(4th SEMESTER)

Course		Contact Hrs.			Marks			Credits
Code	**Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BASES1-401	Aircraft performance	3	1	0	40	60	100	4
BASES1-402	Aircraft Structures	3	1	0	40	60	100	4
BASES1-403	Aircraft Propulsion	3	1	0	40	60	100	4
BASES1-404	Aircraft Systems and Instrumentation	3	0	0	40	60	100	3
BASES1-405	Aircraft Structures Lab.	0	0	2	60	40	100	1
BASES1-406	Aircraft Propulsion Lab.	0	0	2	60	40	100	1
	Management (Select any One)*	3	0	0	40	60	100	3
BHSMC0-018	Introduction to Industrial Management							
BHSMC0-014	Fundamentals of Management for Engineers							
	Mandatory Course							
BMNCC0-002	Environmental Sciences	3	0	0	--	--	100	0
Total		**-**	**-**	**-**	**320**	**380**	**800**	**20**

NOTE: Students will go on Industrial training after 4th Semester

***Detailed syllabus of Management subjects may be seen on the UG Open Electives Page of University website by clicking on "MRSPTU List of Humanities, Social Science and Management Subjects_BHSMC0-XXX"**

AIRCRAFT PERFORMANCE

Subject Code –BASES1-401 **L T P Cr** **Duration:60 Hours**
3 1 0 4

COURSE OBJECTIVES

- The course enables students to learn various concepts related to atmosphere, aerodynamic characteristics, performance parameters and energy methods.
- The course enables students to analyze and estimate performance parameters of different types of aircraft for steady and accelerated flights.

LEARNING OUTCOME

After undergoing the subject, the student will be able to:

- Analyze atmosphere and estimate atmospheric properties.
- Analyze drag for 2D and 3D cases for subsonic and supersonic aircrafts.
- Analyze aerodynamic characteristics of different types of aircrafts.
- Estimate performance parameters for steady flight.
- Estimate performance parameters for accelerated flight.
- Analyze maneuvers and Energy methods.

DETAILED CONTENTS

UNIT – I (11Hrs.)

1. Atmosphere: Standard atmosphere, Relation between geo-potential and geometric altitudes, Pressure, temperature and density altitudes. Relations for isothermal and gradient atmospheric regions, Stability of atmosphere, Measurement of air-speed: Indicated airspeed, Calibrated airspeed, Equivalent airspeed and True airspeed, Airspeed indicator.

UNIT – II (20Hrs.)

2. Drag: Drag, Causes of drag, Types of drag, Factors affecting drag. Drag polar, Compressibility drag, Design for minimum drag, Estimation of drag of complete airplane for subsonic and supersonic cases, Terminal velocity.

3. Aerodynamic characteristics: Force and Moment coefficients from dimensional analysis and their variation with angle of attack, Lift, Drag and moment coefficients, Relations between lift and drag, Aerodynamic center, Center of pressure, Pressure distribution over 2-D airfoil, Estimation of aerodynamic characteristics from measured pressure distribution, Variation of aerodynamic coefficients with Reynold's Number and Mach number, Effect of span, aspect ratio, plan form, sweep, taper and twist on aerodynamic characteristics of a lifting surface, Delta wing aerodynamics.

UNIT – III (16Hrs.)

4. High lift devices: Maximum lift coefficient of airfoils, Leading and trailing edge devices, Deep stall, Propulsive lift, V/STOL configurations.

5. Aircraft performance in steady flight: Straight and Level flight, Variation of drag with flight speed, Minimum drag conditions, Variation of power with flight speed, Minimum power conditions, Gliding flight, Shallow and steep angles of glide, Sinking speed, Minimum sinking

speed, Time of descent, Climbing flight at shallow angles, Correction for steep angles, Time to flight, Maximum rate of climb.

UNIT – IV (13Hrs.)

6. Aircraft performance in accelerated flight: Take-off and landing, Calculation of take-off ground run and take off distances, Minimum ground run, Assisted take-off, Calculation of landing ground run and landing distances, Range and endurance, Numerical problems.

