SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA3351	Transforms and Partial Differential Equations	BSC	3	1	0	4	4
2.	AE3351	Aero Engineering Thermodynamics	PCC	3	0	0	3	3
3.	AE3352	Solid Mechanics	ESC	4	0	0	4	4
4.	CE3391	Fluid Mechanics and Machinery	ESC	3	1	0	4	4
5.	AE3301	Elements of Aeronautical Engineering	PCC	3	0	0	3	3
6.	AE3302	Aircraft Systems and Instruments	PCC	3	0	0	3	3
PRACTICALS								
7.	AS3361	Thermodynamics and Strength of Materials Laboratory	PCC	0	0	4	4	2
8.	CE3362	Fluid Mechanics and Machinery Laboratory	PCC	0	0	4	4	2
9.	GE3361	Professional Development$	EEC	0	0	2	2	1
			TOTAL	19	2	10	31	26

$ **Skill Based Course**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA3452	Vector Calculus and Complex Functions	BSC	3	1	0	4	4
2.	AE3401	Aerodynamics I	PCC	3	0	0	3	3
3.	AE3402	Air Breathing Propulsion	PCC	3	1	0	4	4
4.	AE3491	Mechanics of Machines	PCC	3	0	0	3	3
5.	AE3403	Aircraft Structures-I	PCC	3	0	0	3	3
6.	GE3451	Environmental Sciences and Sustainability	BSC	2	0	0	2	2
7.		NCC Credit Course Level 2#		3	0	0	3	3
PRACTICALS								
8.	AE3411	Aerodynamics Laboratory	PCC	0	0	4	4	2
9.	AE3412	Propulsion Laboratory	PCC	0	0	4	4	2
			TOTAL	17	2	8	27	23

NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	M	H	H	H	H	H
PO2	Problem analysis	M	M	H	H	H	H
PO3	Design / development of solutions	L	L	M	M	M	M
PO4	Investigation	H	H	H	H	H	H
PO5	Modern Tool Usage	L	L	L	L	L	L
PO6	Individual and Team work	M	M	H	H	H	H
PO7	Communication	L	L	L	L	L	L
PO8	Engineer and Society	M	M	M	M	M	M
PO9	Ethics	L	L	L	L	L	L
PO10	Environment and Sustainability	M	M	M	M	M	M
PO11	Project Management and Finance	L	L	L	L	L	L
PO12	Life Long Learning	M	M	M	M	M	M
PSO1	Knowledge of Civil Engineering discipline	M	H	H	H	H	H
PSO2	Critical analysis of Civil Engineering problems and innovation	L	L	M	M	M	M
PSO3	Conceptualization and evaluation of engineering solutions to Civil Engineering Issues	L	L	L	L	L	L

L - Low, M – Medium, H - High

MA3452   **VECTOR CALCULUS AND COMPLEX FUNCTIONS**   **L T P C**
                                                                      3 1 0 4

OBJECTIVES:
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.
- To make the student acquire sound knowledge of techniques in solving ordinary
- differential equations that model engineering problems.

UNIT I   VECTOR   CALCULUS   9+3
Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT II   **ANALYTIC FUNCTION**   **9+3**

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z+c,\ az,\ \dfrac{1}{z},\ z^2$ - Bilinear transformation.

UNIT III   **COMPLEX INTEGRATION**   **9+3**

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.

UNIT IV   **LAPLACE TRANSFORMS**   **9+3**

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

UNIT V   **ORDINARY DIFFERENTIAL EQUATIONS**   **9+3**

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

TOTAL: 60 PERIODS

OUTCOMES:

Upon successful completion of the course, students should be able to:

- Evaluate real and complex integrals using the Cauchy integral formula and the residue theorem.
- Appreciate how complex methods can be used to prove some important theoretical results.
- Evaluate line, surface and volume integrals in simple coordinate systems.
- Calculate grad, div and curl in Cartesian and other simple coordinate systems, and establish identities connecting these quantities.
- Use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.

