FLIGHT CONTROL THEORY

VIII Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE018	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

I. COURSE OVERVIEW:

Flight control system of an aircraft is instrumental in establishing stability of the aircraft through control surfaces. This course introduces the concepts of the control system theory such as transfer functions, step response and impulse response. This course covers stability, feedback and different techniques used for control systems analysis. The course emphasizes on the flight control systems, response analysis for control surface inputs and control augmentation systems such as autopilots.

II. OBJECTIVES:

The course should enable the students to:

I	The concepts of Classical and modern control theory for selection of suitable control system for aircraft.
II	The stability criteria of an aircraft, the aircraft response specifications and control system parameters.
III	The controllability and observability of aerospace systems, and apply the modern control techniques to enhance flight control systems

III. COURSE OUTCOMES:

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

CO 1	**Develop** the first, second and higher order systems using differentialequations	Apply
CO 2	**Utilize** Fourier and Laplace transforms for modeling of dynamical systems and its responses to control inputs.	Apply
CO 3	**Choose** control problems the method for static control of aircraft and its extension to dynamic control	Apply
CO 4	**Analyze** different types of automatic control systems to damp undesirable tendencies of aircraft.	Analyze
CO 5	**Make use of** reversible and irreversible flight control systems to selectthe suitable flight control system.	Apply
CO 6	**Identify** flying qualities of aircraft in relation to aircraft transferfunction with frequency and time response specification.	Apply

IV. SYLLABUS:

UNIT-I	INTRODUCTION TO CONTROL SYSTEMS	Classes: 10

Dynamical systems-principal constituents-input, output-process (plant)-block diagram representation. Inputs-control input, noise. Function of controls regulation (hold), tracking (command)-examples. Measure of effectiveness. Sensitivity of output to control input, noise and system parameters- robustness. Deterministic and stochastic control. Control in everyday life. The pervasiveness of control in nature, engineering and societal systems. The importance of study of control system. Need for stable, effective (responsive), robust control system. Modeling of dynamical systems by differential equations-system parameters. Examples from diverse fields. First and second order systems, higher order systems, single input single output systems, and multiple-input multiple-output.

UNIT-II	MATHEMATICAL MODELLING OF DYNAMIC SYSTEMS	Classes: 10

Control system performance- time domain description- output response to control inputs-- impulse and indicial response- characteristic parameters- significance- relation to system parameters- examples- first and second order linear systems, higher order systems. Synthesis of response to arbitrary input functions from impulse and indicial

response. Review of Fourier transforms and Laplace transforms- inverse transforms- significance, applications to differential equations. 's' (Laplace) domain description of input-output relations- transfer function representation- system parameters- gain, poles and zeroes. Characteristic equation- significance- examples. Frequency and damping ratio of dominant poles. Relation of transfer functions to impulse response. Partial fraction decomposition of transfer functions- significance.

UNIT-III	STADY STATE RESPONSE ANALYSIS	Classes: 10

System type, steady state error, error constants- overall system stability. Application of feedback in stability augmentation, control augmentation, automatic control-examples. Composition, reduction of block diagrams of complex systems-rules and conventions. Control system components - sensors, transducers, servomotors, actuators, filters-modeling, transfer functions. Single-input single-output systems. Multiple input-multiple output systems, matrix transfer functions-examples. Types of control problems- the problem of analysis, control synthesis, system synthesis- examples- static control of aircraft. Extension to dynamic control. System identification from input output measurements importance.

Experimental determination of system transfer functions by frequency response measurements. Example. Frequency domain description- frequency response- gain and phase shift- significance- representation asymptotic (Bode) plots, polar (Nyquist) plots, frequency transfer functions. Characteristic parameters corner frequencies, resonant frequencies, peak gain, and bandwidth- significance. First and second order systems- extension to higher order systems.

UNIT-IV	AIRCRAFT RESPONSE TO CONTROLS	Classes: 07

Approximations to aircraft transfer functions, control surface actuators-review. Response of aircraft to elevator input, Response of aircraft to rudder input and Response of aircraft to aileron input to atmosphere. Need for automatic control. Auto pilots Stability augmentation systems-pitch damper and yaw damper.

UNIT-V	FLYING QUALITIES OF AIRCRAFT	Classes: 08

Reversible and irreversible flight control systems. Flying qualities of aircraft-relation to airframe transfer function. Pilot's opinion ratings. Flying quality requirements- pole-zero, frequency response and time-response specifications. Displacement and rate feedback determination of gains conflict with pilot input s resolution-control augmentation systems- Full authority fly-by-wire. Auto Pilot-Normal acceleration, Turn rate, Pitch rate Commands-Applications.

Text Books:

1. Kuo, B.C., “Automatic Control Systems”, Prentice Hall India, 1992.
2. Stevens, B.L. and Lewis, F.L., “Aircraft Control and Simulation”, John Wiley, 1992.

Reference Books:

1. Mc Lean, D., “Automatic Flight Control Systems”, Prentice Hall, 1990.
2. Bryson, A.E., “Control of Aircraft and Spacecraft”, Princeton University Press, 1994.
3. E H J Pallett, Shawn Coyle “Automatic Flight Control” 4th Edition, 2002.

Web References:

1. https://soaneemrana.org/onewebmedia/INTRODUCTION%20TO%20SPACE%20DYNAMICS1
2. https://nptel.ac.in/courses/101105030/

E-Text Books:

1. https://store.doverpublications.com/0486651134.html
2. https://www.worldcat.org/title/introduction-to-space-dynamics/oclc/867680515

Course Home Page:

AVIATION MANAGEMENT

VIII Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE019	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand about the history of aviation, major players airline industry, current trends and challenges.
II. Impart the knowledge on airport planning, airport operation and various authorities involved in airport management.
III. Understand and gain the knowledge on the meteorological services, environmental regulation and airport fee, rates and charges.
IV. Gain the indepth knowledge on safety regulation, economic regulation and aviation security.
V. Understand about the air traffic control, air space and navigational aid.

UNIT-I	INTRODUCTION	Classes: 10

History of Aviation- organization, global , social & ethical environment-history of aviation in India-Major players in Airline industry-Swot Analysis of different Airline companies in India- market potential of Airline industry in India- new airport development plans-current challenges in airline industry-competition in Airline industry- Domestic & International from an Indian perspective

UNIT-II	AIRPORT INFRASTRUCTURE AND MANAGEMENT	Classes: 10

Airport planning – Terminal planning design & operation -Airport operations – Airport functions-organization structure in an Airline – Airport Authority of India- comparison of global & Indian Airport management- Role of AAI -Airline privatization – Full privatization- Gradual privatization- partial privatization

UNIT-III	AIR TRANSPORT SERVICES	Classes: 09

Various Airport services- international air transport services – Indian Scenario- An overview of Airport in Delhi, Mumbai, Hyderabad & Bangalore.

The role of private operators- Airport development fees, Rates & Tariffs.

UNIT-IV	INSTITUTIONAL FRAMEWWORK	Classes: 08

Role of DGCA-Slot allocation -Methodology followed by ATC & DGCA – management of bi-laterals – economic Regulations.

UNIT-V	CONTROLLING	Classes: 08

Role of air traffic control- airspace & navigational aids- control process – case study in airline industry-Mumbai-Delhi airport privatization-Navi Mumbai airport tendering process- six cases in the airline industry.

Text Books:

1. Graham. a "Managing airports - an International Perspective" butterworth-heinemann, oxford 2001.
2. Wells. a. "Airport Planning and Management, Mcgraw-Hill, London, 4th Edition, 2000.

Reference Books:

1. Alexander t. wells, seth young, "Principles of Airport management", Mcgraw-hill 2003.
2. Richard de neufille, "Airport systems : Planning, Design & Management", Mcgraw-hill London 2007.

Web References:

1. https://memberfiles.freewebs.com/94/47/55224794/documents/airport%20planning%20and%20management.pdf
2. https://books.google.co.in/books?id=RYR6cu4YSBcC&dq=Planning%20and%20Design%20of%20Airports&source=gbs_similarbooks

E-Text Books:

1. https://accessengineeringlibrary.com/browse/airport-planning-and-management-sixth-edition
2. https://www.only4engineer.com/2014/10/planning-and-design-of-airports-by.html

Course Home Page:

ADVANCED SOLID MECHANICS

GROUP- I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE501	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the theory of elasticity including stress strain/displacement and Hooke's law relationships.
II. Analyze solid mechanics problems using classical methods and energy methods.
III. Solve for stresses and deflections of beams under unsymmetrical loading and axisymmetric loading.
IV. Locate the shear center of thin wall beams and obtain stresses and deflections of beams on elastic foundations.

UNIT-I	TRACTION AND STRESSES	Classes: 08

Concept of traction, Cauchy's stress theorem, postulate of Cauchy stress tensor, traction on arbitrary planes, extreme normal and shear traction, octahedral shear stress, and other stress measure – engineering stress.

UNIT-II	AXISYMMETRIC ANALYSIS	Classes: 10

Introduction, thick walled cylinder subjected to internal and external pressures – lame's problem. Stress in composite tubes- shrink fits, sphere with purely radial displacements, stresses due to gravitation, rotating disks of uniform thickness, disks of variable thickness, rotating shafts and cylinders.

UNIT-III	BENDING OF CURVED BEAMS	Classes: 10

Winkler- Bach formula, elasticity solution for: pure bending of curved beams, curved cantilever under end loading.

Beams on elastic foundation, Derivation of the basic governing equation, solution to beam on an elastic foundation subjected to a point load at the center moment at the center, Udl over some length asymmetrically about the center

UNIT-IV	FRACTURE MECHANICS	Classes: 09

Brittle fracture, stress intensity factor, fracture toughness, fracture conditions, fracture modes, plane stress and plane strain, plastic collapse at a notch, experimental determination of K_{IC}, strain-energy release rate, elasto-plastic fracture mechanics, Green's theorem.

UNIT-V	THEORIES OF FAILURE	Classes: 08

Introduction, theories of failure, significance of the theories of failure, use of factor of safety in design, a note on the use of factor of safety, Mohr's theory of failure.

Text Books:

1. L.S. Srinath, "Advanced Mechanics of Solids", Tata McGraw-hill, New Delhi, 2009.
2. P. Raymond, "Solid Mechanics in Engineering", Willey, 2001.

Reference Books:

1. M.H. Sadd, "Elasticity: Theory, Applications, and Numerics", Academic Press, 2nd Edition, 2009.
2. R.G. Budynas, "Advanced Strength and Applied Stress Analysis", McGraw Hill, 3rd Edition, 1999.
3. A.P. Boresi, R.J. Schmidt, "Advanced Mechanics of Materials", John Willey & Sons, 6th Edition, 2003.

Web References:

1. nptel.ac.in/courses/105106049/#
2. www.scribd.com/document/328427870/Advanced-Solid-Mechanics-Web-course-pdf
3. www.myopencourses.com/subject/advanced-solid-mechanics-2

E-Text Books:

1. esag.harvard.edu/rice/e0_Solid_Mechanics_94_10.pdf
2. www.brown.edu/Departments/Engineering/Courses/En175/notes.htm
3. web.mit.edu/abeyaratne/Volumes/RCA_Vol_II.pdf

Course Home Page:

EXPERIMENTAL STRESS ANALYSIS

GROUP - I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE502	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Bring awareness on experimental method of finding the response of the structure to different types of load.
II. Understand the relation between the mechanics theory, experimental stress analysis, and the mechanical, optical, pneumatic and electrical strain gauges for strain measurement.
III. Establish the fundamental concepts and newly experimental techniques and able to use the experimental techniques on the practical problems.
IV. Evaluate and make a fine presentation related to the experimental paper.

UNIT-I	MEASUREMENTS & EXTENSOMETER	Classes: 08

Principles of measurements, accuracy, sensitivity and range of measurements; Mechanical, optical acoustical and electrical extensometers and their uses, advantages and disadvantages.

UNIT-II	ELECTRICAL RESISTANCE STRAIN GAGES	Classes:09

Strain sensitivity in metallic alloys, gage construction, adhesives and mounting techniques, gage sensitivity and gage factor, performance characteristics, environmental effects, strain gage circuits; Potentiometer, wheat stone's bridges, constant current circuits.

UNIT-III	TWO AND THREE DIMENSIONAL PHOTO-ELASTICITY	Classes: 10

Two dimensional photoelasticity; Concepts of light-photo-elastic effects, stress optic law-interpretation of fringe pattern-compensation and separation techniques; Photoelastic materials; Introduction to three dimensional photoelasticity.

Photoelastic (Birefringent) coatings, effects of coating thickness, brittle coatings, types of brittle coatings, advantages and brittle coating applications, crack detection methods and Moire methods: Applications and advantages**.**

UNIT-IV	PHOTO-ELASTICITY	Classes: 10

Nature of light, wave theory of light, optical interference, stress optic law, effect of stressed model in plane and circular polariscopes, isoclinics and isochromatics, fringe order determination fringe multiplication techniques, calibration photoelastic model materials.

UNIT-V	STRAIN ANALYSIS METHODS	Classes: 08
Two element, three element rectangular and delta rosettes, correction for transverse strain effects, stress gauge, plane shear gauge, and stress intensity factor gauge.		
Text Books:		
1. Dally and Riley, "Experimental Stress Analysis", McGraw-Hill, New York, 1978. 2. Sadhu Singh, "Experimental Stress Analysis", Khanna Publisher, 4th Edition, 2009. 3. Srinath L.S tata , "Experimental stress Analysis", McGraw-Hill, 3rd Edition, 2012.		
Reference Books:		
1. M.M.Frocht, John Wiley & sons, "Photoelasticity Vol I and Vol II", McGraw Hill, 2nd Edition, 1969. 2. Perry and Lissner , "Strain Gauge Primer", McGraw Hill, 2nd Edition, 1969.		
Web References:		
1. www.nptel.ac.in/syllabus/syllabus.php?subjectId=112106068 2. www.textofvideo.nptel.iitm.ac.in/112106068/lec1.pdf		
E-Text Books:		
1. www.scribd.com/doc/241582542/Experimental-Stress-Analysis-by-Dally-and-Riley-P-1554n 2. www.apm.iitm.ac.in/smlab/kramesh/book_5.htm 3. www.myopencourses.com/subject/experimental-stress-analysis-1 4. https://www.amazon.com/Data-Structures-C-Noel-Kalicharan/dp/1438253273		
Course Home Page:		

FATIGUE AND FRACTURE MECHANICS

GROUP - I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE503	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand S-N curves, notches, stress concentration and factors, fatigue cycles, cumulative damage and Miner's theory.

II. Explain the crack initiation, growth, fracture, stress & strength of cracked bodies, different theories on fracture mechanics.

III. Illustrate safe life & fail safe design applicable aerospace structure.

UNIT-I	FATIGUE OF STRUCTURES	Classes: 10

S.N. curves, endurance limit, effect of mean stress; Goodman, Gerber and Soderberg relations and diagrams; Notches and stress concentrations; Neuber's stress concentration factors; Plastic stress concentration factors, Notched S-N curves.

UNIT-II	STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR	Classes: 10

Low cycle and high cycle fatigue, Coffin-Manson's relation, transition life, Cyclic Strain hardening and softening, analysis of load histories; Cycle counting techniques, cumulative damage, miner's theory and other theories.

UNIT-III	PHYSICAL ASPECTS OF FATIGUE AND FRACTURE MECHANICS	Classes:08

Phase in fatigue life, crack initiation, crack growth. Final fracture, dislocations theories, fatigue fracture surfaces.

Strength of cracked bodies, potential energy and surface energy; Griffith's theory, Irwin and Orwin extension of Griffith's theory to ductile materials

UNIT-IV	FRACTURE MECHANICS	Classes: 08

Stress analysis of cracked bodies; Effect of thickness on fracture toughness; Stress intensity factors for typical geometries.

UNIT-V	FATIGUE DESIGN AND TESTING	Classes: 09

Safe life and fail safe design philosophies; Importance of Fracture Mechanics in aerospace structure; Application to composite materials and structures.

Text Books:

1. W Barrois and L Ripley, "Fatigue of Aircraft Structures", Pergamon Press, Oxford, 1983.
2. D Brock, "Elementary Engineering Fracture Mechanics", Noordhoff International Publishing Co., London, 1994.

Reference Books:

1. C.G.Sih, "Mechanics of Fracture", Vol.1 Sijthoff and Noordhoff International Publishing Co., Netherland, 1989.
2. J.F.Knott, "Fundamentals of Fracture Mechanics", Butterworth & Co., (Publishers) Ltd., London, 1983.

Web References:

1. https://www.accessengineeringlibrary.com/browse/elements-of-fracture-mechanics.
2. https://www.eng.ox.ac.uk/solidmech/research/fatigue-fracture-mechanics.
3. https://as.wiley.com/WileyCDA/WileyTitle/productCd-1860583121.html.

E-Text Books:

1. https://en.wikipedia.org/wiki/Fatigue (material).
2. https://ocw.mit.edu/courses/materials-science-and...fracture...fatigue.../lecture-notes.
3. https://www.am.chalmers.se/~anek/teaching/fatfract/kursprogram.pdf

Course Home Page:

DESIGN AND ANALYSIS OF COMPOSITE STRUCTURES

GROUP - I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE504	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes:	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the fabrication, analysis and design of composite materials & structures.

II. Explain basic composites technology, including materials and processes, manufacturing, structural design, maintenance, proof of structures and other considerations.

III. Identify the static testing procedure and repairing methodology of composite structural members and joints.

IV. Enrich to develop structural designs using composite materials.

UNIT-I	STRESS STRAIN RELATION	Classes: 08

Introduction- Advantages and application of composite materials, reinforcements and matrices; Generalized Hooke's Law; Elastic constants for anisotropic, orthotropic and isotropic materials.

UNIT-II	METHODS OF ANALYSIS	Classes:08

Micro mechanics: Mechanics of materials approach, elasticity approach to determine material properties; Macro Mechanics; Stress-strain relations with respect to natural axis, arbitrary axis; Determination of material properties; Experimental characterization of lamina.

UNIT-III	LAMINATED PLATES, SANDWICH CONSTRUCTIONS AND FABRICATION PROCESS	Classes: 10

Governing differential equation for a general laminate, angle ply and cross ply laminates; Failure criteria for composites.