7. Maneuvers and energy method: Maneuvering performance, Introductory comments on spins and stalls, Analysis of Spin, Various types of stalling behavior of wings, Turning flight, Maneuvers in 3-D space, Karman's method of JATO, Energy method of performance calculations

INSTRUCTIONAL STRATEGY

The course consists of conceptual and numerical contents for which a combination of LCD projector and black/white boards can be used as teaching aids.

RECOMMENDED BOOKS

1. Aircraft Performance and Design: J. D. Anderson Jr., TATA McGraw-Hill, 2010.
2. Aerodynamics for Engineering Students: E.L. Houghton and N.B. Carruthers, Butterworth Heinemann, 1982.
3. Introduction to Flight: J. D. Anderson Jr., TATA McGraw-Hill, 8th Edition, 2015.

AIRCRAFT STRUCTURES

Subject Code –BASES1-402 | **L T P Cr** | **Duration:60 Hours**
3 1 0 4

COURSE OBJECTIVES

- To enable the student to explain basic principles of elasticity.
- The student should be able to calculate loads acting on the aircraft.
- The student should also be able to do stress analysis of statically determinate and indeterminate structures by matrix method and Finite Element methods.
- To enable the student to find buckling loads of columns and plates

LEARNING OUTCOMES

After undergoing the subject, student will be able to:

- Perform stress analysis of beams, columns and trusses by applying various methods.
- Calculate deflection of structures by various methods..
- Perform stress analysis of statically determinate and indeterminate structures.
- Estimate loads acting on an aircraft.
- Estimate buckling loads of columns and plates.

DETAILED CONTENTS

UNIT –I (12 Hrs.)

1. **Basics of elasticity:** Equations of equilibrium, plane stress, stresses on inclined planes, principal stresses ,compatibility equations ,plane strain ,principal strains, stress-strain relationship**,** numerical problems, temperature effects, experimental measurement of surface strains,2- D problems, stress functions, St. Venant's principle, bending of end loaded cantilever.

UNIT-II (20 Hrs.)

2. **Statically determinate and indeterminate structures:** Statically determinate and indeterminate trusses. Truss analysis by method of joints, Truss analysis with single and double redundancy, other structures with single redundancy, shear center, principle of superposition, Maxwell reciprocal theorem, numerical problems.

3. **Matrix methods:** Introduction to flexible and stiffness methods, choice of method, stiffness matrix for elastic springs, analysis of pin jointed framework, stiffness matrix for uniform beams. Finite Element Method for continuum structures

UNIT-III (18 Hrs.)

4 **Elastic buckling of columns and plates:** Buckling load of Euler columns with different end conditions, beam columns, effect of initial imperfections, pure bending of thin plates, plates subjected to bending and twisting, plates subjected to distributed transverse loads, numerical problems.

5 **Loads on aircraft:** Pure translation, inertia forces on rotating bodies, load factors for translational acceleration, load factors for angular acceleration, numerical problems.

UNIT IV (10 Hrs.)

6 **Analysis of aircraft components:** Loads on structural components, functions of structural components, fabrication of structural components, connections, V-n diagram, Gust loads, crack propagation, stress concentration factor, crack tip plasticity, crack propagation rates

INSTRUCTIONAL STRATEGY

Aircraft Structures being fundamental course, teachers are expected to lay emphasis explain the basic concepts, principles and their applications to aircraft structures. For this purpose teachers are expected to give simple problems and provide tutorial exercises. The teachers are expected to show the actual parts of aircraft wing and fuselage.

RECOMMENDED BOOKS:

1 "Aircraft Structures for Engineering Students", T.H.G. Megson ,4th Edition, Elsevier Ltd., 2012

2 "Aircraft structures", D.J.Peery and J.J.Azhar, 2nd Edition., McGraw Hill, 1996

3 "Structural stability of Columns and Plates", N G R Iyengar, John Wiley & sons, 1988
Ocw.mit.edu/courses/aeronautics-and-astronautics

AIRCRAFT PROPULSION

Subject Code –BASES1-403	L	T	P	Cr	Duration:60 Hours
	3	1	0	4	

COURSE OBJECTIVES

- The basic knowledge and governing laws of various modes of heat transfer, aero- and thermodynamic aspects of propulsive devices, such as, propellers, piston type and turbine type aero engines, their performance parameters and the essential knowledge of fuel combustion, standard ratings of aviation fuels and propellants used in rocket engines.