TEXT BOOKS

1. Erwin Kreyszig," Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Grewal B.S., "Higher Engineering Mathematics ", Khanna Publishers, New Delhi, 43rd Edition, 2014.

REFERENCES

1. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi , 3rd Edition, 2007.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics ", Firewall   Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Peter V. O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.
5. Ray Wylie C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

AE3401 **AERODYNAMICS I** **L T P C**
3 0 0 3

COURSE OBJECTIVES:
- To introduce the concepts of mass, momentum and energy conservation relating to aerodynamics.
- To introduce the Navier Stroke equations and its application
- To make the student understand the concept of vorticity, irrotationality, theory of airfoil and wing sections.
- To introduce the basics of viscous flow.
- To make the student to understand the different boundary layers and Blasius Solution
- To introduce the basics of turbulence flow

UNIT I **INTRODUCTION TO LOW-SPEED FLOW** **9**
Euler equation, incompressible Bernoulli's equation. circulation and vorticity, green's lemma and Stoke's theorem, barotropic flow, kelvin's theorem, streamline, stream function, irrotational flow, potential function, Equipotential lines, elementary flows and their combinations.

UNIT II **TWO-DIMENSIONAL INVISCID INCOMPRESSIBLE FLOW** **9**
Ideal Flow over a circular cylinder, D'Alembert's paradox, magnus effect, Kutta Joukowski's theorem, starting vortex, Kutta condition, real flow over smooth and rough cylinder.

UNIT III **AIRFOIL THEORY** **9**
Cauchy-Riemann relations, complex potential, methodology of conformal transformation, Kutta-Joukowski transformation and its applications, thin airfoil theory and its applications.

UNIT IV **SUBSONIC WING THEORY** **9**
Vortex filament, Biot and Savart law, bound vortex and trailing vortex, horse shoe vortex, lifting line theory and its limitations.

UNIT V **INTRODUCTION TO BOUNDARY LAYER THEORY** **9**
Boundary layer and boundary layer thickness, displacement thickness, momentum thickness, energy thickness, shape parameter, boundary layer equations for a steady, two-dimensional incompressible flow, boundary layer growth over a flat plate, critical Reynolds number, Blasius solution, basics of turbulent flow.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to be able to
CO1: Apply the basics physics for low-speed flows.
CO2: Apply the concept of 2D, inviscid incompressible flows in low-speed aerodynamics.
CO3: Solve lift generation problems using aerofoil theories.
CO4: Make use of lifting line theory for solving flow properties.
CO5: Solve the boundary layer equations for a steady, two-dimensional incompressible flow
CO6: Solve the properties of turbulent flow.

TEXT BOOKS:
1. Anderson, J.D., "Fundamentals of Aerodynamics", McGraw Hill Book Co., 2010
2. Houghton, E.L., and Caruthers, N.B., "Aerodynamics for Engineering students", Edward Arnold Publishers Ltd., London, 1989.
3. E Rathakrishnan, "Theoretical Aerodynamics", John Wiley, NJ, 2013

REFERENCES:
1. Clancey, L J.," Aerodynamics", Pitman, 1986
2. John J Bertin., "Aerodynamics for Engineers", Pearson Education Inc, 2002
3. Kuethe, A.M and Chow, C.Y, "Foundations of Aerodynamics", Fifth Edition, John Wiley & Sons, 2000.
4. Milne Thomson, L.H., "Theoretical Aerodynamics", Macmillan, 1985

MAPPING OF COS AND POS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	-	-	1	1	1	3	2	-
CO2	3	2	1	1	2	-	-	-	-	1	1	1	3	2	-
CO3	3	3	2	-	2	-	-	-	-	1	1	2	3	1	-
CO4	3	2	1	1	2	-	-	-	-	1	1	1	3	1	-
CO5	3	2	1	1	2	-	-	-	-	1	1	1	3	2	-
CO6	3	3	2	-	3	1	1	2	-	1	1	2	1	3	2
Avg	3	2.3	1.3	1	2	1	1	2	-	1	1	1.5	2.6	1.8	2