Basic design concepts of sandwich construction ; Materials used for sandwich construction ; Failure modes of sandwich panels; Various open and closed mould processes; Manufacture of fibers; Types of resins and properties and applications; Netting analysis.

UNIT-IV	DAMAGE TOLERANCE IN COMPOSITES	Classes: 09

Introduction, sources of damage, types of damage, FAR requirements and advisory circulars, building block approach; Impact damages: Damage growth under fatigue loads; residual strength: Tests and analytical methods; Detailed design: Basics of projections, drawing standards and conventions, introduction to CADD, design of composite parts and assembly design; Optimization: Fundamentals of optimization, mathematical concepts in optimization, Optimization of composite plates.

UNIT-V	TESTING OF COMPOSITE STRUCTURES	Classes: 10

Factors influencing testing, test environment, test methods and standards, introduction to static testing of composite structures and examples; Repair of composite aircraft structures: Introduction to repair, repair philosophy, repair sequence, repair criteria, damage assessment, classification of repair, selection of repair joints, repair procedures, certification of repair.

Text Books:

1. Gibson, R.F, "Principles of Composite Material Mechanics", CRC Press, 2nd Edition, 2007.
2. Jones, R.M, Taylor & Francis, "Mechanics of Composite Materials", 2nd Edition, 2010 (Indian Print).
3. Reddy, J.N., "Mechanics of Laminated Composite Plates and Shells – Theory and Analysis", CRC Press, 2nd Edition, 2004.

Reference Books:

1. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites", John Wiley and sons. Inc., New York, 1995.
2. Lubin, G., "Handbook on Advanced Plastics and Fibre Glass", Von Nostrand Reinhold Co., New York, 1989.
3. Autar K.Kaw "Mechanics of Composite Materials", 2nd Edition, CRC Press, 2005.

Web References:

1. www.nptel.ac.in/courses/101104010/
2. www.freevideolectures.com/Course/94/Prestressed-Concrete-Structures/35
3. www.adturtle.biz/LP_TA/index.cfm?T=436857.

E-Text Books:

1. www.samples.sainsburysebooks.co.uk/9781118536957_sample_413689.pdf
2. www.samples.sainsburysebooks.co.uk/9780470972717_sample_386378.pdf
3. www.safaribooksonline.com/library/view/design-and-analysis/9781118536940/
4. https://www.amazon.com/Data-Structures-C-Noel-Kalicharan/dp/1438253273.

Course Home Page:

AEROELASTICITY

GROUP - I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE505	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Outline importance of aeroelasticity in flight vehicle design and classify static and dynamic aeroelastic problems.

II. Describe structural dynamic and steady and unsteady aerodynamics aspects of airframe and its components and their role in aeroelasticity.

III. Construct theoretical basis for the solution of static aeroelastic problems an estimate loads and other critical speeds.

IV. Construct theoretical basis for the solution of flutter problems and estimate of flutter speeds.

UNIT-I	**AEROELASTIC PHENOMENA**	**Classes: 08**

Stability versus response problems; The aeroelastic triangle of forces; Aero elasticity in aircraft design; Prevention of aero elastic instabilities; Influence and stiffness coefficients; Coupled oscillations.

UNIT-II	**DIVERGENCE OF A LIFTING SURFACE**	**Classes: 10**

Simple two dimensional idealizations; Strip theory, integral equation of the second kind exact solutions for simple rectangular wings, 'Semi rigid' assumption and approximate solutions; Generalized coordinates, successive approximations, numerical approximations using matrix equations.

UNIT-III	**STEADY STATE AEROLASTIC PROBLEMS**	**Classes: 08**

Loss and reversal of aileron control, critical aileron reversal speed, aileron efficiency, semi rigid theory and successive approximations.

Lift distribution, rigid and elastic wings; Tail efficiency, effect of elastic deformation on static longitudinal stability.

UNIT-IV	**FLUTTER PHENOMENON**	**Classes: 10**

Non-dimensional parameters, stiffness criteria, dynamic mass balancing, dimensional similarity; Flutter analysis, two dimensional thin airfoils in steady incompressible flow, quasi steady aerodynamic derivatives; Galerkin method for critical flutter speed, stability of disturbed motion, solution of the flutter determinant, methods of determining the critical flutter speeds, flutter prevention and control.

UNIT-V	**EXAMPLES OF AEROELASTIC PROBLEMS**	**Classes: 09**

Galloping of transmission lines and Flow induced vibrations of transmission lines, tall slender structures and suspension bridges.

Text Books:

1. Y.C. Fung, "An Introduction to the Theory of Aeroelasticity", John Wiley & Sons Inc., New York, 2008.
2. E.G. Broadbent, "Elementary Theory of Aeroelasticity", Bun Hill Publications Ltd., 1986.

Reference Books:

1. R.L. Bisplinghoff, H.Ashley, and R.L. Halfmann, "Aeroelasticity", Addison Wesley Publishing Co., Inc., 2nd Edition, 1996.
2. R.H. Scanlan and R. Rosenbaum, "Introduction to the study of Aircraft Vibration and Flutter", Macmillan Co., New York, 1981.

Web References:

1. https://www.efunda.com/math/math_home/math.cfm
2. https://ocw.mit.edu/resources/#Mathematics
3. https://www.sosmath.com/
4. https://mathworld.wolfram.com/

E-Text Books:

1. https://www.e-booksdirectory.com/details.php?ebook=10166
2. https://www.e-booksdirectory.com/details.php?ebook=7400re

Course Home Page:

UNMANNED AIR VEHICLES

GROUP - I

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE506	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Introduce to the student about the basic ideas of Unmanned Air Vehicles.
II. Familiarize the students about the aerodynamics and airframe configurations.
III. Accustom the student to the wide variety of unmanned air vehicles.
IV. Acquaint the student about the various communication and navigation systems of unmanned air vehicles.

UNIT-I	**INTRODUCTION TO UNMANNED AIRCRAFT SYSTEMS**	**Classes: 10**

The systemic basis of UAS-system composition; Conceptual phase; Preliminary design; Selection of the system; Some applications of UAS.

UNIT-II	**AERODYNAMICS AND AIRFRAME CONFIGURATIONS**	**Classes: 10**

Lift-induced Drag; Parasitic Drag; Rotary-wing aerodynamics; Response to air turbulence; Airframe configurations scale effects; Packaging density ; Aerodynamics; Structures and mechanisms; Selection of power-plants; Modular construction; Ancillary equipment.

UNIT-III	**CHARACTERISTICS OF AIRCRAFT TYPES**	**Classes: 09**

Long-endurance, long-range role aircraft; Medium-range, tactical aircraft; Close-range / battlefield aircraft; MUAV types; MAV and NAV types; UCAV; Novel hybrid aircraft configurations; Research UAV.

UNIT-IV	**COMMUNICATIONS NAVIGATION**	**Classes: 08**

Communication media; Radio communication; Mid-air collision (MAC) avoidance; communications data rate and bandwidth usage; Antenna Types NAVSTAR Global Positioning System (GPS) - TACAN - LORAN C - Inertial Navigation - Radio Tracking - Way-point Navigation.

UNIT-V	**CONTROL AND STABILITY**	**Classes: 08**

HTOL Aircraft - Helicopters - OTE/OTE/SPH - Convertible Rotor Aircraft - Payload Control -Sensors – culmon filter- Autonomy.

Text Books:

1. Reg Austin., Unmanned Aircraft Systems, John Wiley and Sons., 2010.

Reference Books:

1. Milman & Halkias, “Integrated Electronics”, McGraw Hill, 1999.
2. Malvino & Leach, “Digital Principles & Applications”, McGraw Hill, 1986.
3. Collinson R.P.G, “Introduction to Avionics”, Chapman and Hall, India, 1996.

4. Bernad Etikin, "Dynamic of flight stability and control", John Wiley, 1972.
Web References:
1. www.tc.gc.ca/eng/civilaviation/publications/page-6557.html 2. www.dhl.com/en/about_us/logistics_insights/dhl_trend_research/ 3. www.books.google.co.in/books?id=guGVDQAAQBAJ&pg=PT3&lpg=PT3&dq
E-Text Books:
www.ebookstrust.com/9048197066/Ebooks%20Textbooks%20Handbook%20Of%20Unmanned.
Course Home Page:

GROUND VEHICLE AERODYNAMICS

GROUP - II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE507	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the basics of vehicle aerodynamics, history of developments and apply the concepts of fluid mechanics to automobiles.
II. Estimate the drag on ground vehicles and analyze the effects of various configurations of cars on drag.
III. Analyze the stability and handling qualities based of ground vehicles due to side wind loads and dirt accumulation.
IV. Apply the above concepts to race car design and understand various experimental techniques applied in automotive aerodynamics.

UNIT-I	**OVERVIEW AND INTRODUCTION**	**Classes: 10**

Historical developments and trends, fundamentals of fluid mechanics, flow phenomenon related to vehicles, external and internal flow problem, resistance to vehicle motion, mechanics of air flow around a vehicle, pressure distribution, aerodynamic forces, vehicle drag and types, side and lift forces, performance potential of vehicle aerodynamics.

UNIT-II	**AERODYNAMIC DRAG AND SHAPE OPTMIZATION OF CARS**	**Classes: 10**

Cars as a bluff body, flow field around a car, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles.

Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square back, dust flow patterns at the rear, effect of rear configuration, effect of fasteners

UNIT-III	**VEHICLE HANDLING AND STABILITY**	**Classes: 09**

Origin, characteristics and effects of forces and moments on a vehicle, lateral stability problems.

Vehicle dynamics under side winds, dirt accumulation on the vehicle, wind noise: Mechanisms and generation design features, measurement and techniques.

UNIT-IV	**RACE CAR AERODYNAMICS**	**Classes: 08**

Basic vehicle body concepts, aerodynamics of the complete vehicle, flow over wheels, sliding seal and skirts, under body channels, simple add on: spoilers, strakes and wickers, internal flow, race car wings, most current examples in detail design.

UNIT-V	**MEASUREMENT AND TEST TECHNIQUES**	**Classes: 08**

Wind tunnel scope, fundamental techniques, simulation limitations, prototype tests,
wind tunnel types and testing methods, test techniques: scope, measuring equipment and transducers, road testing methods.

Text Books:

1. Wolf- Heinrich Hucho, “Aerodynamics of Road vehicles”, SAE International 1998.
2. Joseph Katz, “Race Car Aerodynamics Designing for Speed”, Bentley Publishers, 2nd Edition, 1996.

Reference Books:

1. Alan Pope, “Wind Tunnel Testing”, John Wiley & Sons, 2nd Edition, 1974.

Web References:

1. https://www.buildyourownracecar.com/race-car-aerodynamics-basics-and-design/
2. https://www.ara.bme.hu/oktatas/letolt/Vehicleaerodyn/Vehicleaerodyn.pdf
3. https://auto.howstuffworks.com/fuel-efficiency/fuel-economy/aerodynamics.html
4. https://www.slideshare.net/friendsrtg/vehicle-body-engineering-aerodynamics

E-Text Books:

1. https://dlx.bookzz.org/genesis/1111000/58a5c1c372f8f523a0c58e26c3c531eb/_as/[Wolf-Heinrich_Hucho_(Eds.)]_Aerodynamics_of_Road_(BookZZ.org).pdf
2. https://dlx.bookzz.org/genesis/555000/2c09a10c7a7c0f3deaeeb9ddc4251c26/_as/[Joseph_Katz]_Race_Car_Aerodynamics_Designing_for(BookZZ.org).pdf

Course Home Page:

ADVANCED COMPUTATIONAL AERODYNAMICS

GROUP - II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE508	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Explain the concept of panel methods, analyze various boundary conditions applied and demonstrate several searching and sorting algorithms.
II. Describe the initial methods applied in the process of CFD tools development their advantages and disadvantages over modern developed methods.
III. Demonstrate different methods evolved in analyzing numerical stability of solutions and evaluate the parameters over which the stability depends and their range of values.
IV. Understand advanced techniques and methods in time marching steps and identify different boundary conditions for different cases in CFD techniques.

UNIT-I	NUMERICAL SOLUTIONS	Classes: 10

Euler equations: Flux approach, Lax-Wendroff method, basic principles of upwind schemes, flux vector splitting, Steger Warming flux vector splitting, Van Leer flux vector splitting, Upwind reconstruction, evolution, Godunov's first order upwind method, Roe's first order upwind method.

UNIT-II	TIME DEPENDENT METHODS	Classes: 10

Stability of solution, explicit methods, FTFS, FTCS, FTBS, Leapfrog method, Lax method. Implicit methods: Euler's FTCS, Crank Nicolson method, description of Lax- Wendroff scheme, McCormack two step predictor-corrector method, description of time split methods, approximate factorization schemes.

UNIT-III	BOUNDARY CONDITIONS	Classes: 09

Boundary Layer Equations: Setting up the boundary layer equations, flat plate boundary layer solution, boundary layer transformations, explicit and implicit discretization, solution of the implicit difference equations, integration of the continuity equation, boundary layer edge and wall shear stress, Keller-box scheme.

Concept of dummy cells, solid wall inviscid flow, viscous flow, farfield concept of characteristic variables, modifications for lifting bodies inlet outlet boundary, injection boundary, symmetry plane, coordinate cut, periodic boundaries, interface between grid blocks, flow gradients at boundaries of unstructured grids.

UNIT-IV	METHOD OF CHARACTERISTICS	Classes: 08

Philosophy of method of characteristics, determination of characteristic lines, two dimensional irrotational flow, determination of compatibility equations, unit processes, supersonic nozzle design by the method of characteristics, supersonic wind tunnel nozzle, minimum length nozzles, domain of dependence and range of influence.

UNIT-V	PANEL METHODS	Classes: 08

Basic formulation, boundary conditions, physical considerations, reduction of a problem to a set of linear algebraic equations, aerodynamic loads, preliminary considerations prior to establishing numerical solution, steps toward constructing a numerical solution, solution of thin airfoil with lumped vortex filament, accounting for effects of compressibility and viscosity.

Text Books:

1. Tannehill John C, Anderson Dale A, Pletcher Richard H, "Computational Fluid Mechanics and Heat Transfer", Taylor & Francis, 2nd Edition, 1997.
2. Chung T G, "Computational Fluid Dynamics", Cambridge University Press, 2nd Edition, 2010.
3. Katz Joseph and Plotkin Allen, "Low-Speed Aerodynamics", Cambridge University Press, 2nd Edition, 2006.

Reference Books:

1. Anderson J D, "Modern Compressible Fluid Flow", McGraw Hill, 2nd Edition, 1990.
2. Anderson J D, "Fundamentals of Aerodynamics", Tata McGraw Hill, 5th Edition, 2010.
3. Anderson J D, "Computational Fluid Dynamics", McGraw Hill, 1995.

Web References:

1. https://s6.aeromech.usyd.edu.au/aerodynamics/index.php/sample-page/subsonic-aerofoil-and-wing-theory/2d-panel-methods/
2. www.wind.civil.aau.dk/lecture/8sem_CFD/Lecture1/Lecture1.pdf
3. personalpages.manchester.ac.uk/staff/david.d.apsley/lectures/comphydr/timedep.pdf

E-Text Books:

1. https://books.google.co.in/books/about/Advanced_Computational_Fluid_and_Aerodyn.html?id=dWS4jgEACAAJ&redir_esc=y.
2. https://www.scribd.com/doc/159468983/Low-Speed-Aerodynamics-Joseph-Katz-Alen-Plotkin
3. https://www.crcpress.com/Computational-Fluid-Mechanics-and-Heat-Transfer-Third-edition/Pletcher-Tannehill-Anderson/p/book/9781591690375.
4. https://www.faadooengineers.com/threads/8482-Computational-Fluid-Dynamics-Ebook-Ppt-Pdf-Download.

Course Home Page:

EXPERIMENTAL AERODYNAMICS

GROUP - II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE509	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Describe basic fundamentals of Aerodynamics experiments, their need in comparison with numerical computation and theoretical studies.
II. Develop concepts of flow similarity and evaluate the loss coefficients of wind tunnel components.
III. Analyze the concept of force and moment measurements using wind tunnel balance and extrapolate it to new balance development.
IV. Summarize various techniques for pressure, velocity, temperature measurement and flow visualization.

UNIT-I	FUNDAMENTALS OF EXPERIMENTS IN AERODYNAMICS	Classes: 08

Forms of aerodynamic experiments, observations, measurement objectives. History: Wright Brother's wind tunnel, model testing, wind tunnel principles, scaling laws, scale parameters, geometric similarity, kinematic similarity& dynamic similarity. Wind tunnels: low speed tunnel, high speed tunnels, transonic, supersonic and hypersonic tunnels, shock tubes. Special tunnels: low turbulence tunnels, high Reynolds number tunnels, environmental tunnels, automobile tunnels, distinctive features, application.

UNIT-II	WIND TUNNEL EXPERIMENTATION CONSIDERATIONS	Classes: 10

Low speed wind tunnels, principal components. Function, description, design requirements, constraints and loss coefficients. Wind tunnel performance flow quality, power losses, wind tunnel corrections, sources of inaccuracies: buoyancy, solid blockage, wake blockage, streamline curvature causes, estimation and correction.

UNIT-III	WIND TUNNEL BALANCE	Classes: 08

Load measurement: low speed wind tunnel balances, mechanical & Strain gauge types, null displacement methods & strain method, sensitivity, weigh beams, steel yard type and current balance type, balance linkages, levers and pivots.

Model support three point wire support, three point strut support, platform balance, yoke balance, strain gauge, 3-component strain gauge balance, description, application.

UNIT-IV	PRESSURE, VELOCITY & TEMPERATURE MEASUREMETNS	Classes: 11

Pressure: static pressure, surface pressure orifice, static probes, pitot probe for total pressure, static pressure and flow angularity, pressure sensitive paints, steady and unsteady pressure measurement and various types of pressure probes and transducers, errors in pressure measurement. Temperature: measurement of temperature using thermocouples, resistance thermometers, temperature sensitive paints and liquid crystals. Velocity: measurement of airspeed, Mach number from pressure measurements, flow direction, boundary layer profile using pitot static probe, 5 hole probe yaw meter, total head rake, hot wire anemometry, laser doppler anemometry, particle image velocimetry, working principle description of equipment, settings, calibration, measurement, data processing, applications.