- With this basic knowledge, the student can move on to studying the advance propulsion systems.

LEARNING OUTCOMES

After undergoing the subject, student will be able to:

- Define governing laws of various IC Engines, cycles and modes of heat transfer; thermodynamic aspects of aerospace propulsion systems and their performance parameters
- Describe fuel combustion and flame-stability.
- Examine and analyze compressors and turbines.
- Estimate performance of various types of engines

DETAILED CONTENT

UNIT I: (17 Hrs.)

1. **Heat Transfer and Propellers:** Heat transfer process, Heat conduction, thermal conductivity, general equations of heat conduction with source, conduction problems in 1D and 2D with and without source; Convective heat transfer fundamentals, Introduction to radiative heat transfer, Coupled heat transfer problems.

   Ideal momentum theory and blade element theory and their relative merits, numerical problems on the performance of propellers using propeller charts, selection of propellers, fixed, variable and constant speed propellers, prop-fan, material for propellers, shrouded propellers helicopter rotor in hovering performance.

UNIT II: (16 Hrs.)

2. **Aircraft Piston Engines**: Brief historical sketch of S.I. and C.I. engines, 4-stroke and 2-stroke engines, thermodynamics of engine analysis, combustion process, air standard cycles, various type of arrangements or multi-cylinder aircraft engines, their merits and operational efficiencies, intake and exhaust manifolds, cooling and lubrication systems, valve timing and arrangements, I.H.P., B.H.P and F.H.P, engine performance, effect of altitude, power required and power available, supercharging, preliminary design of aircraft piston engine.

UNIT III: (14 Hrs.)

3. **Fuels and Combustion:** Liquid fuels, hydrocarbons, gasoline, starting mixtures and temperatures, vapor lock, other liquid fuels and blends, combustion knock and knock rating, carburetion and fuel injection, ignition of the charge, ignition system, and gas turbine fuels, solid and liquid propellants

UNIT IV: (13 Hrs.)

4. **Aircraft Gas Turbine Engines:** Air-standard Brayton cycle, actual gas turbine engine cycle, compressor and turbine efficiencies, compressor work and turbine work, centrifugal and axial type of compressor, their comparative action, relative merits in operations, combustion chambers: various arrangements, simplex and duplex burners.

INSTRUCTIONAL STRATEGY

Session plan/course-material uploading, class-room teaching associated with assignments, quiz, viva-voce and evaluation.

RECOMMENDED BOOKS

1. Holman J.P., "Heat Transfer", 2nd Edition, McGraw Hill.
2. Gebhart B., "Heat Transfer", 2nd Edition, McGraw Hill.
3. Dommasch, Sherby and Connolly, "Airplane Aerodynamics", Pitman.
4. Litchy L.C., "I C. Engines", McGraw Hill.
5. Mattingly J.D., "Elements of Gas Turbine Propulsion", McGraw Hill 1st Ed.1997.
6. Cohen Rogers and Sarvanmattoo, "Gas Turbine Theory", John Wiley.
7. P. G. Hill and C. R. Peterson, "Mechanics and Thermodynamics of Propulsion", Addison Wesley, 1970.
8. J.L Kereebrock, "Aircraft Propulsion System Technology and Design", MIT Press, 1991.

AIRCRAFT SYSTEMS AND INSTRUMENTATION

Subject Code –BASES1-404 | **L T P Cr** | **Duration:45 Hours**

3 0 0 3

COURSE OBJECTIVES

- To enable the student to describe control systems of aircraft.
- The student should be able to describe working principle of Flight instruments
- The student should be able to apply the knowledge of digital system to covert and acquire data from various subsystems.