AE3402	AIR BREATHING PROPULSION	L T P C
		3 1 0 4

OBJECTIVES:
1. To establish fundamental approach and application of jet engine components.
2. To learn about the analysis of flow phenomenon and estimation of thrust developed by jet engine.
3. To introduce about the application of various equations in Gas Turbine Engines.
4. To learn the concepts of jet engine combustion chambers
5. To acquire knowledge on compressors and turbines

UNIT I   PRINCIPLES OF AIR BREATHING ENGINES   9+6
Operating principles of piston engines – thermal efficiency calculations – classification of piston engines – illustration of working of gas turbine engines – factors affecting thrust – methods of thrust augmentation – performance parameters of jet engines.

UNIT II   JET ENGINE INTAKES AND EXHAUST NOZZLES   9+6
Ram effect, Internal flow and Stall in subsonic inlets – relation between minimum area ratio and eternal deceleration ratio – diffuser performance – modes of operation - supersonic inlets – starting problem on supersonic inlets – shock swallowing by area variation – real flow through nozzles and nozzle efficiency – losses in nozzles – ejector and variable area nozzles - interaction of nozzle flow with adjacent surfaces – thrust reversal.

UNIT III   JET ENGINE COMBUSTION CHAMBERS   9+6
Chemistry of combustion, Combustion equations, Combustion process, classification of combustion chambers – combustion chamber performance – effect of operating variables on performance – flame stabilization, Cooling process, Materials, Aircraft fuels, HHV, LHV, Orsat apparatus

UNIT IV   JET ENGINE COMPRESSORS   9+6
Euler's turbo machinery equation, Principle operation of centrifugal compressor, Principle operation of axial flow compressor– Work done and pressure rise – velocity diagrams – degree of reaction – free vortex and constant reaction designs of axial flow compressor – performance parameters axial flow compressors– stage efficiency.

UNIT V   JET ENGINE TURBINES   9+6
Principle of operation of axial flow turbines– limitations of radial flow turbines- Work done and pressure rise – Velocity diagrams – degree of reaction – constant nozzle angle designs – performance parameters of axial flow turbine– turbine blade cooling methods – stage efficiency calculations – basic blade profile design considerations – matching of compressor and turbine

TOTAL: 75 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected

CO1: To be able to apply control volume and momentum equation to estimate the forces produced by aircraft propulsion systems

CO2: To be able to describe the principal figures of merit for aircraft engine

CO3: To be able to describe the principal design parameters and constraints that set the performance of gas turbine engines.

CO4: To apply ideal and actual cycle analysis to a gas turbine engine to relate thrust and fuel burn to component performance parameters.

CO5: Understanding the workings of multistage compressor or turbine, and to be able to use velocity triangles and the Euler Turbine Equation to estimate the performance of a compressor or turbine stage.

TEXT BOOK:

1. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" Pearson education (2009)

REFERENCES:

1. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. "Gas Turbine Theory", Pearson Education Canada; 6th edition, 2008.
2. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 2nd edition 2014.
3. Oates, G.C., "Aero thermodynamics of Aircraft Engine Components", AIAA Education Series, New York, 1985.
4. "Rolls Royce Jet Engine", Rolls Royce; 4th revised edition, 1986

MAPPING OF COS AND POS:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	3	1	1	2	3	1	1	1	2	3	1	1	3	1	1
CO 2	3	2	2	3	3	2	3	2	2	3	1	1	3	1	1
CO 3	3	3	3	3	2	1	2	1	3	2	1	1	3	1	1
CO 4	3	3	3	2	3	2	2	1	2	1	2	1	3	1	1
CO 5	3	3	2	2	3	1	1	1	1	1	1	1	3	1	1
	3	2.4	2.2	2.4	2.8	1.4	1.8	1.2	2	2	1.2	1	3	1	1