UNIT-V	FLOW VISUALIZATION TECHNIQUES	Classes: 08

Flow visualization: necessity, streamlines, streak lines, path lines, time lines, tufts, china clay, oil film, smoke, hydrogen bubble. Optical methods: density and refractive index, schlieren system, convex lenses, concave mirrors, shadowgraph, interferometry, working principle, description, setting up, operation, observation, recording, interpretation of imagery, relative merits and applications.

Text Books:

1. Jewel B Barlow, William H Rae Jr. & Alan Pope, "Low Speed Wind Tunnel Testing", John Wiley& Sons Inc, Re-Print, 1999.
2. Alan Pope, Kennith L Goin, "High Speed Wind Tunnel Testing", John Wiley & Sons, Reprint, 1965.

Reference Books:

1. Gorlin S M & Slezinger I I, "Wind tunnels & Their Instrumentations", NASA publications, Translated version, 1966.
2. Jorge C Lerner & Ulfilas Boldes, "Wind Tunnels and Experimental Fluid Dynamics Research", InTech, 1st Edition, 2011.
3. Liepmann H W and Roshko A, "Elements of Gas Dynamics", John Wiley & Sons, 4th Edition, 2003.

Web References:

1. https://nptel.ac.in/courses/101106040/
2. https://ocw.metu.edu.tr/course/view.php?id=66
3. https://www.mace.manchester.ac.uk/our-research/research-themes/aerospaceengineering/specialisms/aerodynamics/
4. https://www.ara.co.uk/services/experimental-aerodynamics/
5. https://soliton.ae.gatech.edu/labs/windtunl/

E-Text Books:

1. https://www.scribd.com/doc/221788571/Wind-Tunnel-Testing-Barlow-Rae-Pope
2. https://www.scribd.com/document/84868596/Wind-Tunnelsibooksonline.com/library/view/data-structures-using/9789332524248/

Course Home Page:

HYPERSONIC AERODYNAMICS

GROUP - II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE510	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Apply the basics of aerodynamics to know the boundary layer and variation of properties at different velocities.

II. Compute aerodynamic forces and moments on different aerodynamic bodies at different conditions.

III. Understand aerodynamic heating for bodies travelling at hypersonic speeds and importance of high entropy layer.

IV. Analyze and appreciate the complementary role of experiments and numerical computations in handling hypersonic flows.

UNIT-I	GENERAL CHARACTERIZATION OF HYPERSONIC FLOWS	Classes: 09

Defining hypersonic flow, characterizing hypersonic flow using fluid dynamic phenomena, basic equations of motion, equilibrium and non-equilibrium flows, equilibrium conditions, dependent variables, transport properties, continuity, momentum and energy equations, general form of the equations of motion in conservation form.

UNIT-II	DEFINING THE AEROTHERMODYNAMIC ENVIRONMENT, EXPERIMENTAL MEASUREMENTS OF HYPERSONIC FLOWS	Classes: 10

Empirical correlations complemented by analytical techniques, general comments about computational fluid dynamics, computations based on a two layer flow model, techniques treating entire shock layer in a unified fashion, calibration and validation of the computational fluid dynamics codes, experimental measurements of hypersonic flows: ground-based simulation of hypersonic flows, ground-based hypersonic facilities, experimental data and model design considerations, flight tests, importance of interrelating computational fluid dynamics, ground test data and flight test data.

UNIT-III	STAGNATION-REGION FLOW FIELD AND PRESSURE DISTRIBUTION	Classes:08

Stagnating streamline, stagnation-point convective heat transfer, radiative heat flux; pressure distribution, Newtonian flow models, departure from the Newtonian flow field.

Shock wave boundary layer (viscous) interaction for two dimensional compression ramps, tangent cone and tangent wedge approximations, need for more sophisticated models, pressure distributions for a reacting gas, pressures in separated regions.

UNIT-IV	BOUNDARY LAYER AND CONVECTIVE HEAT TRANSFER, VISCOUS INTERACTIONS	Classes: 09

Boundary conditions, metricor equivalent cross section radius, convective heat transfer and skin friction, effects of surface catalycity, base heat transfer in separated flow; viscous interactions: compression ramp flows, shock interactions, flow field perturbations around swept fins, corner flows, examples of viscous interactions for hypersonic vehicles: X-15, space shuttle orbiter, hypersonic air-breathing aircraft.

UNIT-V	AERODYNAMIC FORCES AND MOMENTS, AEROTHERMODYNAMICS AND DESIGN CONSIDERATIONS OF HYPERSONIC VEHICLES	Classes: 09

Newtonian aerodynamic coefficients, re entry capsule aerodynamics, shuttle orbiter aerodynamics, X-15 aerodynamics, hypersonic aerodynamics of research plane, dynamic stability considerations. Design considerations: re-entry vehicles, design philosophy, design considerations for rocket-launched glide reentry vehicles, air breathing vehicles, combined rocket and air breathing powered vehicles, design of a new vehicle.

Text Books:

1. John J Bertin, "Hypersonic Aerothermodynamics, , AIAA Education Series, 1st Edition, 1994.
2. Mikhailov G K & Parton V Z, "Super and Hypersonic Aerodynamics and Heat Transfer", CRC publishers, 1st Edition, 1992.

Reference Books:

1. John D Anderson, " Hypersonic and High Temperature Gas Dynamics", AIAA Education Series, 2nd Edition, 2006.
2. Ernst H Hirshchel, "Basics of Aerothermodynamics", Springer-Verlag, 1st Edition, 2005.

Web References:

1. https://nptel.ac.in/courses/101103003/
2. https://www.grc.nasa.gov/www/BGH/

E-Text Books:

1. https://bookzz.org/book/678872/21935f
2. https://bookzz.org/book/1201615/e314e1
3. https://bookzz.org/book/592471/7e27f3

Course Home Page:

HIGH ANGLE OF ATTACK AERODYNAMCS

GROUP - II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE511	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the flows over various configurations of aircrafts at high angle of attack and phenomena like separation and vortex breakdown.
II. Analyze the topological approach of solving attached and separated flows by determining characteristics of skin friction lines and singular points
III. Implement the flow concepts in linear aerodynamics over wings and bodies using various linear panel methods of various orders.
IV. Analyze the intricacies in the rolled up vortex sheet and understand the deviation in nonlinear aerodynamics and methods to solve the flow problem.

UNIT-I	INTRODUCTION TO FLOWS AT HIGH ANGLE OF ATTACK	Classes: 10

Medium and high aspect ratio finite lifting wing at low subsonic speeds, low aspect ratio rectangular wings, slender delta type wings, elongated slender bodies, aircraft type configuration, vortex breakdown, unsteady aerodynamics at high angle of attack on slender configurations, effect of separation at high angle of attack in hypersonic flows.

UNIT-II	TOPOLOGY OF SEPARATING AND REATTACHING VORTICAL FLOW	Classes: 10

Equations of vortical flows, vorticity and transport equation, Biot Savart law, topological concepts for the analysis of vortical flows.

UNIT-III	LINEAR AERODYNAMICS OF WINGS AND BODIES	Classes: 10

Equation for potential subsonic flows, equations for the lifting wing at low speeds, linear panel methods for the wings and bodies at subsonic speeds.

Low and high order linear panel methods for subsonic and supersonic flows, comparison of various panel methods.

UNIT-IV	VORTEX FLOWS AND THE ROLLED UP VORTEX	Classes: 05

Vortex core of the rolled up wake, rolled up tip vortices, rolling up the vortex wake behind wings, rolling up of vortex lines of zero thickness vortex sheet, rolling up of finite thickness vortex sheet, the bursting of the rolled up vortices.

UNIT-V	NON-LINEAR AERODYNAMICS OF WINGS AND BODIES	Classes: 10

Analytical and semi empirical methods for calculations of the non-linear aerodynamic characteristics, introduction to non-linear panel methods for aircraft and missile configuration at high angle of attack, introduction to solutions of Euler equations for flows over configurations at high angle of attack, introduction to solutions of Navier Stokes equations for flows over configurations at high angle of attack.

Text Books:

1. Josef Rom, "High Angle of Attack Aerodynamics: Subsonic, Supersonic and Transonic Flows", Springer Verlag, 1st Edition, 1992.
2. Jack N Nielsen, "Missile Aerodynamics", McGraw Hill Company Inc, 1st Edition, 1960.

Reference Books:

1. Yahya S M, "Fundamentals of Compressible flow with Aircraft and Rocket Propulsion", New Age International, 3rd Edition, 2003.
2. John D Anderson, "Modern Compressible flow with historical perspective", McGraw-Hill Education, 3rd Edition, 2002.

Web References:

1. https://www.dept.aoe.vt.edu/~mason/Mason_f/ConfigAeroHiAlphaNotes.pdf
2. https://www.dept.aoe.vt.edu/~mason/Mason_f/HiAlphaBasicsPres.pdf

E-Text Books:

1. https://dlx.bookzz.org/genesis/958000/d80cf472f4537894a8039e06ea5110fb/_as/[Josef_Rom_(auth)]_ High_Angle_of_Attack_Aerodyna(BookZZ.org).pdf
2. https://www.amazon.in/High-Angle-Attack-Aerodynamics-Supersonic/dp/3540976728.

Course Home Page:

HELICOPTER AERODYNAMICS

GROUP - II

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE512	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the elements of helicopter aerodynamics and ground effect machines, their components and methods of control.
II. Formulate the mathematical model using simple blade element theory, analyze its figure of merit and evaluate power estimations.
III. Evaluate performance and its effect on altitude and understand the preliminary stability aspects of helicopters.
IV. Apply the aerodynamics, propulsion and control concepts for various VTOL and STOL aircraft and ground effect machines.

UNIT-I	**ELEMENTS OF HELICOPTER AERODYNAMICS**	**Classes: 10**

Configurations based on torque reaction, jet rotors and compound helicopters, methods of control, collective and cyclic pitch changes, lead and lag, flapping hinges.

UNIT-II	**IDEAL ROTOR THEORY**	**Classes: 10**

Hovering performance, momentum and simple blade element theories, figure of merit, profile and induced power estimation, constant chord and ideal twist rotors.

UNIT-III	**POWER ESTIMATES**	**Classes: 09**

Induced, profile and parasite power requirements in forward flight.

Performance curves with effects of altitude, preliminary ideas on helicopter stability.

UNIT-IV	**LIFT, PROPULSION AND CONTROL OF VSTOL AIRCRAFT**	**Classes: 08**

Various configurations: propeller, rotor, ducted fan and jet lift, tilt wing and vectored thrust, performance of VTOL and STOL aircraft in hover, transition and forward motion.

UNIT-V	**GROUND EFFECT MACHINES**	**Classes: 08**

Hover height, lift augmentation and power calculations for plenum chamber and peripheral jet machine, drag of hovercraft on land and water, applications of hovercraft.

Text Books:

1. Gessow A, and Myers G C, “Aerodynamics of Helicopter”, Macmillan &Co., 1st Edition 1987.
2. McCormick B W, “Aerodynamics of V/STOL Flight”, Academic Press, 1st Edition, 1987.

Reference Books:

1. Johnson W, “Helicopter Theory”, Princeton University Press, 1st Edition, 1980.
2. McCormick BW, “Aerodynamics, Aeronautics and Flight Mechanics” John Wiley, 1st Edition, 1995.
3. Gupta L, “Helicopter Engineering”, Himalayan Books, 1st Edition, 1996.

Web References:

1. https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/helicopter_flying_handbook/media/hfh_ch02.pdf
2. https://www.mionome.com/Uni/Helicopter%20Aerodynamic.pdf
3. https://itlims.meil.pw.edu.pl/zsis/pomoce/WTLK/ENG/Sup/Aerodynamics_of_a_Helicopter_Rotor_in_Forward_Flight.pdf

E-Text Books:

1. https://books.google.co.in/books?id=PnV2JuLZi4C&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
2. https://aerostudents.com/files/rotorcraftMechanicsAndDesign/SeddonBasicHelicopterAerodynamics.pdf

Course Home Page:

THEORY OF COMBUSTION

GROUP - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE513	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the concepts in combustion theory and illustrate students involved in combustion research with the required fundamental knowledge in combustion stoichiometry.
II. Familiarize in the area of combustion in various engines, generalise stability limits and flame stabilization in diffusion flame.
III. Calculate the combustion efficiency. Discuss fundamental combustion problems arising from gas turbine combustion or more generally from combustion in steady flowing premixed systems.
IV. Determine the supersonic combustion. Combustion in rocket engines and emission. Different types of combustion chambers in gas-turbine engines, primary requirements of the combustor, afterburners.

UNIT-I	**BASICS OF COMBUSTION THEORY**	**Classes: 08**

Combustion stoichiometry and thermo chemical calculation, chemical kinetics and equilibrium, transport phenomena, theory of viscosity, conductivity and diffusivity.

UNIT-II	**PRE-MIXED FLAMES**	**Classes: 10**

Description of premixed flames, burning velocity and parametric dependences, experimental methods of measuring burning velocity, simple one-dimensional thermal theory of flame, concepts of minimum ignition energy, quenching distance, stability limits and flame stabilization.

UNIT-III	**DIFFUSION FLAME**	**Classes: 10**

Jet flame physical description, theoretical analysis-Burke-Schumann's analysis, mechanism of soot formation, Defining of premixed, diffusion flames, liquid fuel combustion flames.

Liquid fuel combustion, difference between premixed and diffusion flames, liquid fuel combustion-conservation equations, calculation of mass burning rate, droplet burning.

UNIT-IV	**COMBUSTION IN RECIPROCATING AND GAS- TURBINE ENGINES**	**Classes: 09**

Description of the combustion process in piston engines, Combustion efficiency and factors affecting it, Rankine - Hugoniot curves, deflagration and detonation in reciprocating engines and preventive methods; Description of different types of combustion chambers in gas-turbine engines, primary requirements of the combustor, afterburners.

UNIT-V	**COMBUSTION IN ROCKET ENGINES AND EMISSION**	**Classes: 08**

Types of rockets based on combustion, solid fuel combustion, combustion of carbon particle, simplified analysis, boundary layer combustion, combustion of carbon sphere with co burning gas phase; Chemical emission from combustion and its effects, exhaust gas analysis, emission control.

Text Books:

1. Stephen R Turns, "An Introduction to combustion Concepts and Application", TMH Publication, 3rd Edition, 2011.
2. Fawzy El-Mahallawy, Saad El-Din Habik, Elsevier "Fundamentals and Technology of combustion", 1st Edition, 2002.

Reference Books:

1. Charles E. Baukal, "Heat Transfer in Industrial Combustion", CRC Press, 1st Edition, 2000.
2. G. Singer, "Combustion, Fossil Power Systems" Ed Publications, 4th Edition, 1966.
3. S. P. Sharma, Chandra Mohan "Fuels and Combustion", Tata McGraw Hill Publishing Co., 1st Edition, 1987.

Web References:

1. https://www.personal.utulsa.edu/~kenneth-weston/chapter3.pdf
2. https://www.em-ea.org/guide%20books/book-2/2.1%20fuels%20and%20combustion.pdf

E-Text Books:

1. https://books.google.co.in/books?id=cVJkP4oEjZsC&printsec=frontcover&dq=Fuels+and+Combustion+latest+edition&hl=en&sa=X&ved=0ahUKEwjK2tWHzPfNAhVMto8KHRiMCBAQ6AEIHTAA#v=onepage&q=Fuels%20and%20Combustion%20latest%20edition&f=false
2. https://poisson.me.dal.ca/site2/courses/mech4840/04_Fuels%20&%20Combustion%20calculation09.pdf

Course Home Page:

TURBOMACHINERY

GROUP - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE514	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Learn basic concepts of turbo machinery, hydraulic pumps and effects of flow parameters on the performance of the machine.
II. Analyze geometrical conditions and description of the main components in Centrifugal pumps, Pelton, Francis, Kaplan and gas-turbines.
III. To understand energy transfer and losses in centrifugal compressors, axial fans and steam turbines
IV. Knowledge about Basic design of Wind turbines, Reversible Pumpturbines, multi-phase pumps and wet gas compressors. Main components in a Hydro Power Plant and Gas Power Plant. Analyze estimation of parameters required to design an efficient turbo machine.

UNIT-I	INTRODUCTION TO TURBOMACHINERY	Classes: 10

Classification of turbomachines, second law of thermodynamics applied to turbine and compressors work, nozzle, diffuser work, fluid equation, continuity, Euler's, Bernoulli's, equation and its applications, expansion and compression process, reheat factor, preheat factor

UNIT-II	FUNDAMENTAL CONCEPTS OF AXIAL AND RADIAL MACHINES	Classes: 10

Euler's equation of energy transfer, vane congruent flow, influence of relative circulation, thickness of vanes, number of vanes on velocity triangles, slip factor, Stodola, Stanitz and Balje's slip factor, suction pressure and net positive suction head, phenomena of cavitation in pumps, concept of specific speed, shape number, axial, radial and mixed flow machines, similarity laws.

UNIT-III	AXIAL COMPRESSOR AND FANS	Classes: 09

Flow through axial flow fans, principle of axial fan and propeller, application of fan for circulation and ventilation, stage pressure rise and work done.

Slip stream and blade element theory for propellers, performance and characteristics of axial fans, effects of cascading, degree of reaction, blade loading coefficient and blade loss.

UNIT-IV	CENTRIFUGAL COMPRESSORS	Classes: 08

Flow through centrifugal compressors, stage velocity triangles, specific work, forward, radial and backward swept vanes, enthalpy entropy diagrams, degree of reaction, slip factor, efficiency, vaneless and vane diffuser system, volute as spiral casing, surge and stall in compressors.

UNIT-V	AXIAL TURBINES	Classes: 08

Stage velocity triangles, work, efficiency, blade loading, flow coefficient, single stage impulse and reaction turbines, degree of reaction, 50% reaction turbine stage, radial equilibrium and actuator disc approach for design of turbine blades, partial admission problems in turbines, losses in turbomachines

Text Books:

1. Yahya S.M, “Turbines, Compressor and Fans”, Tata Mcgraw-Hill, 4th Edition, 2010.
2. Shepherd D.G., “Principles of Turbomachinery”, 2nd Edition, Collier Macmillan, 1961.
3. Venkanna B.K., “Fundamentals of Turbomachinery”, 3rd Edition, PHI, 2009.