LEARNING OUTCOMES

After undergoing the subject, student will be able to:

- Illustrate various types of aircraft control systems mechanisms.
- Design Hydraulic and Pneumatic Systems for aircraft subsystems.

- Use Gyroscope and Accelerometer for effective navigation and guidance of aircraft.
- Explain the role of cockpit instruments and system of aircraft.
- Use digital system to confined and acquire data from various subsystems.

UNIT –I (10 Hrs)

1. **Flight control systems:** Conventional Systems, Power assisted and Fully Powered Flight Controls, Power Actuated Systems, Engine Control Systems, Push Pull Rod System, Flexible Push Full Rod System, Components, Modern Control Systems, Digital Fly by Wire Systems, Auto Pilot System, Active Control Technology.
2. **Communication and navigation system:** Introduction to Communication and navigation system of aircraft, Instrument Landing Systems, VOR, CCV Case Studies.

UNIT –II (10 Hrs.)

3. **Aircraft systems:** Hydraulic Systems: Study of Typical Workable System components, Hydraulic System Controllers, Modes of Operation, Pneumatic Systems: Advantages, Working Principles, Typical Air Pressure System, Brake System, Typical Pneumatic Power System Components, Landing Gear Systems: Classification, Shock Absorbers, Retraction Mechanism.

UNIT –III (13 Hrs.)

4. **Engine systems:** Fuel Systems for Piston and Jet Engines, Components of Multi Engines, Lubricating Systems for Piston and Jet Engines, Engine Starting and Ignition Systems, Typical examples for Piston and Jet Engines.

5. **Auxiliary system:** Basic Air Cycle Systems, Vapor Cycle Systems, Boot-Strap Air Cycle System, Pressurization system, Oxygen Systems, Fire Protection Systems, Deicing and Anti Icing Systems.

UNIT –IV (12 Hrs)

6. **Gyroscopic instruments:** Gyroscope and its properties, gyro system, Vertical gyroscope-Horizon, Direction gyro-direction indicator, Rate gyro-rate of turn and slip indicator, acceleration and turning errors.

7. **Measurements and instrumentation:** Pressure measurement, temperature measurement, fuel quantity measurement, engine power and control instruments-measurement of RPM, manifold pressure, torque, exhaust gas temperature, EPR, fuel flow, engine vibration, monitoring. Data acquisition and Handling systems: Introduction-signal conditioners-Instrumentation amplifiers-filters. Data conversion -multiplexers-A/D-D/A conversion. Telemetry-Airborne and ground system-PC based telemetry system. Introduction to telemetry flight data testing. Application of telemetry in UAVs and Satellites.

INSTRUCTIONAL STRATEGY

Session Plan/course-material uploading, Aircraft Hanger Visit, Class-room teaching associated with assignments, presentations, Videos of animation of aircraft systems and Flight Instruments working, quiz, in-class tests, viva-voce and evaluation.

RECOMMENDED BOOKS

1 Electrical and Electronics measurements and instruments. Author, A.K. Shawney, 2010

2 Aircraft flight instrumentation by Pallett, 1988

3 Advanced Aircraft Systems by David A. Lombardo, 1993

Airframe and Powerplant MECHANICS (Airframe Book), FAA, 1976

AIRCRAFT STRUCTURES LAB

Subject Code –BASES1-405 **L T P Cr** **Duration:30 Hours**

0 0 2 1

COURSE OBJECTIVE

The aircraft structures Lab with enable the student to conduct experiments, so that they are able to understand the theoretical concepts and principles in a better way.

DETAILED CONTENTS

1 Prove Maxwell Reciprocal theorem for a simply supported beam

2 Prove Maxwell Reciprocal theorem for a cantilever beam

3 To determine/calculate shear centre of a channel section

4 Determine/calculate shear centre of a Z section

5 To Determine/calculate shear centre of a rectangular section

6 Find direct strain in a simply supported beam by strain gauges

7 Determine/calculate direct strain in a cantilever by strain gauges

8 Stress analysis of a truss by using software

9 Stress analysis of initially bent column by using software

10 Stress analysis of a pinned column by using software

11 Stress analysis of a column with both ends fixed by using software

MEANS OF ASSESSMENT

Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce.