AE3491　　　　　　**MECHANICS OF MACHINES**　　　　　**L　T　P C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　3　0　0　3

COURSE OBJECTIVES:
1. To understand the principles in the formation of mechanisms and their kinematics.
2. To learn the basic concepts of toothed gearing and kinematics of gear trains.
3. To study the effect of friction in different machine elements.
4. To analyse the forces and torque acting on simple mechanical systems
5. To understand the importance of balancing and vibration

UNIT I　　　　KINEMATIC ANALYSIS IN SIMPLE MECHANISMS AND CAMS　　　　9
Mechanisms – Terminology and definitions – kinematics inversions and analysis of 4 bar and slide crank chain – velocity and acceleration polygons – cams – classifications – displacement diagrams - layout of plate cam profiles.

UNIT II　　　　TOOTHED GEARING AND GEAR TRAINS　　　　9
Gear terminology – law of toothed gearing – involute gearing – Gear tooth action - Interference and undercutting – gear trains – parallel axis gear trains – epicyclic gear trains.

UNIT III　　　　FRICTION ASPECTS IN MACHINE COMPONENTS　　　　9
Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Friction clutches – Belt drives – Friction aspects in brakes.

UNIT IV　　　　STATIC AND DYNAMIC FORCE ANALYSIS　　　　9
Applied and Constrained Forces – Free body diagrams – Static equilibrium conditions – Static Force analysis in simple mechanisms – Dynamic Force Analysis in simple machine members – Inertia Forces and Inertia Torque – D'Alembert's principle.

UNIT V　　　　BALANCING OF ROTATING MASSES AND VIBRATION　　　　9
Static and Dynamic balancing – Balancing of revolving masses – Balancing machines – Free vibrations – natural Frequency – Damped Vibration – bending critical speed of simple shaft – Forced vibration – harmonic Forcing – Vibration isolation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: Design the linkages and the cam mechanisms for specified output motions.
CO2: Determine the gear parameters of toothed gearing and speeds of gear trains in various applications.
CO3: Evaluate the frictional torque in screw threads, clutches, brakes and belt drives.
CO4: Determine the forces on members of mechanisms during static and dynamic equilibrium conditions.
CO5: Determine the balancing masses on rotating machineries and the natural frequencies offree and forced vibratory systems

TEXT BOOK
1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017.

REFERENCES
1. Cleghorn. W. L., Nikolai Dechev, "Mechanisms of Machines", Oxford University Press, 2015.
2. Rao.J.S. and Dukkipati.R.V. "Mechanism and Machine Theory", New Age International Pvt. Ltd., 2006.
3. Rattan, S.S, "Theory of Machines", McGraw-Hill Education Pvt. Ltd., 2014.
4. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2009.
5. Thomas Bevan, "The Theory of Machines", Pearson Education Ltd., 2010

MAPPING OF COS AND POS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2.5	2	-	1	-	-	-	-	3	3	1	1
CO2	3	3	3	3	2	-	1	-	-	-	1	3	3	1	1
CO3	3	2.5	2.5	2.5	2	2	1	-	-	-	1	3	3	1	1
CO4	3	3	3	2.5	2	-	1	-	-	-	1	3	3	1	1
CO5	3	3	3	3	2	2	1	-	-	-	1	3	3	1	1
Avg	3	2.7	2.9	2.7	2	0.8	1	-	-	-	0.8	3	3	1	1

AE3403   **AIRCRAFT STRUCTURES – I**   **L T P C**
                                                        3 0 0 3

COURSE OBJECTIVES:
- To provide the students an understanding on the linear static analysis of determinate and indeterminate aircraft structural components.
- To provide the students an understanding on energy methods to statically determinate and indeterminate structures
- To make the students to Create a structure to carry the given load.
- To make the students to Calculate the response of statically indeterminate structures under various loading conditions.
- To provide the design process using different failure theories

UNIT I   STATICALLY DETERMINATE & INDETERMINATE STRUCTURES   9
Plane truss analysis – method of joints – method of sections – method of shear – 3-D trusses – principle of super position, Clapeyron's 3 moment equation and moment distribution method for indeterminate beams.