Reference Books:

1. Peng W.W., “Fundamentals of Turbo machinery”, 2nd Edition, Wiley, 2007.
2. Korpela S.A., “Principles of Turbo machinery”, 2nd Edition, Wiley, 2011.
3. Turton R.K., “Principles of Turbo machinery”, 3rd Edition, Springer, 1994.

Web References:

1. https://www.cfd-online.com/Wiki/Turbomachinery
2. https://www.leka.lt/sites/default/files/dokumentai/key-concepts-in-turbo-machinery_1.pdf
3. https://www.sciencedirect.com/science/book/9781856177931

E-Text Books:

1. https://elearning.vtu.ac.in/newvtuelc/courses/15/E-Notes/turbomachines/Unit-I%20&%20Unit-II_GRS.pdf
2. https://engineering-e-book.blogspot.com/2008/01/turbomachinery-books.html
3. https://myopencourses.com/subject/computational-fluid-dynamics-for-turbomachinery

Course Home Page:

HEAT TRANSFER

GROUP - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE515	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the basic modes of heat transfer like conduction, convection radiation with and without phase change in solid liquids and gases.
II. Design and analyze thermal fluidic components in engineering systems to energy mechanisms (in the form of heat transfer) for steady and unsteady state.
III. Conduct experiments in laboratories and analyze the results with theoretical ones to evolve research oriented projects in the field of heat transfer as well as propulsion.
IV. Apply the concepts of heat transfer with convective mode in internal and external flows involved in engineering components and work in real time problems in Industry.

UNIT-I	INTRODUCTION TO HEAT TRANSFER, CONDUCTION	Classes: 10

Modes and mechanisms of heat transfer, Basic laws of heat transfer. Conduction heat transfer: Fourier rate equation, Steady and unsteady and periodic heat transfer -Initial and boundary conditions, Overall heat transfer coefficient, Electrical analogy, Critical radius of insulation, Extended surfaces (Fins) Long, Short and insulated tips. Application to error measurement of temperature. Significance of Biot and Fourier numbers, Chart solutions of transient conduction systems –concept of Functional Body.

UNIT-II	CONVECTION, FORCED CONVECTION	Classes: 08

Buckingham Pi Theorem, application for developing semi-empirical non-dimensional correlation for convection heat transfer-significance of non-dimensional numbers-Concepts of Continuity, Momentum and Energy Equations. Concepts of hydrodynamic and thermal boundary layer -Flat plates and Cylinders. Concepts about Hydrodynamic and Thermal Entry Lengths-division of internal flows based on this- use of empirical correlations for Horizontal Pipe Flow and annulus flow.

UNIT-III	FREE CONVECTION, CONDENSATION	Classes: 10

Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates and pipes. Film boiling. Film wise and drop wise condensation, Nusselt's theory of condensation on a vertical plate.

Film condensation on vertical and horizontal cylinders using empirical correlations. Application in Aero engines, Gas turbine combustion chamber – Working principle, correlation with convection and condensation.

UNIT-IV	HEAT EXCHANGERS	Classes: 08

Classification of heat exchangers, overall heat transfer Coefficient and fouling factor, Concepts of LMTD and NTU methods, Problems using LMTD and NTU Methods, Application in Aero engines.

UNIT-V	RADIATION HEAT TRANSFER	Classes: 09

Emission characteristics, Laws of black-body radiation, Irradiation, Total and Monochromatic quantities, Laws of Planck, Wien, Kirchhoff, Lambert, Stefan and Boltzmann, Heat exchange between two black bodies, concepts of shape factor, Emissivity, heat exchange between grey bodies, radiation shields, electrical analogy for radiation networks. Application in Space Engineering

Text Books:

1. Yunus A. Cengel, "Heat Transfer- A Practical Approach", Tata McGraw hill Education (P) Ltd, New Delhi, India. 4th Edition,2012.
2. R. C. Sachdeva, "Fundamentals of Engineering, Heat and Mass Transfer", New Age, New Delhi, India, 3rd Edition, 2012

Reference Books:

1. Holman, "Heat Transfer"Tata McGraw Hill education (P) Ltd, New Delhi, India. 10th Edition, 2012.
2. Ghoshdastidar, P. S. "Heat Transfer", Oxford University Press, New Delhi, India. 2nd Edition, 2012.

Web References:

1. https://nptel.ac.in/courses/112101097/
2. https://hyperphysics.phy-astr.gsu.edu/hbase/thermo/heatra.html

E-Text Books:

1. https://bookzz.org/book/2556672/5ef6f5
2. https://bookzz.org/book/533930/66495a
3. https://bookzz.org/book/495953/61bfa5

Course Home Page:

CRYOGENICS

GROUP - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE516	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the behavior of fluids at cryogenic temperatures and utilize the feature for cryogenic application in aerospace propulsion.
I. Analyze the behavior of solids at cryogenic temperatures and develop systems used in hybrid rocket propulsion systems.
II. Estimate thermodynamically gas liquefaction systems and elucidate the application of liquefied gas in aerospace propulsion.
III. Create thermodynamically gas separation systems and experiment in a sustained environment for possible synthesis of rarefied gases for testing.

UNIT-I	**INTRODUCTION TO CRYOGENICS**	**Classes: 10**

Thermo physical and fluid dynamic properties of liquid and gas hydrogen, Thermo physical and fluid dynamic properties of liquid and gas helium, Liquefaction systems of hydrogen and helium gases, Liquefaction systems of hydrogen and helium gases, Refrigeration and liquefaction principals; Joule Thomson effect and inversion curve; Adiabatic and isenthalpic expansion with their comparison.

UNIT-II	**PROPERTIES OF CRYOGENIC SUBSTANCE**	**Classes: 10**

Cryogenic fluids, Solids at cryogenic temperatures; Superconductivity, Recuperative – Linde – Hampson, Claude, Cascade, Heylandt, Kapitza, Collins, Simon; Regenerative – Stirling cycle and refrigerator, Slovay refrigerator, Gifford-McMahon refrigerator, Vuilleumier refrigerator, Pulse Tube refrigerator; Liquefaction of natural gas.

UNIT-III	**CRYOGENIC INSULATIONS**	**Classes: 08**

Vacuum insulation, Evacuated porous insulation, Gas filled Powders and fibrous materials.

Solid foams, Multilayer insulation, Liquid and vapour Shields, Composite insulations.

UNIT-IV	**STORAGE AND INSTRUMENTATION OF CRYOGENIC LIQUIDS**	**Classes: 08**

Design considerations of storage vessel; Dewar vessels; Industrial storage vessels; Storage of cryogenic fluids in space; Transfer systems and Lines for cryogenic liquids; Cryogenic valves in transfer lines; Two phase flow in Transfer system; Cool-down of storage and transfer systems, Measurement of strain, pressure, flow, liquid level and Temperature in cryogenic environment; Cryostats.

UNIT-V	**CRYOGENIC EQUIPMENTS**	**Classes: 09**

Cryogenic heat exchangers – recuperative and regenerative; Variables affecting heat exchanger and system performance; Cryogenic compressors, Pumps, expanders; Turbo alternators; Effect of component inefficiencies; System Optimization, Magneto-caloric refrigerator; 3He-4He Dilution refrigerator; Cryopumping; Cryogenic Engineering applications in energy, aeronautics, space, industry, biology, preservation Application of Cryogenic Engineering in Transport.

Text Books:

1. Flynn, T.M., Dekker, Marcel “Cryogenic Engineering”, Plenum Press, USA, 2009.
2. Timmerhaus, K.D, Flynn, T.M, “Cryogenic Process Engineering”, Plenum Press, USA, 2009.

Reference Books:

1. Bose A. and Sengupta P.“Cryogenics: Applications and Progress”, Tata McGraw Hill, 2010.
2. Barron R., “Cryogenic Systems”, Oxford University Press, 2012.
3. Haselden, G.G.,“Cryogenic Fundamentals”, Academic Press, 2012.

Web References:

1. https://nptel.ac.in/courses/112101004/
2. https://www.slac.stanford.edu/econf/C0605091/present/CERN.PDF

E-Text Books:

1. https://bookzz.org/book/690085/5d838f
2. https://bookzz.org/book/2121781/aff7cc
3. https://bookzz.org/book/939475/a6994a

Course Home Page:

AERO ENGINE DESIGN

GROUP - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE517	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Perform parametric and performance analysis of aircraft engines to achieve engine performance requirements identified in constraint and mission analysis.
II. Describe the fundamental thermodynamic and gas dynamic principles used in the parametric analysis and performance analysis of aero engines.
III. Explain the fundamental design tools used for analysis and preliminary design of main burner and afterburner, fundamental design tools used for analysis and preliminary design of inlet and nozzle.
IV. Demonstrate, Analyze and choose appropriate materials used in rockets& missiles, mission and weight requirements.

UNIT-I	**FUNDAMENTALS OF ENGINE DESIGN**	**Classes: 10**

Engine design roadmap, preliminary propulsion design sequence, basic definitions, unit conversions, standard atmosphere, compressible flow equations, mission profile, performance requirements and constraints, desired capabilities.

UNIT-II	**CONSTRAINT ANALYSIS AND MISSION ANALYSIS**	**Classes: 10**

Concept, design tools, preliminary estimates for constraint analysis, examples of constraint analysis, selection of preliminary design point, complete constraint boundary conditions, constant speed climb, horizontal acceleration, climb and acceleration, takeoff acceleration, constant altitude and speed cruise, constant altitude and speed turn, best subsonic cruise Mach number and altitude, liter, warm-up, takeoff rotation, constant energy height maneuver, general determination of takeoff weight, example and sample mission analysis.

UNIT-III	**ENGINE SELECTION**	**Classes: 09**

Parametric cycle analysis, station numbering, gas model, component efficiencies, engine performance analysis, computational inputs and outputs, finding plausible solutions.

Parametric and performance behaviors, examples, integrated results, design choices, performance cycle analysis, component performance analysis, iterative solution scheme, component behavior.

UNIT-IV	**ENGINE SIZING**	**Classes: 08**

Subsonic inlets, supersonic inlets, nozzles, drag, sizing, constraints, selecting number of engines, final reprise, engine system design, engine static structure, starting, overall operation.

UNIT-V	**ENGINE COMPONENT OPERATION**	**Classes: 08**

Operation lines, fan and compressor aerodynamics, turbine aerodynamics, engine life, high pressure and low pressure turbine design, combustion system components, combustion process, fuels, and ignition, afterburners, sample inlet and exhaust nozzle design.

Text Books:

1. Mattingly J.D., Heiser W.H., Pratt D.T., "Aircraft Engine Design", AIAA ES, 2nd Edition, 2002.

Reference Books:

1. Mathur, M., and Sharma, R.P., "Gas Turbines and Jet and Rocket Propulsion", Standard Publishers, New Delhi 1998.
2. Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W., Freeman & Co. Ltd., London, 1982.
3. Parker, E.R., "Materials for Missiles and Spacecraft", McGraw-Hill Book Co. Inc., 1982.

Web References:

1. https://www.tutorialspoint.com/aero_engine_design
2. https://www.geeksforgeeks.org/aero_engine-design/
3. https://www.studytonight.com/aeroenginedesign.
4. https://www.coursera.org/specializations/aeroenginedesign

E-Text Books:

1. https://www.freeengineeringbooks.com/AeroSpace/AircraftDesignBooks.php
2. https://jntuaerobooks.blogspot.in/p/aero-3-1-books.html
3. https://www.amazon.in/Jet-Engines-Fundamentals-Theory-Operation/dp/1853108340

Course Home Page:

ROCKET AND MISSILES

GROUP - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE518	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Learn Fundamentals of rocket and missile systems, functions and disciplines and the full spectrum of rocket systems, uses and technologies.
II. Understand the Fundamentals and uses of solid, liquid and hybrid rocket systems and differences between systems built as weapons and those built for commerce.
III. Explain the use of low and high fidelity performance modeling, including performance loss factors, Staging theory, performance and practices for multi-stage rockets.
IV. Discuss the reliability issues in rocket systems, and strategies to improve reliability, including random and systematic failures, non-linier reliability curves.

UNIT-I	ROCKET DYNAMICS	Classes: 10

Classification of launch vehicles and missiles, rocket systems, airframe components, forces and moments acting on a rocket, propulsion, aerodynamics, gravity, inertial and non-inertial frames, coordinate transformation, equations of motion for three-dimensional motion through atmosphere and vacuum, earth's atmosphere, numerical problems.

UNIT-II	SOLID PROPULSION AND PYROTECHNICS	Classes: 10

Solid propellant rockets, classification, components and their design considerations, propellant grain design, grain mechanical properties, ballistics and burn rate design issues, igniter design, types of nozzles, thrust vector control, pyrotechnic devices and systems, classification, mechanisms and application of pyrotechnic devices in rockets and missiles; design problems in rocket systems.

UNIT-III	LIQUID PROPULSION AND CONTROL SYSTEMS	Classes: 09

Liquid propellant rockets, classification and components, thrust chamber, feed systems, propellant tanks, turbo-pumps, types of valves and applications, design considerations.

Different bipropellant systems like cryogenics and their characteristics, pogo and slooh engine gimbal systems and thrusters for control; Spacecraft propulsion and control systems design problems.

UNIT-IV	MULTI-STAGING OF ROCKET AND SEPERATION DYNAMICS	Classes: 08

Navigation and guidance systems in rockets and missiles, aerodynamic control systems of missiles, multi-staging of rockets, vehicle optimization techniques, stage separation system, dynamics, separation techniques, rocket flight dispersion, numerical problems.

UNIT-V	DESIGN, MATERIALS AND TESTING OF ROCKETS	Classes: 08

Design requirements and selection, performance evaluation and assessment, space environment on the selection of materials for rockets and spacecraft, material selection for specific requirements, advance materials, super alloys and composite materials, qualification of rocket and missile systems, types of testing and evaluation of design and function.

Text Books:

1. Sutton, G.P., et al., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 1993.
2. Martin J.L Turner , "Rocket & Space Craft Propulsion, Springers –oraxis publishing, 2001.

Reference Books:

1. Mathur, M., and Sharma, R.P., "Gas Turbines and Jet and Rocket Propulsion", Standard Publishers, New Delhi 1998.
2. Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W., Freeman & Co. Ltd., London, 1982.
3. Parker, E.R., "Materials for Missiles and Spacecraft", McGraw-Hill Book Co. Inc., 1982.

Web References:

1. https://www.tutorialspoint.com/materials for rockets & missiles.
2. https://www.geeksforgeeks.org/ rockets & missiles /
3. https://www.studytonight.com/ rockets & missiles/
4. https://www.coursera.org/specializations/ rockets & missiles –spacecraft.

E-Text Books:

1. https://www.scribd.com/doc/268924096/c-rockets&missiles-mathur-eBook
2. https://www.safaribooksonline.com/library/view/rockets&missiles-using/9789332524248/
3. https://www.amazon.com/rockets &missiles-C-sutton
4. https://www.scribd.com/doc/40147240/rockets and missiles-Using-c-by-parker-ER-946

Course Home Page:

PRECISION ENGINEERING

GROUP - III

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE519	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the BIS code fits and tolerances for geometrical dimensioning and tolerance (GD & T).
II. Understand the principal application of different measuring instruments.
III. Summarize the application of latest manufacturing techniques (nano).

UNIT-I	ACCURACY AND ALIGNMENT TESTS	Classes : 09

Accuracy and alignment tests: General concept of accuracy, spindle rotation accuracy, test methods, displacement accuracy, dimensional wear of cutting tools, accuracy of NC systems, clamping errors, setting errors, location of rectangular prism, cylinder, basic type of tests, measuring instruments used for testing machine tools, alignment tests, straightness, flatness, parallelism, squareness, circularity, cylindricity.

UNIT-II	INFLUENCE OF STATIC STIFFNESS,THERMAL EFFECTS	Classes : 09

Influence of static stiffness, thermal effects: Static stiffness, nature of deformation in a machine tool, overall stiffness of a lathe, compliance of work piece, errors due to the variation of the cutting force and total compliance, accuracies due to thermal effects, methods of decreasing thermal effects-Influence of vibration on accuracy.

UNIT-III	PRECISION MACHINING	Classes: 09

Top down and bottom up approach, development of nanotechnology, precision and micromachining, diamond turning of parts to nanometer accuracy.

Stereo microlithography, machining of micro-sized components, mirror grinding of ceramics, ultra precision block gauges.

UNIT-IV	NANO MEASURING SYSTEMS	Classes: 09

In-process measurement of position of processing point, post process and online measurement of dimensional features, mechanical measuring systems, optical measuring systems, electron beam measuring systems, pattern recognition and inspection systems.

UNIT-V	LITHOGRAPHY	Classes : 09

Nano Lithography, photolithography, nano lithography, photolithography, electron beam lithography, ion beam lithography, optical lithography, LIGA process, dip pen lithography, deep UV.

Text Books:

1. Murthy R.L, “Precision Engineering in Manufacturing”, New Age International, New Delhi, 2005.
2. Norio Taniguchi, “Nanotechnology”, Oxford university press, Cambridge, 1996.

Reference Books:

1. Lee TongHong, “Precision Motion Control, Design and Implementation”, Springer Verlag, UK, 2001.
2. Liangchi Zhang, “Precision Machining of Advanced Materials”, Trans Tech Publications Ltd., Switzerland, 2001.
3. Hiromu Nakazawa, “Principles of Precision Engineering”, Oxford university press, 1994.

Web References:

1. https://nptel.ac.in/courses/112106138/
2. https://nptel.ac.in/courses/118102003/

E-Text Book:

1. https://accessengineeringlibrary.com/browse/precision-engineering
2. https://books.google.co.in/books/about/Precision_Engineering_in_Manufacturing.html?id=vueapsbGLc4C

Course Home Page:

NON DESTRUCTIVE TESTING

GROUP - IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE520	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil		Practical Classes: Nil			Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understanding the basic principles of various non destructive testing methods, fundamentals, discontinuities in different product forms.
II. Differentiate various defect types and select the appropriate non destructive testing methods for better evaluation of the specimen.
III. Implement and document a written procedure paving the way for further training in specific techniques of non destructive inspection of the experimental subject.
IV. Recognize the principles and operational techniques of the radiographic testing followed by its interpretation and evaluation.

