aircraft Manufacturers

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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

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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 :

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/A1DS; 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.

Passing marks - 40 Marks.

OR

In view of the above entire course the students in terms of batches of 20 students each may be assigned a project work encompassing People's Bio-diversity Register (PBR) of any Gram Panchayat as per the format of Bio-diversity Authority of India under the guidance of a teacher. The PBR should be evaluated for 100 marks.

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

TEXT BOOKS:

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