UNIT II   ENERGY METHODS   9
Strain Energy in axial, bending, torsion and shear loadings. Castigliano's theorems and their applications. Energy theorems – dummy load & unit load methods – energy methods applied to statically determinate and indeterminate beams, frames, rings & trusses.

UNIT III   COLUMNS   9
Euler's column curve – inelastic buckling – effect of initial curvature – Southwell plot – columns with eccentricity – use of energy methods – theory of beam columns – beam columns with different end conditions – stresses in beam columns.

UNIT IV   FAILURE THEORIES   9
Ductile and brittle materials – maximum principal stress theory - maximum principal strain theory - maximum shear stress theory - distortion energy theory – octahedral shear stress theory.

UNIT V   INDUCED STRESSES   9
Thermal stresses – impact loading – Fatigue – Creep - Stress Relaxation
                                                        TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, Students can able to
- CO1: Explain the method to analyse the linear static analysis of determinate and indeterminate aircraft structural components
- CO2: Apply the energy methods to determine the reactions of structure.
- CO3: Analyse the column structure with different end condition.
- CO4: Design the component using different theories of failure.
- CO5: Create a structure to carry the given load by considering effect of induced stresses

TEXT BOOKS:
1. 'Mechanics of Materials' by James M. Gere & Barry J Goodno, cengage Learning Custom Publishing; 8th edition, 2012.
2. Megson T M G, `Aircraft Structures for Engineering students' Butterworth-Heinemann publisher, 5th edition, 2012.
3. N.C. Pandya, C.S. Shah, "Elements of Machine Design", Charotar Publishing House, 15th edition, 2009.

REFERENCES:
1. Bruhn E F, 'Analysis and Design of Flight Vehicle Structures', Tri-State Off-set Company, USA, 1985
2. Donaldson, B.K., 'Analysis of Aircraft Structures - An Introduction' Cambridge University Press publishers, 2 nd edition, 2008
3. Peery, D.J., and Azar, J.J., Aircraft Structures, 2nd edition, McGraw – Hill, N.Y., 1999.

MAPPING OF COS AND POS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	-	2	1	-
CO2	3	3	2	1	-	-	-	-	-	-	2	-	3	1	-
CO3	3	2	2	1	2	-	-	-	-	-	-	-	3	1	-
CO4	2	1	1	2	3	-	-	-	-	-	2	-	-	-	1
CO5	3	2	2	2	3	-	-	-	-	-	-	-	-	2	1
Avg	2.8	2.2	1.8	1.6	2.5	-	-	-	-	-	2	2	2.8	1.4	1

GE3451	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY	L	T	P	C
		2	0	0	2

UNIT - I   ENVIRONMENT AND BIODIVERSITY
Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT – II   ENVIRONMENTAL   POLLUTION
Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

UNIT – III   RENEWABLE SOURCES OF ENERGY.
Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT - IV   SUSTAINABILITY AND MANAGEMENT

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and Protocols- Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT - V   SUSTAINABILITY PRACTICES

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economic and technological change.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
5. Erach Bharuch "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

AE3411	AERODYNAMICS LABORATORY	L T P C
		0 0 4 2

OBJECTIVE:

- To understand pressure distribution and characteristic over an airfoil and bluff bodies due to airflow .
- To measure the forces and moments acting on the airfoil at different angle of attack using wind tunnel balance set up.
- To visualize the flow pattern over an object by different method.

LIST OF EXPERIMENTS

1. Calibration of a subsonic Wind tunnel.
2. Determination of lift for the given airfoil section.
3. Pressure distribution over a smooth circular cylinder.
4. Pressure distribution over a rough circular cylinder.