UNIT-I	OVERVIEW OF NON DESTRUCTIVE TESTING	Classes: 09

NDT versus mechanical testing, overview of the non destructive testing methods for the detection of manufacturing defects as well as material characterization; Relative merits and limitations, various physical characteristics of materials and their applications in NDT, visual inspection, v unaided and aided.

UNIT-II	SURFACE NON DESTRUCTIVE EXAMINATION METHODS	Classes: 09

Liquid Penetrant Testing: Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results; Magnetic particle testing; Theory of magnetism, inspection materials magnetisation methods, interpretation and evaluation of test indications, principles and methods of demagnetization, residual magnetism.

UNIT-III	THERMOGRAPHY AND EDDY CURRENT TESTING (ET)	Classes: 09

Thermography: Principles, contact and non contact inspection methods, techniques for applying liquid crystals.

Advantages and limitation, infrared radiation and infrared detectors, instrumentations and methods, applications; Eddy Current Testing; Generation of eddy currents, properties of eddy currents, Eddy current sensing elements, probes, instrumentation, types of arrangement, applications, advantages, limitations, interpretation/evaluation.

UNIT-IV	ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE)	Classes: 09

Ultrasonic Testing: Principle, transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A-scan, B-scan, C-scan; Phased array ultrasound, time of flight diffraction; Acoustic emission technique, V principle, AE parameters, applications.

UNIT-V	EXPERIMENTAL METHODS	Classes:09

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, inverse square, law, characteristics of films , graininess, density, speed, contrast, characteristic curves, pentameters, exposure charts, radiographic equivalence. Fluoroscopy; Xerox; Radiography, computed radiography, computed tomography.

Text Books :

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010.

Reference Books:

1. Paul E Mix, "Introduction to Non-destructive Testing: a training guide", Wiley, 2nd Edition New Jersey, 2005.
2. Charles, J. Hellier, "Handbook of Non-destructive Evaluation", McGraw Hill, New York 2001.

Web References:

1. https://nptel.ac.in/syllabus/syllabus_pdf/113106070.pdf
2. https://nptel.ac.in/courses/113106070/24

E-Text Books:

1. https://www.springer.com/la/book/9780412625008
2. https://eprints.nmlindia.org/1850/1/177-193.PDF
3. https://www.tower.com/non-destructive-test-evaluation-materials-prof-j-prasadpaperback/wapi/124712958

Course Home Page:

CAD / CIM

GROUP - IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE521	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

Objectives:

The course should enable the students to:

I. Understand the basics of computer aided designing, computer aided manufacturing and computer integrated manufacturing.
II. To study about group technology, computer aided process planning, material requirement planning (MRP) Enterprise resource planning (ERP).
III. Gain knowledge about shop floor control and Flexible manufacturing systems (F.M.S).
IV. Emphasizes the integration of manufacturing enterprise using computer integrated manufacturing (CIM) technologies.

UNIT-I	**INTRODUCTION**	**Classes: 08**

Computers in industrial manufacturing , product cycle, CAD/CAM hardware, basic structure, CPU, memory types, input devices, display devices, hard copy devices, and storage devices, computer graphics, raster scan graphics coordinate system, database structure for graphics modeling, transformation of geometry, three dimensional transformations, mathematics of projections, clipping, hidden surface removal.

UNIT-II	**GEOMETRIC MODELLING**	**Classes: 10**

Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired, drafting and modeling systems, basic geometric commands, layers, display control commands, editing, dimensioning and solid modeling.

UNIT-III	**GROUP TECHNOLGY COMPUTER AIDED PROCESS PLANNING**	**Classes: 10**

History of group technology, role of G.T in CAD/CAM integration, part families, classification and coding, DCLASS and MCLASS and OPTIZ coding systems, facility design using G.T, benefits of G.T, cellular manufacturing.

Process planning, role of process planning in CAD/CAM integration, approaches to computer aided process planning, variant approach and generative approaches, CAPP and CMPP systems.

UNIT-IV	**COMPUTER AIDED PLANNING AND CONTROL, SHOP FLOOR CONTROL AND INTRODUCTION TO FMS**	**Classes: 09**

Production planning and control, cost planning and control, inventory management, material requirements planning (ERP), control, phases, factory data collection system, automatic identification methods, bar code technology, automated data collection system; FMS, components of FMS, types, FMS workstation, material handling and storage system, FMS layout, computer control systems, applications and benefits.

UNIT-V	**COMPUTER AIDED PLANNING AND CONTROL AND COMPUTER MONITORING**	**Classes: 08**

Production planning and control, cost planning and control, inventory management, material requirements planning (MRP), shop floor control, lean and agile manufacturing, types of production monitoring systems, structure model of manufacturing, process control and strategies, direct digital control.

Text Books :

1. A. Zimmers, P. Groover, “CAD/ CAM”, Prentice- Hall India, 2008.
2. Zeid, Ibrahim, “CAD / CAM Theory and Practice”, Tata McGraw-Hill, 1997.
3. Mikell. P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson Education 2001.
4. Ranky, Paul G., “Computer Integrated Manufacturing”, Prentice hall of India Pvt. Ltd.,2005
5. Yorem Koren, “Computer Integrated Manufacturing”, McGraw Hill, 2005.

Reference Books:

1. P. Groover, Automation, “Production Systems & Computer Integrated Manufacturing”, Pearson Education.2nd Edition 1989.
2. Lalit Narayan, “Computer Aided Design and Manufacturing”, Prentice-Hall India.3rd Edition 2002.
3. Radhakrishnan, Subramanian, “CAD / CAM / CIM”, New Age.4th Edition 2016.
4. Jami J Shah, Martti Mantyla, “Parametric and Feature-Based CAD/CAM: Concepts, Techniques, and Applications”, John Wiley & Sons Inc, 1995.
5. Alavala, “CAD/ CAM: Concepts and Applications”, PHI Publications, 4th Edition, 2016.
6. W. S. Seames, “Computer Numerical Control Concepts and Programming”, 4th Edition 1999.

Web References:

1. https://en.wikipedia.org/wiki/CAD/CAM_dentistry
2. https://en.wikipedia.org/wiki/Computer-aided_manufacturing
3. https://en.wikipedia.org/wiki/Computer-integrated_manufacturing

E-Text Books:

1. https://books.google.co.in/books?id=8W0E9eK2raMC
2. https://books.google.co.in/books?id=mzm9WuuI4mQC
3. https://books.google.co.in/books?id=F5d6CwAAQBAJ

Course Home Page:

COMPOSITES FABRICATION AND MACHINING

GROUP - IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
AAE522	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

Objectives:

The course should enable the students to:

I. Develop advance research and development projects on composite materials and its fabrication processes.
II. Classify the composites and composite materials based on matrix and fibres, fibers fabrication methodology.
III. To study matrix material, reinforcements of polymer matrix composites, MMC and ceramic matrix composites.
IV. Understand the operation of conventional machining, Fabrication of Metal Matrix Composites, Basic Requirements in Selection of constituents, solidification.

UNIT-I	OVERVIEW AND INTRODUCTION	Classes: 08

Definition of composite material, classification based on matrix and topology, classification and characteristics of composites, conventional vs. composite materials, advantages and limitations, salient applications in various fields constituents of composites, interfaces and interphases, distribution of constituents, nano-composites; Classification of polymers properties of thermo plastics properties of thermosetting plastics, prepare layup and autoclave processing.

UNIT-II	FIBERS AND MATRIX MATERIALS	Classes: 10

fibers fabrication, structure, properties and applications glass fiber, boron fiber, carbon fiber, organic fiber, ceramic and metallic fibers whiskers fabrication of matrix materials polymers, metals and ceramics and their properties interfaces wettability types of bonding at the interface tests for measuring interfacial strength physical and chemical properties.

UNIT-III	PROCESSING OF POLYMER MATRIX COMPOSITES, METAL MATRIX COMPOSITES AND CERAMIC MATRIX COMPOSITES	Classes: 10

Thermoset matrix composites: hand layup, spray, filament winding, pultrusion, resin transfer moulding, autoclave moulding bag moulding, compression moulding with bulk moulding compound and sheet Moulding Compound thermoplastic matrix composites film stacking, diaphragm forming, thermoplastic tape laying, injection moulding interfaces in PMCs structure, properties and application of PMCs recycling of PMCs.

Metallic matrices: aluminium, titanium, magnesium; Copper alloys processing of MMCs: Liquid state, solid state, in situ fabrication techniques diffusion bonding powder metallurgy techniques interfaces in MMCs; Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration; Lanxide process in situ chemical reaction techniques: Chemical vapour deposition, chemical vapours impregnation, SOLGEL interfaces in CMCs.

UNIT-IV	FABRICATION OF COMPOSITES	Classes: 09

Fabrication Composites: Fabrication of metal matrix composites: Commonly used matrices, basic requirements in selection of constituents, solidification processing of composites - XD process, spray processes; Osprey process, rapid solidification processing, dispersion processes; Stir-casting and

compocasting, screw extrusion, liquid metal impregnation technique; Squeeze casting, pressure infiltration, lanxide process), principle of molten alloy infiltration, rheological behavior of melt particle slurry, synthesis of in situ composites; Fabrication of polymer matrix composites; Commonly used matrices basic requirements in selection of constituents, moulding method, low pressure closed molding, pultrusion, filament winding, fabrication of ceramic matrix composites; Various techniques of vapour deposition, liquid phase method and hot pressing etc., fabrication of nano-composite.

UNIT-V	NONTRADITIONAL MACHINING OF FRPs AND HEALTH AND SAFETY ASPECTS IN MACHINING FRPS	Classes: 08

Abrasive water jet machining, laser machining, electric discharge machining; Hazard sources and route exposure, dust generation in dry machining, aerosol emission in laser machining, work place control.

Text Books :

1. Krishnan K Chawla, "Composite Materials: Science and Engineering", Springer, International Edition, 2012.
2. Jamal Y. Sheikh ahmad, "Machining of Polymer Composites", Springer, International Edition, 2009.
3. Autar. K. Kaw, "Mechanics of Composite Materials", Taylor & Francis Group, LLC, 2006.

Reference Books:

1. J.N Reddy, "Mechanics of laminated composite plates and shells theory and Analysis", CRC Press LLC, 2nd Edition, 2004.
2. P. K. Mallick, "Fiber Reinforced Composites: Materials, Manufacturing and Design", CRC press, 1stEdition, 2010.

Web References:

1. https://link.springer.com/book/10.1007%2F978-0-387-74365-3.
2. https://www.hydrojet.com/capabilities/composites/
3. https://www.me.iitb.ac.in/~ramesh/courses/ME338/comp.pdf

E-Text Books:

1. https://www.cantab.net/users/bryanharris/Engineering%20Composites.pdf
2. https://www.sciencedirect.com/science/article/pii/B9781856174152500034
3. https://www.sciencedirect.com/science/article/pii/B9781856174152500022

Course Home Page:

MECHANISM AND MACHINE DESIGN

Group- IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
AAE523	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

Objectives:

The course should enable the students to:

I. Understand the basic mechanism involved in machine design and basic relative kinematics relations of two moving point.
II. Identify individual links and categorize the type of the connection of the links (joints) for the mechanism of machines.
III. Explain the fundamentals of specific link and joint combinations such as gyroscopic motion, followers, cam and gear systems.
IV. Define kinematic analysis and develop analytical equations describing the relative position, velocity and acceleration of all moving links.

UNIT-I	MECHANISMS & MACHINES	Classes: 08

Elements of links, classification, rigid link, flexible and fluid link, types of kinematic pairs, sliding, turning, rolling, screw and spherical pairs, lower and higher pairs, closed and open pairs, constrained motion, completely, partially or successfully constrained, and incompletely constrained, mechanism and machines, classification, kinematic chain, inversion of mechanism, inversion of quadratic cycle, chain, single and double slider crank chains; Exact and approximate straight line mechanisms: Paucellier, hart t, Chibichef, pantograph.

UNIT-II	KINEMATIC ANALYSIS OF MECHANISMS	Classes: 10

Velocity and acceleration, motion of link in machine, determination of velocity and acceleration diagrams, graphical method, application of relative velocity method for four bar chain, analysis of slider crank chain for displacement, velocity and acceleration of sliding, acceleration diagram for a given mechanism, Kleins construction, Coriolis acceleration, determination of Coriolis component of acceleration.

UNIT-III	PLANE MOTION OF BODY & GYROSCOPIC MOTION PRECESSION	Classes: 10

Instantaneous centre of rotation, centroids and axodes, relative motion between two bodies, three centres in line theorem, graphical determination of instantaneous centre, diagrams for simple mechanisms and determination of angular velocity of points and links.

The gyroscope, free and restrained, working principle, the free gyro, rate gyro, integrating gyro as motion measuring instruments, effect of precession on the stability of vehicles, motorbikes, automobiles, airplanes and ships, static and dynamic forces generated due to in precession in rotating mechanisms.

UNIT-IV	CAMS AND FOLLOWERS, STEERING GEARS	Classes: 09

Cams and followers, definition uses, types, terminology, types of follower motion, uniform velocity, simple harmonic motion and uniform acceleration, maximum velocity and acceleration during outward and return strokes, roller follower, circular cam with straight, concave and convex flanks, condition for correct steering, Davis steering gear, Ackerman's steering gear, velocity ratio, hook's joint, single and double hooks joint, universal coupling, applications.

UNIT-V	GEARS AND GEAR TRAINS, DESIGN OF FOUR BAR MECHANISMS	Classes: 08

Introduction to gears: Types, law of gearing; Tooth profiles: Specifications, classification, helical, bevel and worm gears, simple and reverted gear train, epicyclic gear trains, velocity ratio or train value, four bar mechanism, Freudenstein equation, Precession point synthesis, Chebyshev's method, structural error.

Text Books :

1. Amithab Ghosh, Asok Kumar Malik, "Theory of Mechanisms and Machines", East West Press Pvt Ltd, 2001.
2. J. S. Rao, R.V. Dukkipati "Mechanism and Machine Theory / New Age Publications", 1996.
3. Neil Sclater, P. Nicholas, Chironis "Mechanisms and Mechanical Devices Sourcebook", New York McGraw-Hill, publications, 3rd Edition.1963

Reference Books:

1. Dr Jagdish Lal, J. M. Shaw "Theory of Machines", 1st Edition, 1985.
2. Abdulla Sharif, Dhanpat Rai, "Theory of Machines", 5th Edition, 1987,
3. P. L. Ballaney, "Theory of Machines", Khanna Publishers, 3rd Edition, 2003,
4. J. E. Shigley, R. Charles, Mischke, "Mechanical engineering and design", TMH, 1st Edition, 2003.

Web References:

1. https://en, wikipedia.org/wiki/Mechanism_(engineering)
2. https://en, wikipedia.org/wiki/Machine_(mechanical)
3. https://en, wikipedia.org/wiki/Crank_(mechanism)

E-Text Books:

1. https://engineeringstudymaterial.net/ebook/mechanisms-and-mechanical-devices-sourcebook/
2. https://accessengineeringlibrary.com/browse/mechanisms-and-mechanical-devices-sourcebook-fifth-edition
3. https://www,amazon,com/Mechanisms-Mechanical-Devices-Sourcebook-Fourth-ebook/dp/B0062Y79H0#navbar

Course Home Page:

PRODUCT DESIGN AND DEVELOPMENT

Group- IV

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
AAE524	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

Objectives:

The course should enable the students to:

I. Prioritize the growth of the organization and utilize the surplus capacity of the organization, such as physical facility, man power.
II. Develop the market share and to target new market segment and ensure complete product range in company's portfolio.
III. Apply contemporary theories of effective product design through the adaptive and/or original redesign of consumer products.

UNIT-I	**INTRODUCTION**	**Classes: 08**

Significance of product design, product design and development process, sequential engineering design method, the challenges of product development, product planning and project selection: Identifying opportunities, evaluate and prioritize projects, allocation of resources.

UNIT-II	**IDENTIFYING CUSTOMER NEEDS, PRODUCT SPECIFICATIONS AND CONCEPT GENERATION**	**Classes: 10**

Interpret raw data in terms of customers need, organize needs in hierarchy and establish the relative importance of needs; Establish target specifications, setting final specifications; Activities of concept generation, clarifying problem, search both internally and externally, explore the output.

UNIT-III	**INDUSTRIAL DESIGN AND CONCEPT SELECTION**	**Classes: 10**

Assessing need for industrial design, industrial design process, management, assessing quality of industrial design.

Overview, concept screening and concept scoring, methods of selection.

UNIT-IV	**THEORY OF INVENTIVE PROBLEM SOLVING (TRIZ)**	**Classes: 09**

Fundamentals, methods and techniques, general theory of innovation and TRIZ, value engineering applications in product development and design, model-based technology for generating innovative ideas.

UNIT-V	**CONCEPT TESTING, INTELLECTUAL PROPERTY AND DESIGN FOR ENVIRONMENT**	**Classes: 08**

Elements of testing: qualitative and quantitative methods including survey, measurement of customers' response; Elements and outline, patenting procedures, claim procedure; Impact, regulations from government, ISO system.

Text Books:

1. K. T Ulrich, S. D. Eppinger, "Product Design and Development", Tata McGraw-Hill, 5th Edition, 2008.
2. K. Otto, K. Wood, "Product Design", Pearson, 1st Edition, 2001.

Reference Books:

1. Steven Eppinger, Karl Ulrich, "Product Design and Development", McGraw-Hill Education, 1st Edition, 2011.

2. Karl T. Ulrich, Steven D. Eppinger, “Product Design and Development”, McGraw-Hill, 1st Edition, 2012.
3. Semyon D. Savransky, “Engineering of creativity: Introduction to TRIZ methodology of inventive Problem Solving”, CRC Press, 1st Edition, 2000.

Web References:

1. https://nptel.ac.in/courses/105106049/#
2. https://www.rqriley.com/pro-dev.htm

E-Text Books:

1. https://faculty1.aucegypt.edu/farag/presentations/Chapter1.pdf
2. https://appinventor.mit.edu/explore/sites/all/files/teachingappcreation/unit1/DesignUnit1.pdf

Course Home Page:

AVIONICS AND INSTRUMENTATION

GROUP-V

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE525	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Impart the knowledge in various types of Avionics systems, its components & its applications in aerospace industries.
II. Offer a rigorous avionics technology, Review of the basic system integration and the different type of avionics architectures.
III. Provide necessary knowledge to study the aircraft instrumentation sensors, displays and different type of sensors.
IV. Give knowledge about military aircraft adaptation, avionics and mission system interface and gives the difference between civilian aircraft avionics and military aircraft avionics.