AIRCRAFT PROPULSION LAB

Subject Code –BASES1-406 **L T P Cr** **Duration:30 Hours**

0 0 2 1

COURSE OBJECTIVE

- At the end of this course, the student should be able to perform experiments to measure different aircraft engine parameters.

DETAILED CONTENTS

1. Study the functioning of aircraft piston engines having various arrangements of cylinders.
2. Study of Jet Engine.
3. Experiments on Continuous Combustion test rig.
4. Conduct Morse test on given multi cylinder engine.
5. Conduct dynamometer test and retardation test
6. Performance test on reciprocating air compressor.

MEANS OF ASSESSMENT

Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce.

***NOTE**: During the summer vacation after 4th/ 6th semester, students are ready for industrial experience. Therefore, they may choose to undergo Internship / Innovation / Entrepreneurship related activities. Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry.

ENVIRONMENTAL SCIENCES

Subject Code: BMNCC0-002 **L T P C** **Duration: 30 Hrs.**

2 0 0 0

Course Objectives:

1. To identify global environmental problems arising due to various engineering/industrial and technological activities and the science behind these problems
2. To realize the importance of ecosystem and biodiversity for maintaining ecological balance.
3. To identify the major pollutants and abatement devices for environmental management and sustainable development.
4. To estimate the current world population scenario and thus calculating the economic growth, energy requirement and demand.
5. To understand the conceptual process related with the various climatologically associated problems and their plausible solutions.

. UNIT-I

1. The Multidisciplinary Nature of Environmental Studies:

Definition, scope and importance, Need for public awareness.

2. **Natural Resources**

Renewable and Non-renewable Resources: Natural resources and associated problems.

(a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

(b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

(c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

(d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

(e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies.

UNIT-II

Environmental Pollution: Definition

(a) Causes, effects and control measures of:

i) Air pollution

ii) Water pollution

iii) Soil pollution

iv) Marine pollution

v) Noise pollution

vi) Thermal pollution

vii) Nuclear pollution

(b) **Solid Waste Management**: Causes, effects and control measures of urban and industrial wastes.

(c) Role of an individual in prevention of pollution.

(d) Pollution Case Studies.

(e) Disaster management: floods, earthquake, cyclone and landslides.

UNIT-III

Social Issues and the Environment

(a) From unsustainable to sustainable development

(b) Urban problems and related to energy

(c) Water conservation, rain water harvesting, Watershed Management

(d) Resettlement and rehabilitation of people; its problems and concerns, Case studies.

(e) Environmental ethics: Issues and possible solutions

(f) Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case studies.

(g) Issues involved in enforcement of environmental legislation

UNIT-IV

Human Population and the Environment

(a) Population growth, variation among nations

(b) Population explosion – Family Welfare Programmes

(c) Environment and human health

(d) Human Rights

(e) Value Education

(f) Women and Child Welfare

(g) Role of Information Technology in Environment and Human Health

(h) Case Studies.

Environmental Science related activities:

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around US. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethoses. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students on the above issues through following two types of activities.

(a) Awareness Activities:

i) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste.

ii) Slogan making event

iii) Poster making event

iv) Cycle rally

v) Lectures from experts.

(b) Actual Activities:

i) Plantation

ii) Gifting a tree to see its full growth

iii) Cleanliness drive

iv) Drive for segregation of waste

v) To live some big environmentalist for a week or so to understand his work

vi) To work in kitchen garden for mess

vii) To know about the different varieties of plants

viii) Shutting down the fans and ACs of the campus for an hour or so

Recommended Books

1. Agarwal, K. C. 2001 Environment Biology, Nidi Publ. Ltd. Bikaner.
2. Jadhav, H & Bhosale, V.M. 1995. Environment Protection and Laws. Himalaya Pub House, Delhi 284p.
3. Rao M. N. & Datta A.K. 1987. Waste Water Treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345 p.
4. Principle of Environment Science by Cunninghan, W.P.
5. Essentials of Environment Science by Joseph.