5. Pressure distribution over a symmetric aerofoil.
6. Pressure distribution over a cambered aerofoil.
7. Force measurement using wind tunnel balancing set up.
8. Flow over a flat plate at different angles of incidence.
9. Flow visualization studies in low speed flows over cylinders.
10. Flow visualization studies in low speed flows over airfoil with different angle of incidence.
11. Flow visualization on bluff bodies using water flow channel
12. Flow visualization using Hele-shaw apparatus.

TOTAL: 60 PERIODS

OUTCOMES:
- Calculate the aerodynamic forces and moments experienced by airfoils, wings and bluff bodies.
- Evaluate the performance of thin airfoils with the effects of angle of attack and camber by considering thin aerofoil theory
- Measure flow velocity , lift and drag by use of wind tunnel instrument and to Visualize the flow by water flow and smoke methods.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl. No.	Name of the Equipment	Quantity	Experiment No.
1	Subsonic Wind tunnel	1	1,2,4,5,6,7,8,9,10
2	Models(aerofoil, rough and smooth cylinder , flat plate)	2	5,6,7,8,9,10
3	Angle of incidence changing mechanism	1 No.	8,10
4	Multi tube Manometer	1 No.	2,3,4,5,6
5	Pitot-Static Tubes	1 No.	1
6	Cylinder models (Rough and Smooth)	2 Nos.	3,4
7	Wind Tunnel balances (3 or 6 components)	1 No.	7
8	Smoke Generator	1 No.	8,9,10
9	Water flow channel	1 No.	8,9,10
10	Hele shaw apparatus	1 No.	12

AE3412   **PROPULSION LABORATORY**   **L T P C**
                                                                   0 0 4 2

OBJECTIVES:
- To explore practically components of aircraft piston and gas turbine engines and their working principles.
- To impart practical knowledge of flow phenomenon of subsonic and supersonic jets.
- To determine practically thrust developed by rocket propellants.

LIST OF EXPERIMENTS
1. Study of aircraft piston and its components .
2. Determine the velocity profiles of free jets.
3. Determine Velocity profiles of wall jets.
4. Wall pressure measurements of a subsonic diffusers and ramjet ducts.
5. Flame stabilization studies using conical and hemispherical flame holders.
6. Cascade testing of compressor blades.
7. Velocity and pressure measurements high speed jets.
8. Wall Pressure measurements of supersonic nozzle.
9. Wall pressure measurements on supersonic inlet

10. Flow visualization of supersonic flow.
11. Performance test of propeller
12. Study of gas turbine engines and its components

TOTAL:60 PERIODS

OUTCOMES
- Identify components and information of piston and gas turbine engine.
- Analyze the behaviour of flow through ducts and jet engine components to distinguish subsonic and supersonic flow characteristics.
- Visualize flow phenomenon in supersonic flow.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1		1	-	-	2	-	1	3	2	2
CO2	3	3	3	2	1	1	2		-	2	-	2	3	2	2
CO3	3	3	3	2	2	2	-	-	-	1	-	1	3	2	3
	3.00	2.33	2.67	1.67	1.33	1.50	1.50	1.00		1.67		1.33	3.00	2.00	2.33

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No.	Name of the Equipment	Quantity	Experiment No.
1	Jet engine	1	1
2	Piston engine	1	1
3	Jet facility with compressor and storage tank	1	2,3,,8,9,10
4	Multitube manometer	3	2,3,4,6,8,9
5	Wind tunnel	1	6
6	0-5 bar pressure transducer with pressure indicator OR DSA pressure scanner	8 1	8,9
7	Ramjet facility	1	4
8	Conical flame holder model	1	5
9	Hemispherical flame holder model	1	5
10	Water flow channel	1	5
11	Compressor blade set	1	6
12	Schlieren or Shadowgraph set up	1	10
13	Convergent nozzle	1	8
14	Convergent divergent nozzle	1	7,8,9,10
15	Thruster with load cells	1	7