UNIT-I	AVIONICS TECHNOLOGY	Classes: 10

Evolution of electronics; The nature of microelectronic devices, processors, memory devices; Introduction to avionics, systems integration, need - data bus systems, MIL STD 1553 bus system, ARINC 429/ARINC 629 bus systems, optical data bus systems; Integrated modular avionics architectures , commercial off the shelf systems; Avionics packaging.

UNIT-II	AIRCRAFT INSTRUMENTATION - SENSORS AND DISPLAYS	Classes: 10

Air data sensors, magnetic sensing, inertial sensing, and radar shensors. The electromechanical instrumented flight deck, early flight deck instruments, attitude direction indicator, horizontal situation indicator, altimeter, airspeed indicator; Advanced flight deck display system architectures, display systems, display media, future flight deck displays.

UNIT-III	COMMUNICATION AND NAVIGATION AIDS	Classes: 09

Radio frequency spectrum, communication systems, HF, VHF, satellite communications; ATC transponder, traffic collision avoidance system; Navigational aids; Automatic direction finding, VHF Omni range, distance measuring equipment; TACAN, VORTAC; Satellite navigation systems, the GPS.

Basic navigation, radio, inertial navigations, satellite navigation; GPS, differential GPS, wide area augmentation systems, local area augmentation system, and GPS overlay program; Integrated navigation, sensor usage; Flight management system (FMS); FMS control and display unit; Lateral navigation.

UNIT-IV	MILITARY AIRCRAFT ADAPTATION	Classes: 08

Avionic and mission system interface, navigation and flight management; Navigation aids, flight deck displays, communications, aircraft systems; Applications, personnel, material and vehicle transport, air-to-air refueling, maritime patrol, airborne early warning, ground surveillance; Electronic warfare, the EW spectrum, electronic support measures, electronic countermeasures, electro-optics and the infra-red.

UNIT-V	AIRBORNE RADAR, ASTRIONICS - AVIONICS FOR SPACECRAFT	Classes: 08

Propagation of Radar waves, functional elements of radar, antenna- transmitter; Types of radar- pulse Doppler, civil aviation applications, military applications; Attitude determination and control of spacecraft, magnetometers, sun sensors, star trackers, earth and horizon sensors; Command and telemetry

Text Books:

1. Moir, I. and Seabridge, A., Civil Avionics Systems, AIAA Education Series, AIAA, 2002.
2. Collinson, R.P.G., Introduction to Avionics Systems, Springer, 2nd Edition, 2003.

Reference Books:

1. Helfrick, A., Principles of Avionics, Avionics Communications Inc. Leesburg, 2000.
2. Henderson, M. F., Aircraft Instruments & Avionics for A &P Technicians, Jeppesen Sanderson Training Products, 1993.

Web References:

1. https://soaneemrana.org/onewebmedia/INTRODUCTION%20TO%20SPACE%20DYNAMICS1
2. https://nptel.ac.in/courses/101105030/

E-Text Books:

1. https://store.doverpublications.com/0486651134.html
2. https://www.worldcat.org/title/introduction-to-space-dynamics/oclc/867680515

Course Home Page:

AIR TRANSPORTATION SYSTEMS

GROUP - V

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE526	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand complexity and transport operation systems.
II. Evaluate the nature of accidents and the role of the accident investigation process.
III. Describe how safety management systems (SMS) work to decrease airport and aircraft accidents.
IV. Understand many transport issues involved in handling passengers, freight of aircraft.

UNIT-I	AVIATION INDUSTRY	Classes: 08

Introduction, history of aviation, evolution, development, growth, challenges; Aerospace industry, air transportation industry- economic impact, types and causes; Airline industry, structure and economic characteristics; Airlines as oligopolists, other unique economic characteristics; Significance of airline passenger load factors.

UNIT-II	NATURAL ENVIRONMENT, REGULATORY ENVIRONMENT AND OPERATIONAL ENVIRONMENT	Classes: 10

The earth as a habitat, The Earth: physical issues affecting demand- surface, core, continents; Shape of demand; Demand forecasting- based on historical data, comparative analysis, theoretical demand models; Reliability of forecasts; The breadth of regulation- ICAO, IATA, national authorities (DGCA, FAA); Service properties: service volumes, international air service agreements, deregulation, privatization; Evolution: Communication, navigation and surveillance systems (CNSS); Radio communications: VHF, HF, ACARS, SSR, ADS; Navigation: NDB, VOR, DME, area-navigation systems(R-Nav), ILS, MLS, GPS, INS, laser-INS; Surveillance: SSR, ADS; Airborne elements: AFCS, PMS, electronic control and monitoring/engine instrumentation and central automated systems, EFIS, FMS, GPWS, TCAS- future trends.

UNIT-III	AIRCRAFT	Classes: 10

Costs- project cash-flow, aircraft price; Compatibility with the operational infrastructure; Direct and indirect operating costs; Balancing efficiency and effectiveness-payload-range, fuel efficiency.

Technical contribution to performance, operating speed and altitude, aircraft field length performance; Typical operating costs; Effectiveness- wake-vortices, cabin dimensions, flight deck.

UNIT-IV	AIRPORTS AND AIRLINES	Classes: 09

Setting up an airport: airport demand, airport sitting, runway characteristics, length, declared distances, aerodrome areas, obstacle safeguarding; Runway capacity, evaluating runway capacity, sustainable runway capacity; Setting up an airline, modern airline objectives; Route selection and development, airline fleet planning, annual utilization and aircraft size, seating arrangements; Indirect operating costs; Aircraft- buy or lease; Revenue generation, computerized reservation systems, yield management; Integrating service quality into the revenue-generation process; Marketing the seats; Airline scheduling; Evaluating success, financial viability, regulatory compliance, efficient use of resources, effective service.

UNIT-V	AIRSPACE	Classes: 08

Categories of airspace, separation minima, airspace sectors, capacity, demand and delay; Evolution of air traffic control system, procedural ATC system, procedural ATC with radar assistance, first generation 'automated' ATC system, current generation radar and computer-based ATC systems; Aerodrome air traffic control equipment and operation - ICAO future air-navigation systems (FANS); Air-navigation service providers as businesses.

Text Books:

1. Hirst, M., "The Air Transport System", Woodhead Publishing Ltd, Cambridge, England, 2008.

Reference Books:

1. Wensven, J.G., "Air Transportation: A Management Perspective", Ashgate, 2nd Edition 2007.
2. Belobaba, P., Odoni, A. and Barnhart, C., Global Airline Industry, 2nd Edition Wiley, 2009.
3. M. Bazargan, M., "Airline Operations and Scheduling", Ashgate, 1st Edition 2004.

Web References:

1. https://pdfs.semanticscholar.org/7f85/e5cffcdd85e25bd495b5762e1ca4facda739.pdf2.pdf.pdfhttp://andromeda.rutgers.edu/~jy380/research/air-schedule/chapter50.pdf

E-Text Books:

1. https://link.springer.com/book/10.1007%2F978-3-7091-1880-

Course Home Page:

AIRPORT PLANNING AND MANAGEMENT

GROUP - V

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE527	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand design and planning of airport operation systems.

II. Understand many operational issues involved in design of airports.

UNIT-I	**AIRPORTS AND AIRPORT SYSTEMS**	**Classes: 08**

Introduction: Airport management on an international level; The national plan of integrated airport systems; The nation's airport system plan; The rules that govern airport management; Organizations that influence airport regulatory policie; A historical and legislative perspective: Introduction the formative period of aviation and airports, Airport growth: World War II and the postwar period airport modernization: The early jet age.

UNIT-II	**COMPONENTS OF THE AIRPORT**	**Classes: 10**

The components of an airport. The airfield. Navigational aids (NAVAIDS) located on airfields; Air traffic control and surveillance facilities located on the airfield; Weather reporting facilities located on airfields; Security infrastructure on airfields; Airspace and air traffic control: Brief history of air traffic control; The basics of air traffic control; Current and future enhancements to air traffic control; Airport terminals and ground access: The historical development of airport terminals; Components of the airport terminal; Airport ground access.

UNIT-III	**AIRPORT OPERATIONS AND FINANCIAL MANAGEMENT**	**Classes: 10**

Airport operations management: Introduction, pavement management, aircraft rescue and fire fighting (ARFF); Snow and ice control, safety inspection programs.

Bird and wildlife hazard management; Airport security: Security at commercial service airports, security at general aviation airports; The future of airport security.

UNIT-IV	**AIRPORT FINANCIAL MANAGEMENT**	**Classes: 09**

Airport financial accounting, revenue strategies at commercial airports, pricing of airport facilities and services, variation in the sources of operating revenues, rise in airport financial burdens, airport funding, grant programs, airport financing, private investment sale of the airport.

UNIT-V	**AIRPORT CAPACITY AND DELAY**	**Classes: 08**

Defining capacity, factors affecting capacity and delay, estimating capacity, analytical estimates of delay: The queueing diagram; The future of airport management: Introduction, restructuring of commercial air carriers, new large aircraft, small aircraft transportation systems.

Text Books:

1. Alexander T Wells, Ed. D Seth Young, "Airport planning and Management", 6nd Edition, 2011.

Reference Books:

1. Norman J. Ashford, H. P. Martin Stanton, Clifton A. Moore, Pierre Coutu, "Airport Operations", McGraw Hill, 3rd Edition, 2013.

Web References:

1. https://memberfiles.freewebs.com/94/47/55224794/documents/airport%20planning%20and%20management.pdf
2. https://books.google.co.in/books?id=RYR6cu4YSBcC&dq=Planning%20and%20Design%20of%20Airports&source=gbs_similarbooks

E-Text Books:

1. https://accessengineeringlibrary.com/browse/airport-planning-and-management-sixth-edition
2. https://www.only4engineer.com/2014/10/planning-and-design-of-airports-by.html

Course Home Page:

AIRWORTHINESS AND CERTIFICATIONS

GROUP-V

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
AAE528	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

Objectives:

The course should enable the students to:

I. Collaborate effective implementation of the safety related airworthiness rules, regulations and requirements contained in the various national documents and standards and recommended practices.

II. Evaluate the weaknesses in the engineering activities of the operators, maintenance and other related organizations so that necessary corrective measures can be taken in time before they become a potential safety hazard.

III. Apply and implement the standards and recommended practices laid down in the ICAO Annexes 1, 6 and 8.

UNIT-I	BASIC CONCEPTS	Classes: 08

Introduction to aircraft rules as far as they relate to airworthiness and safety of aircraft; airworthiness requirements for civil and military aircraft CAA, FAA, JAR and ICAO regulations; defense standards; military standards and specifications.

UNIT-II	RESPONSIBILITIES OF AME LICENSES	Classes: 10

Privileges and responsibilities of various categories of AME license and approved persons; knowledge of mandatory documents like certificate of registration, certificate of airworthiness, conditions of issue and validity; export certificate of airworthiness; knowledge of log book, journey log book, technical log book, etc.

UNIT-III	CERTIFICATION	Classes: 10

Procedure for development and test flights and certification; certificate of flight release, certificate of maintenance, approved certificates.

Technical publications, aircraft manual, flight manual, aircraft schedules.

UNIT-IV	REGULATION PROCEDURES	Classes: 09

Registration procedure, certification, identification and marking of aircraft; modification, concessions, airworthiness directives, service bulletins; crew training and their licenses, approved inspection, approved materials, identification of approved materials; bonded and quarantine stores; storage of various aeronautical products like rubber goods, various fluids.

UNIT-V	CASE STUDIES AND INVESTIGATIONS	Classes: 08

Accident investigation procedures; circumstances under which C of A is suspended; ICAO and IATA regulations, Chicago and Warsaw conventions; familiarization of recent issues of advisory circulars; civil aviation requirements section 2-airworthiness.

Text Books:

1. DGCA, "Aircraft Manual (India): The Aircraft Act 1934 Along With the Aircraft Rules, 1937", Sterling Book House, 2009.
2. "Civil Aviation Contingency Operations Manual of Planning, Training and Operations", Transport Canada publication, 1999.
3. "Civil Aircraft Airworthiness Information and Procedures (CAP 562)", safety and airspace regulation group, Version 4.1, 2016.

Reference Books:

1. Richard S. Leavenworth, Eugene Lodewick Grant, "Statistical quality control", McGraw-Hill Education, 2000.
2. Parker E.R., "British Civil Airworthiness Requirements", Civil Aviation Authority, revised edition, 2001.
3. Great Britain, Board of Trade, "Aeronautical Information Circulars", H.M. Stationery Office, 1967.

Web References:

1. https://dgca.nic.in/aic/aic-ind.htm
2. https://dgca.nic.in/rules/car-ind.htm
3. https://www.dgca.nic.in/rules/adv-ind.htm
4. https://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=92

E-Text Books:

1. https://books.google.co.in/books?id=VC9k9KD4t3UC&printsec=frontcover&dq=gran+el+statistical+quality+control&hl=en&sa=X&ved=0ahUKEwjWgZujkd_QAhXHRo8KHaq1BcQQ6AEIJjAA#v=onepage&q&f=false
2. https://dgca.nic.in/circular/aac01_2016.pdf

Course Home Page:

FLIGHT SCHEDULING AND OPERATIONS

GROUP - V

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE529	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand complexity and scheduling of airline operation systems.
II. Understand many operational issues involved in handling passengers, freight and aircraft at airports.

UNIT-I	**NETWORK FLOWS AND INTEGER PROGRAMMING MODELS**	**Classes: 08**

Complexity of airline planning, operations and dispatch, need for optimization, role of operations research and simulation; Networks: definitions, network flow models, shortest path problem, minimum cost flow problem, maximum flow problem, multi-commodity problem; Integer programming models, set covering/partitioning problems, travelling salesman problem, mathematical formulation, decision variables, objective function, constraints, methods of solution; Solution by simulation.

UNIT-II	**FLIGHT SCHEDULING, FLEET ASSIGNMENT AND AIRCRAFT ROUTING**	**Classes: 10**

Significance of flight scheduling; The route system of the airlines, point-to-point flights, hub and spoke flights; Schedule construction, operational feasibility, economic viability; Route development and flight scheduling process, load factor and frequency, case study; Purpose of fleet assignment; Fleet types, fleet diversity, fleet availability, performance measures, formulation of the fleet assignment problem, decision variables, objective function, constraints, solution; Goal of aircraft routing, maintenance requirements, other constraints; Routing cycles, route generators; Mathematical models of routing, decision variables, objective functions, alternatives, constraints- flight coverage and aircraft available; Example problems and solutions.

UNIT-III	**CREW AND MANPOWER SCHEDULING**	**Classes: 10**

Crew scheduling process, significance; Development of crew pairing, pairing generators, mathematical formulation of crew pairing problem, methods of solution.

Crew roistering, rostering practices; The crew rostering problem, formulation, solutions; Manpower scheduling, modeling, formulation of the problem, solutions.

UNIT-IV	**GATE ASSIGNMENT AND AIRCRAFT BOARDING STRATEGY, AIRLINE IRREGULAR OPERATION, DISRUPTION OF SCHEDULE AND RECOVERY**	**Classes: 09**

Gate assignment, significance, the problem, levels of handling-passenger flow, distance matrix-mathematical formulation, solution; Common strategies for aircraft boarding process, mathematical model, interferences, model description, aisle interferences; The problem statement, the time band approximation model- formulation of the problem, the scenarios - solution.

UNIT-V	**COMPUTATIONAL COMPLEXITY, CASE STUDIES OF AIRLINE OPERATIONS AND SCHEDULING AND SIMULATION.**	**Classes: 08**

Complexity theory, heuristic procedures; Case studies of airline operation and scheduling, study through simulation modeling, use of available software.

Text Books:

1. Bazargan, M., “Airline Operations and Scheduling”, Ashgate Publishing Ltd, 2nd Edition, 2010.

Reference Books:

1. Belobaba, P., Odoni, A., Barnhart, C. “The Global Airline Industry”, Wiley, 2nd Edition 2009.
2. Wu, Cheng-Lu0ng, “Airline Operations and Delay Management”, Ashgate Publishing Ltd, 2010.
3. Wensveen, J.G., “Air Transportation: A Management Perspective”, Ashgate Publishing Ltd 6th Edition., 2007.
4. Ahuja, R. et al, “Network Flows-Theory, Algorithms and Applications”, Prentice-Hall, 1993.

Web References:

1. https://51.254.215.131/files/airport-operations-book-pdf.pdf
2. https://andromeda.rutgers.edu/~jy380/research/air-schedule/chapter50.pdf

E-Text Books:

1. https://51.254.215.131/files/airport-operations-book-pdf.pdf
2. https://andromeda.rutgers.edu/~jy380/research/air-schedule/chapter50.pdf

Course Home Page:

AIRPORT OPERATIONS

GROUP-V

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE530	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Analyze and understand the complexity and functioning of airport operation systems.
II. Understand many operational issues involved in handling passengers, freight and aircraft at airports.

UNIT-I	THE AIRPORT AS AN OPERATIONAL SYSTEM	Classes: 08

Private airports and public use airports, commercial service airports and primary commercial service airports, general aviation airports, reliever airports; Hub classification, large hubs, medium hubs, small hubs, non-hubs; Components of an airport, airside, landside; Airport as a system, function of the airport-complexity of airport operation; Airport planning: Airport system planning, airport master plan, airport layout plan- forecasting, facilities requirements, design alternatives. Financial plans, land use planning, environmental planning.

UNIT-II	GROUND HANDLING AND BAGGAGE HANDLING	Classes: 10

Ground handling: Passenger handling; Ramp handling; Aircraft ramp servicing; Ramp layout; Departure control; Division of ground handling responsibilities; Control of ground handling efficiency; Baggage handling: Context, history and trends; Baggage handling processes; Equipment, systems and technologies, process and system design drivers; Organization; Management and performance metrics.

UNIT-III	PASSENGER TERMINAL AND CARGO OPERATIONS	Classes: 10

Passenger terminal operations: Functions of the passenger terminal; Terminal functions; Philosophies of terminal management; Direct passenger services; Airline related passenger services; Airline related operational functions; Government requirements; Non-passenger related airport authority functions; processing very important persons; Passenger information systems; Space components and adjacencies.

Aids to circulation; Hubbing considerations; Cargo operations: The cargo market; Expediting the movement; Flow through the terminal; Unit load devices; Handling within the terminal; Cargo apron operation; Facilitation; Examples of modern cargo terminal design and operation; Cargo operations by the integrated carriers.

UNIT-IV	AIRPORT TECHNICAL SERVICES AND ACCESS	Classes: 09

Airport technical services: The scope of technical services; Safety management system; Air traffic control; Tele communications; Meteorology; Aeronautical information; Airport access: Access as part of the airport system; Access users and modal choice; Access interaction with passenger; Access modes; In town and other off; Airport terminals; Factors affecting access; Mode choice.

UNIT-V	OPERATIONAL ADMINISTRATION AND PERFORMANCE	Classes: 08

Operational administration and performance: Strategic context; Tactical approach to administration of airport operations; Managing operational performance; Key success factors for high; Performance;

Airport operations control centres: The concept of airport operations; airport operations control system; The airport operations consideration; Airport performance monitoring; Design and equipment considerations; Organizational and human resources considerations; Leading AOCCSs; Best practices in airport operations.

Text Books:

1. Norman J. Ashford, H. P. Martin Stanton, Clifton A. Moore, Pierre Coutu, "Airport Operations", McGraw Hill, 3rd Edition, 2013.
2. R. Horonjeff, F. X. McKelvey, W. J. Sproule, S. B. Young, "Planning and Design of Airports", McGraw Hill, 5th Edition, 2010.

Reference Books:

1. A. Kazda, R. E. Caves, "Airport Design and Operation", Elsevier, 2nd Edition, 2007.
2. A. T. Wells, S. B. Young, "Airport Planning and Management", McGraw Hill, 6th Edition, 2011.

Web References:

1. https://memberfiles.freewebs.com/94/47/55224794/documents/airport%20planning%20and%20management.pdf
2. https://books.google.co.in/books?id=RYR6cu4YSBcC&dq=Planning%20and%20Design%20of%20Airports&source=gbs_similarbooks

E-Text Books:

1. https://accessengineeringlibrary.com/browse/airport-planning-and-management-sixth-edition
2. https://www.only4engineer.com/2014/10/planning-and-design-of-airports-by.html

Course Home Page:

SPACECRAFT ATTITUDE AND CONTROL

GROUP-VI

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE531	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the representative mission profile and attitude determination and control methods and define the coordinate systems.
II. Demonstrate different attitude kinematics and dynamics of spacecraft and modes of operation of sensors.
III. Discuss Global positioning system, gyroscopes and reaction wheels characteristics, disturbances and configurations.
IV. Illustrate attitude control of spacecraft, different attitude determination methods, problems and errors.

UNIT-I	**INTRODUCTION**	**Classes:04**

Representative mission profile, representative examples of attitude determination and control methods of attitude determination and control, time measurements, the spacecraft-centered celestial sphere, coordinate systems, elementary spherical geometry.

UNIT-II	**ATTITUDE KINEMATICS AND DYNAMICS**	**Classes: 09**

Attitude kinematics, attitude matrix, vector addition of angular velocity, vector kinematics, kinematics of attitude parameterizations, quaternion kinematics, rodrigues parameter kinematics, modified rodrigues parameter kinematics, rotation vector kinematics, Euler angle kinematics, attitude error kinematics, attitude dynamics.

UNIT-III	**SENSORS AND ACTUATORS**	**Classes: 11**

Redundancy, star trackers, modes of operation, field of view, resolution, update rate, proper motion, parallax, and aberration, sun sensors, horizon sensors, magnetometers.

Global positioning system, gyroscopes, reaction wheels, reaction wheel characteristics, disturbances, configurations, control moment gyros, magnetic torquers, thrusters, nutation dampers.

UNIT-IV	**STATIC ATTITUDE DETERMINATION METHODS**	**Classes: 11**

The TRIAD algorithm, Wahba's problem, quaternion solutions of Wahba's problem, matrix solutions of Wahba's problem, error analysis of Wahba's problem, MLE for attitude determination, induced attitude errors from orbit errors, TRMM attitude determination, GPS attitude determination.

UNIT-V	**ATTITUDE CONTROL**	**Classes: 10**

Introduction, attitude control, attitude thruster control, magnetic torque attitude control, effects of noise, SAMPEX control design, attitude determination, magnetic torque control law, science modes, reaction wheel control law, simulations.

Text Books:

1. F. Landis Markley. John L. Crassidis, “Fundamentals of Spacecraft Attitude Determination and Control”, Springer, New York, 2nd Edition 2014.
2. James R. Wertz, “Spacecraft Attitude Determination and Control”, Kluwer Academic Publishers, Dordrecht, 1978.

Reference Books:

1. Anton H. de Ruiter, Christopher Damaren, James R. Forbes, “Spacecraft Dynamics and Control: An Introduction”, John Wiley and Sons, 2013.
2. Marcel J. Sidi, “Spacecraft Dynamics and Control: A Practical Engineering Approach”, Cambridge University Press, 1997.

Web References:

1. link.springer.com/book/10.1007%2F978-94-009-9907-7
2. https://s3.amazonaws.com/suncam/npdocs/211.pdf

E-Text Books:

1. https://books.google.co.in/books?isbn=1493908022
2. https://books.google.co.in/books?isbn=9400999070

Course Home Page:

AUTOMATIC CONTROL OF AIRCRAFT

GROUP-VI

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE532	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the guidance and control of aircraft and explain different augmentation system and concepts.
II. Demonstrate different auto pilot systems, flight path stabilization and Automatic Flare Control.
III. Discuss fly by wire flight control systems and different flight control law design using back stepping algorithm.
IV. Illustrate operating principles and design of guidance laws, Launch Vehicle and Mission requirements.

UNIT-I	**INTRODUCTION**	**Classes: 04**

Introduction to Guidance and control: Definition, historical background.

UNIT-II	**AUGMENTATION SYSTEMS**	**Classes: 07**

Need for automatic flight control systems, stability augmentation systems, control augmentation systems, gain scheduling concepts.

UNIT-III	**LONGITUDINAL AUTOPILOT**	**Classes: 12**

Displacement Autopilot: Pitch orientation control system, acceleration control system, glide slope coupler and automatic flare control.

Flight path stabilization, longitudinal control law design using back stepping algorithm.

UNIT-IV	**LATERAL AUTOPILOT**	**Classes: 10**

Damping of the dutch roll, methods of obtaining coordination, yaw orientation control system, turn compensation, automatic lateral beam guidance.

UNIT-V	**FLY BY WIRE FLIGHT CONTROL**	**Classes: 12**

Introduction to Fly-by-wire flight control systems, fly-by-wire flight control features and advantages, control laws, redundancy and failure survival, digital implementation, fly-by-light flight control.

Text Books:

1. Blake Lock, J.H, "Automatic control of Aircraft and missiles", John Wiley Sons, New York, 1990.
2. Stevens B.L & Lewis F.L, "Aircraft control & simulation", John Wiley Sons, New York, 1992.
3. Collinson R.P.G, "Introduction to Avionics", Chapman and Hall, 1st Edition India, 1996.

Reference Books:

1. Garnel.P. & East. D.J, “Guided Weapon control systems”, Pergamon Press, Oxford, 1st Edition 1977.
2. Bernad Etikin, “Dynamic of flight stability and control”, John Wiley, 1st Edition 1972.
3. Nelson R.C, “Flight stability & Automatic Control”, McGraw Hill, 1st Edition 1989.

Web References:

1. https://ocw.mit.edu/courses/aeronautics-and-astronautics/16...aircraft.../lecture-16
2. www.fsd.mw.tum.de/research/flight-control/
3. nptel.ac.in/courses/101108056/

E-Text Books:

1. https://books.google.co.in/books?isbn=1118870972
2. https://books.google.co.in/books?isbn=0387007261

Course Home Page:

FLIGHT SIMULATION

GROUP-VI

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE533	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Illustrate the history of flight simulation, role of simulation, aerodynamic models with examples.
II. Understand the principle of modeling and simulation of flight control systems, different equations of aircraft system.
III. Describe the dynamics of aircraft and model validation, the atmospheric conditions and different axis systems of aircraft
IV. Define various model validation and visual systems, visual database management, projection systems, problems in visual systems.

UNIT-I	INTRODUCTION	Classes: 10

Historical Perspective, the first 40 years of flight 1905–1945,analogue computing, 1945–1965, digital computing 1965–1985, the microelectronics revolution, 1985 present, the case for simulation, safety, financial benefits, training transfer, engineering flight simulation, the changing role of simulation, the organization of a flight simulator, equations of motion, aerodynamic model, engine model, data acquisition, gear model, weather model, visual system, sound system, motion system, control loading, instrument displays, navigation systems, maintenance, the concept of real-time simulation, pilot cues, visual cueing, motion cueing, training versus simulation, examples of simulation, commercial flight training, military flight training, Ab initio flight training, land vehicle simulators, engineering flight simulators aptitude testing, computer-based training, maintenance training.

UNIT-II	PRINCIPLES OF MODELLING	Classes: 10

Modelling concepts, Newtonian mechanics, axes systems, differential equations, numerical integration, approximation methods, first order methods, higher order methods, real-time computing, data acquisition, data transmission, data acquisition, flight data, interpolation, distributed systems, a real-time protocol, and problems in modelling.

UNIT-III	AIRCRAFT DYNAMICS	Classes: 09

Principles of flight modelling, the atmosphere, forces, aerodynamic lift, aerodynamic side force, aerodynamic drag, propulsive forces, gravitational force, moments, static stability, aerodynamic moments, aerodynamic derivatives, axes systems, the body frame, stability axes, wind axes, inertial axes, transformation between axes.

Earth-centred earth-fixed frame, latitude and longitude, quaternions, equations of motion; Propulsion, piston engines, jet engines, the landing gear, the equations collected; The equations revisited: Long range navigation, coriolis acceleration.

UNIT-IV	SIMULATION OF FLIGHT CONTROL SYSTEMS	Classes: 08
The Laplace transform, simulation of transfer functions; Proportional–integral–derivative control systems, trimming, aircraft flight control systems, the turn coordinator and the yaw damper, the auto-throttle, vertical speed management, altitude hold, heading hold, localizer tracking, auto-land systems, flight management systems.		
UNIT-V	**MODEL VALIDATION AND VISUAL SYSTEMS**	**Classes: 08**
Simulator qualification and approval, model validation methods, cockpit geometry, open-loop tests, closed-loop tests, latency, performance analysis, longitudinal dynamics, lateral dynamics, model validation in perspective; Visual systems: Background, the visual system pipeline, graphics operations, real-time image generation, a rudimentary real time wire frame image generation system, an open GL real-time image generation system, an open GL real-time textured image generation system, an open scene graph image generation system, visual database management, projection systems, problems in visual systems.		

Text Books:

1. David Allerton, "Principles of Flight simulation" John Wiley & Sons, Ltd Publication, 1st Edition 1999.
2. M. J Rycroft, "Flight simulation", Cambridge university press, 1st Edition, 1999.
3. J. M. Rolfe, K. J. Staples "Flight simulation", Cambridge University press, 1st Edition, 1987.
4. Jeffrey Strickland, "Missile Flight Simulation", Lulu press, Inc, 2nd Edition, 2012.
5. Jonathan M. Stern "Microsoft Flight Simulator Handbook" Brady Publishing, 1st Edition, 1995.

Reference Books:

1. Ranjan Vepa, "Flight Dynamics, Simulation, and Control: For Rigid and Flexible Aircraft",
2. CRC press, 1st Edition, 2014.
3. Duane Mc Ruer, Irving Ashkenas, Dunstan Graham "Aircraft Dynamics and Automatic Control" Princeton University Press, 2nd Edition, 2014.
4. Brian L. Stevens, Frank L. Lewis, "Aircraft Control and Simulation", John Wiley & Sons Ltd Publication, 2nd Edition, 2003.

Web References:

1. https://www.doc.ic.ac.uk/~nd/surprise_96/journal/vol1/kwc2/article1.html
2. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.132.5428&rep=rep1&type=pdf
3. https://research.omicsgroup.org/index.php/Flight_simulator
4. https://as.wiley.com/WileyCDA/WileyTitle/productCd-0471371459.html

E-Text Books:

1. https://www.aeronautics.nasa.gov/pdf/principles_of_flight_in_action_9_12.pdf
2. https://helijah.free.fr/dev/Principles-of-Flight-Simulation.pdf
3. https://leseprobe.buch.de/images-adb/ee/49/ee495ffc-8dc1-4a07-ad7b-b18540b9fb60.pdf
4. https://samples.sainsburysebooks.co.uk/9780470682197_sample_388478.pdf

Course Home Page:

ORBITAL MECHANICS

GROUP-VI

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE534	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Impart the knowledge in two-body, restricted three-body and n-body problem, Hamiltonian dynamics, canonical transformations, Poincare surface sections.
II. Offer a rigorous vector analysis of rotational kinematics, Review of the basic Newtonian dynamics and Analysis of spacecraft altitude dynamics.
III. Provide necessary knowledge to study the satellite and interplanetary trajectories and Formal approaches for handling coordinate transformations.
IV. Solve the orbital problems related to Earth satellite orbits using Hamilton's and generate interplanetary orbits in the frame work of restricted three-body problem.
V. Understand the rendezvous problems in orbitsal transfer problems, to provide the knowledge about link between two spacecrafts.

UNIT-I	INTRODUCTION TO ORBITAL MECHANICS	Classes: 10

Fundamental principles and definitions, problem of two bodies, Kepler's equation; Equation of motion in inertial frame, equations of relative motion, angular momentum and the orbit formulas; Central orbits, circular orbits, elliptical orbits.

UNIT-II	ORBITAL POSITION AND ORBITS IN THREE DIMENSIONS	Classes: 10

Time since periapsis, parabolic trajectories, hyperbolic trajectories, geocentric right ascension-declination frame, state vector and the geocentric equatorial frame, orbital elements and the state vector; Coordinate transformation, transformation between geocentric equatorial and perifocal frames; Effects of the Earth's oblateness.

UNIT-III	PRELIMAMINARY ORBIT DETERMINATION	Classes: 09

Gibbs method of orbit determination from three position Lambert's problem, sidereal time top centric coordinate system, top centric equatorial coordinate system, top centric horizon coordinate system.

Orbit determination from angle and range measurements angles only, preliminary orbit determination; Gauss method of preliminary orbit determination.

UNIT-IV	ORBITAL MANEUVERS	Classes: 08

Kepler's equation and Lambert's theorem, force model, fundamentals of perturbation theory, perturbation in the elements, Lagrange's and Hamilton's equations, the method of canonical transformations, the general integrals of the problem of n-bodies, the problem of three bodies, restricted three-body problem, periodic and quasi-periodic orbits, Poincare surface sections.

UNIT-V	RELATIVE MOTION AND RENDEZVOUS	Classes: 08

Approximations to Relative motion in orbit Linearization of the equations of relative motion in orbit Clohessy-Wiltshire equations two-impulse rendezvous maneuvers Relative motion in close-proximity circular orbits.

Text Books:

1. Curtis, Howard D., "Orbital Mechanics for Engineering Students", Butterworth Heinemann, Elsevier series, 3rd Edition, 2010.
2. Bate, Roger R.; Mueller, Donald D.; White, Jerry E. "Fundamentals of Astrodynamics". Dover Publications, 1st Edition 1971.

Reference Books:

1. Sellers, Jerry J.; Astore, William J.; Giffen, Robert B.; Larson, Wiley J. Kirkpatrick, Douglas H., ed. "Understanding Space An Introduction to Astronautics", McGraw Hill, 2nd Edition,2004.
2. Bryson, A.E., "Control of Aircraft and Spacecraft." Princeton University Press, 1994.
3. Thomson, William T. "Introduction to Space Dynamics." New York: Wiley. 3rd Edition, 1963.

Web References:

1. https://soaneemrana.org/onewebmedia/INTRODUCTION%20TO%20SPACE%20DYNAMICS1
2. https://projectehermes.upc.edu/Enginyeria_Aeroespacial/4A/Enginyeria%20espacial/Teoria/Extra/Orbital%20Mechanics%20for%20Engineering%20Students.pdf

E-Text Books:

1. https://store.doverpublications.com/0486651134.html
2. https://worldcat.org/title/introduction-to-space-dynamics/oclc/867680515

Course Home Page:

SPACE DYNAMICS

GROUP-VI

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE535	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Impart the knowledge in two-body, restricted three-body and n-body problem, Hamiltonian dynamics, canonical transformations, poincare surface sections.
II. Illustrate the importance of vector analysis of rotational kinematics, review of the basic newtonian dynamics and analysis of spacecraft altitude dynamics.
III. Understand and gain the knowledge to study the satellite and interplanetary trajectories and formal approaches for handling coordinate transformations.
IV. Analyze and solve the space dynamic problems related to earth satellite orbits using Hamilton's and generate interplanetary orbits in the frame work of restricted three-body problem.

UNIT-I	**INTRODUCTION TO SPACE DYNAMICS**	**Classes: 10**

Basic concepts: Atmospheric and space flight basic definitions, vector operations; Coordinate systems and rotation matrix, Euler axis and principal angle, Euler angles, Euler symmetric parameters (Quaternion), Rodriguez parameters, attitude kinematics.

UNIT-II	**FUNDAMENTALS OF SPACE FLIGHT**	**Classes: 10**

Newton's law of gravitation, gravitational potential, escapes velocity, mechanics of circular orbits and circular velocity non circular orbits; The two body problem, derivation of Kepler's laws from Newton's law.

UNIT-III	**SPACE FLIGHT ORBITS AND ATMOSPHERE ENTRY**	**Classes: 09**

Orbit equation, space vehicle trajectories, transfer orbit changes.

Introduction to earth and planetary entry, equations of motion for atmosphere entry; Application to ballistic entry, case study.

UNIT-IV	**ORBIT TRANSFER**	**Classes: 08**

Coplanar transfer, Hohmann transfer and Bielliptic transfer; Orbital change due to impulsive thrust; Noncoplanar transfer; Interception and Rendezvous, continuous thrust transfer.

UNIT-V	**ATTITUDE DYNAMICS**	**Classes: 08**

Euler Equations of rotational motion, rotational kinetic energy; Principal body frame, torque free rotation of spacecraft, spacecraft with attitude thrusters, spacecraft with rotors, gravity gradient satellite, dual spin satellite.

Text Books:

1. Ashish Tewari, "Atmospheric and space flight dynamics" Birkhauser publications, 1st Edition, 2007
2. Vallado, David A., "Fundamentals of Astrodynamics and Applications", Kluwer Academic Publishers, London, 3rd Edition, 2007.

Reference Books:

1. Roy, Archie E., "The Foundation of Astrodynamics", The Macmillan Company, Collier Macmillan Limited, London, 3rd Edition, 2007.
2. Kaplan, Marshall H., "Modern Spacecraft Dynamics and Control", John Wiley & Sons, New York, 1st Edition, 1976.

Web References:

1. https://soaneemrana.org/onewebmedia/INTRODUCTION%20TO%20SPACE%20DYNAMICS1
2. https://nptel.ac.in/courses/101105030/

E-Text Books:

1. https://store.doverpublications.com/0486651134.html
2. https://worldcat.org/title/introduction-to-space-dynamics/oclc/867680515

Course Home Page:

ATMOSPHERIC RE-ENTRY VEHICLE

GROUP-VI

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE536	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Discuss the fundamental aspects of Re-entry.
II. Understand the major theories, approaches and methodologies used in Re-entry.
III. Analyze to build up the skills in the actual implementation of Re-entry mechanism using MATLAB/C++ code.
IV. Demonstrate the applications of Re-entry for interplanetary missions.
V. Understand basic thoughts and philosophy associated with different types of Re-entry.

UNIT-I	**INTRODUCTION TO RE-ENTRY AND ATMOSPHERIC MODEL**	**Classes: 10**

What is Re-entry? Background, meteorites-nature's re-entry, artifacts-manmade re-entry, standard atmospheres, atmospheric description, physical foundations of an atmospheric model, derived atmospheric quantities, exponential atmosphere, planetary atmospheres.

UNIT-II	**AXIS TRANSFORMATIONS, FORCE AND MOMENT EQUATIONS**	**Classes:09**

Directional cosine matrix, updating the DCM, Euler angles, updating Euler angles, axis/angle Parameters, updating the axis/angle parameters, Euler four-parameter method (Quaternions), Newton's second law of motion, force and moment equations, calculation of the moments and products of inertia.

UNIT-III	**FLOW FIELD DESCRIPTION, RE-ENTRY VEHICLE PARTICLE MECHANICS, DECOYS AND THE IDENTIFICATION OF RE-ENTRY VEHICLES**	**Classes: 10**

Introduction, flow field determination, fluid flow governing equations, definition of fluid: Microscopic and macroscopic structure of gases, flow regimes, free molecular flow, continuum flow.

Hypersonic Flow, impact methods, transition flow re-entry physics, equations of planar motion, re-entry case studies, some non dimensional representations, heat transfer and dynamics, estimators, decoy effectiveness.

UNIT-IV	**MANEUVERING RE-ENTRY VEHICLES: PARTICLE MOTION**	**Classes: 08**

Introduction, drag polar, MARV state equations, dive line guidance, determining the projected interception point, interceptor guidance equations, interceptor state equations, other guidance laws.

UNIT-V	**ANGULAR MOTION DURING RE-ENTRY**	**Classes: 08**

Introduction, planar motion, static stability, phugoid and spiral motion, aerodynamic force and moments in a body frame, rolling moment, pitching moment equations in an exponential atmosphere.

Text Books:

1. Regan, Frank J. "Dynamics of Atmospheric Re-entry". AIAA, 1993.
2. Hankey, Wilbur L. "Re-entry Aerodynamics". AIAA, 1988.

Reference Books:

1. Vk Harrison, H. Ron. "Atmospheric and Space Flight Dynamics: Modeling and Simulation with MATLAB and Simulink" TewariA. Birkhauser Verlag, Viaduktstrasse 42, CH-4051 Basel, Switzerland, 1st Edition, 2007.

Web References:

1. www.amazon.com/Re-Entry-Making-Transition-Missions/dp/0927545403
2. www.amazon.com/Reentry-Team-Caring-Returning-Missionaries/dp/1880185075/ref=pd_sim_14_3?_encoding=UTF8&psc=1&refRID=H4C5H050A6E0PYN3X4NQ

E-Text Books:

1. www.arc.aiaa.org/doi/abs/10.2514/8.9476?journalCode=jasps
2. www.arc.aiaa.org/doi/abs/10.2514/5.9781600862342.0081.0142
3. www.arc.aiaa.org/action/doSearch?AllField=re-entry+aerodynamics

Course Home Page:

ELEMENTS OF MECHANICAL ENGINEERING

VI Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AME551	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Familiarize with fundamentals of mechanical systems.
II. Understand and appreciate the significance of mechanical engineering in different fields of engineering.
III. Understanding of application and usage of various engineering materials.

UNIT-I	INTRODUCTION TO ENERGY SYSTEMS	Classes: 09

Introduction: Prime movers and its types, concept of force, pressure, energy, work, power, system, heat, temperature, specific heat capacity, change of state, path, process, cycle, internal energy, enthalpy, statement of zeroth law and first law; Energy: Introduction and application, of energy sources like fossil fuels, nuclear fuels, hydels, solar, wind, and bio-fuels, environment issues like global warming and ozone depletion; Properties of gases: Gas laws, Boyle's law, Charle's law, gas constant, relation between C_p and C_v, various non flow processes like constant volume processes, constant pressure process, isothermal process, adiabatic process, poly-tropic process.

UNIT-II	STEAM TURBINES, HYDRAULIC MACHINES	Classes: 09

Properties of steam: Steam formation, types of steam enthalpy, specific volume, internal volume, internal energy and dryness fraction of steam, use of steam tables, calorimeters; Heat engine: Heat engine cycle and heat engine, working substances, classification of heat engines, description and thermal efficiency of carnot, Rankine, otto cycle, diesel cycles; Steam boilers: Introduction, cochran, lancashire, babcock, and Wilcox boiler, functioning of different mountings and accessories.

UNIT-III	INTERNAL COMBSUTION ENGINES, REFRIGERATION AND AIR-CONDITIONING	Classes: 09

Internal combustion engines: Introduction, classification, engine details, four stroke, two stroke cycle, petrol engine, diesel engine, indicated power, brake power, efficiencies; Pumps: Types, operation of reciprocating. rotary, centrifugal pumps, priming.

Air compressors: Types, operation of reciprocating, rotary air compressors, significance of multi-staging; Refrigeration and air-conditioning: Refrigerant, vapor compression refrigeration system, vapor absorption refrigeration system, domestic refrigerator, window and split air conditioners.

UNIT-IV	MACHINE TOOLS AND AUTOMATION	Classes: 09

Machine tools and automation machine tools operation: Turning, facing , knurling, thread cutting, taper turning by swiveling the compound rest, drilling, boring, reaming, tapping, counter sinking, counter boring, plane milling, end milling, slot milling; Robotic and automation: Introduction, classification based on robot configuration, polar, cylindrical, cartesian, coordinate and spherical, application, advantages and advantages; Automation: Definition, types, fixed, programmable and flexible automation, NC/CNC machines, basic elements with simple block diagrams, advantages and disadvantages.

UNIT-V	ENGINEERING MATERIALS, JOINING PROCESS	Classes: 09
Engineering materials and joining processes: Types, applications of ferrous metals, non-ferrous metals, alloys; Composites: Introduction, definition, classification and application (Automobile and Air Craft).		
Text Books:		
1. V. K. Manglik, "Elements of Mechanical Engineering", Prentice Hall, 1st Edition, 2013. 2. Mikell P. Groover, "Automation, Production Systems and CIM", Prentice Hall, 4th Edition, 2015.		
Reference Books:		
1. S. Trymbaka Murthy, "A Text Book of Elements of Mechanical Engineering", University Press, 4th Edition, 2006. 2. K. P. Roy, S. K. Hajra Choudary, Nirjhar Roy, " Element of Mechanical Engineering", Media Promoters & Publishers, 7th Edition, 2012. 3. Pravin Kumar, "Basic Mechanical Engineering", Pearson, 1st Edition, 2013.		
Web References:		
1. http://www.nptel.ac.in/courses/112107144/ 2. *http://www*.nptel.ac.in/courses/112101098/download/lecture-37.pdf		
E-Text Books:		
1. www.wiley-vch.de/vch/journals/2081/books/2081_rel_title_varadan.pdfM 2. www.ebooks.cawok.pro/Artech.House.Publishers.An.Introduction.to.Microelectrical.pdf		
Course Home Page:		

DISASTER MANAGEMENT

VI Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACE551	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Identify the major disaster types and develop an understanding of modern disaster management.
II. Recognize and develop awareness of the chronological phases of natural disaster response and refugee relief operations.
III. Understand the key concepts of disaster management related to development and the relationship of different disaster management activities.
IV. Categorize the organizations that are involved in natural disaster assistance and relief system.

UNIT-I	ENVIRONMENTAL HAZARDS AND DISASTERS	Classes: 09

Environmental hazards and disasters: meaning of environmental hazards, environmental disasters and environmental stress; concept of environmental hazards, environmental stress and environmental disasters, different approaches and relation with human ecology, landscape approach, ecosystem approach, perception approach, human ecology and its application in geographical researches.

UNIT-II	TYPES OF ENVIRONMENTAL HAZARDS AND DISASTERS	Classes: 09

Types of environmental hazards and disasters: Natural hazards and disasters, man induced hazards and disasters, natural hazards, planetary hazards/ disasters, extra planetary hazards/ disasters, planetary hazards, endogenous hazards, exogenous hazards.

UNIT-III	ENDOGENOUS HAZARDS	Classes: 09

Endogenous hazards, volcanic eruption, earthquakes, landslides, volcanic hazards/ disasters, causes and distribution of volcanoes, hazardous effects of volcanic eruptions, environmental impacts of volcanic eruptions.

Earthquake hazards/ disasters, causes of earthquakes, distribution of earthquakes, hazardous effects of, earthquakes, earthquake hazards in India, human adjustment, perception and mitigation of earthquake.

UNIT-IV	EXOGENOUS HAZARDS	Classes: 09

Exogenous hazards/ disasters, infrequent events, cumulative atmospheric hazards/ disasters; Infrequent events: Cyclones , lightning , hailstorms; Cyclones: Tropical cyclones and local storms, destruction by tropical cyclones and local storms (causes, distribution human adjustment, perception and mitigation); Cumulative atmospheric hazards/ disasters: Floods, droughts, cold waves, heat waves floods; Causes of floods, flood hazards India, flood control measures (human adjustment, perception and mitigation); Droughts: Impacts of droughts, drought hazards in India, drought control measures, extra planetary hazards/ disasters, man induced hazards /disasters, physical hazards/ disasters, soil erosion, Soil erosion: Mechanics and forms of soil erosion, factors and causes of soil erosion, conservation measures of soil erosion; Chemical hazards/ disasters: Release of toxic chemicals, nuclear explosion, sedimentation processes; Sedimentation processes: Global sedimentation problems regional sedimentation problems, sedimentation and environmental problems, corrective measures of erosion and sedimentation, biological hazards/ disasters, population explosion.

UNIT-V	EMERGING APPROACHES IN DISASTER MANAGEMENT	Classes: 09

Emerging approaches in Disaster Management, Three Stages

1. Pre, disaster stage (preparedness)
2. Emergency Stage
3. Post Disaster stage, Rehabilitation.

Text Books:

1. Pardeep Sahni, "Disaster Mitigation: Experiences and Reflections", PHI Learning Pvt. Ltd., 1st Edition, 2001.
2. J. Glynn, Gary W. Hein Ke, "Environmental Science and Engineering", Prentice Hall Publishers, 2nd Edition, 1996.

Reference Books:

1. R.B.Singh (Ed), "Environmental Geography", 2nd Edition, 1990.
2. R.B. Singh (Ed), "Disaster Management", 2nd Edition, 2006.

Web References:

1. https://www.google.co.in/?gfe_rd=cr&ei=,iAwWLiDIazv8we8_5LADA#q=disater+mangement
2. http://ndma.gov.in/images/policyplan/dmplan/National%20Disaster%20Management%20Plan%20May%202016.pdf
3. http://www.eib.europa.eu/attachments/pipeline/20080021_eia_en.pdf
4. http://www.ndmindia.nic.in/

E-Text Books:

1. https://www.google.co.in/?gfe_rd=cr&ei=,iAwWLiDIazv8we8_5LADA#q=disaster+management+e+textbooks
2. http://cbse.nic.in/natural%20hazards%20&%20disaster%20management.pdf\
3. http://www.digitalbookindex.org/_search/search010emergencydisastera.asp
4. http://www.icbse.com/books/cbse,ebooks,download

Course Home Page:

GEOSPATIAL TECHNIQUES

VI SEMESTER: Common for all branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACE552	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Apply the technical skills to use geo-referenced data for the purpose of economic, educational, and social development.
II. Apply descriptive and analytical knowledge about map reading, statistics, and geospatial technologies.
III. Integrate the domains of geography and apply their knowledge to issues concerning people, places, and environments.
IV. Describe**,** analyze, and explain the patterns, processes, and interactions of human and physical phenomena on Earth's surface.

UNIT-I	INTRODUCTION TO GEOSPATIAL DATA	Classes: 09

Introduction geospatial data, why to study geospatial data, importance of geospatial technology, spatial data infrastructure, three important geospatial technologies, spatial elements, coordinates and coordinate systems, basic electromagnetic radiation.

UNIT-II	PHOTOGRAMMETRY AND REMOTE SENSING	Classes: 09

Definition and scope, history of photogrammetry and remote sensing, principle, remote sensing data acquisition, remote sensing data analysis methods, advantages and limitations, hardware and software required; Map vs mosaic, ground control points; Energy interactions with atmosphere and earth surface features.

UNIT-III	MAPPING AND CARTOGRAPHY	Classes: 09

What is map and its importance, map scale and types, elements of map and indexing, map coordinate systems, visual interpretation of satellite images, interpretation of terrain evaluation.

Introduction to digital data analysis, cartographic symbolization, classification of symbols, colours in cartography, scale and purpose of a map, cartographic design, thematic cartography, digital cartography.

UNIT-IV	GEOGRAPHIC INFORMATION SYSTEM	Classes: 09

Introduction to GIS, definition and terminology, GIS categories, components of GIS, fundamental operations of GIS, a theoretical framework for GIS, GIS data structures, data collection and input overview, processing of spatial data, data input or output, vector data model, raster data model, geometric representation of spatial feature and data structure; Spatial data and modeling, tin, DTM, overlay, spatial measurement etc.

UNIT-V	GEOSPATIAL TECHNOLOGIES APPLICATIONS	Classes: 09

Visual image analysis for land use/land cover mapping, land use and land cover in water resources, surface water mapping and inventory, geological and soil mapping, agriculture applications for forestry applications, water resources applications, urban and regional planning, environmental assessment, principles of land form identification and evaluation: sedimentary, igneous and metamorphic rock terrain.

Text Books:

1. John D. Bossler, Taylor, Francis, "Manual of Geospatial Science and Technology", CRC Press, 2010.
2. M. Anji Reddy, "Textbook of Remote Sensing and Geographical Information Systems", BS Publication, 2001.

Reference Books:

1. C. P. Lo Albert, K.W. Yonng, "Concepts and Techniques of GIS", 2nd Edition, 2007.
2. Otto Huisman and Rolf A. de "Principles of Geographic Information Systems", 4th Edition, 2009

Web References:

1. https://www.aaas.org/content/what-are-geospatial-technologies
2. http://www.istl.org/10-spring/internet2.htmls
3. https://geography.columbian.gwu.edu/applied-geospatial-techniques
4. http://kiran.nic.in/pdf/publications/Geospatial_Techniques.pdf

E-Text Books:

1. http://link.springer.com/book/10.1007%2F978-94-007-1858-6
2. http://www.springer.com/us/book/9789400718579
3. http://cbseacademic.in/web_material/doc/2014/7_Geospatial%20Technology%20Text%20Book%20(Class-XII).pdf
4. http://freegeographytools.com/2009/two-free-textbooks-on-geospatialgeostatistical-analysis.

Course Home Page:

PRINCIPLES OF OPERATING SYSTEMS

VI Semester: Common for all Braches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACS551	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the functionalities of main components in operating systems.
II. Analyze the algorithms used in memory and process management.
III. Understand the clock synchronization protocols.
IV. Interpret the concepts of input and output storage for file management.

UNIT-I	INTRODUCTION	Classes: 10

Operating systems objectives and functions: Computer system architecture, operating systems structure, operating systems operations; Evolution of operating systems: Simple batch, multi programmed, time shared, real time systems, operating system services; Systems calls: Types of systems calls.

UNIT-II	PROCESS AND CPU SCHEDULING, PROCESS COORDINATION	Classes: 10

Process concepts: The process, process state, process control block, threads; process scheduling: Scheduling queues, schedulers, context switch, preemptive scheduling, dispatcher, scheduling criteria, scheduling algorithms, Process synchronization, the critical section problem; semaphores and monitors.

UNIT-III	MEMORY MANAGEMENT AND VIRTUAL MEMORY	Classes: 08

Logical and physical address space: Swapping, contiguous memory allocation, paging, structure of page table.

Segmentation: Segmentation with paging, virtual memory, demand paging; Page replacement, page replacement algorithms, thrashing.

UNIT-IV	FILE SYSTEM INTERFACE	Classes: 09

The concept of a file, access methods, directory structure, file system mounting, file sharing, protection, file system structure, file system implementation, allocation methods, free space management, directory implementation.

UNIT-V	DEADLOCKS, PROTECTION	Classes: 08

System model: Deadlock characterization, methods of handling deadlocks, deadlock prevention, dead lock avoidance, dead lock detection, principles of protection, domain of protection, access matrix, implementation of access matrix.

Text Books:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Principles", Wiley Student Edition, 8th Edition, 2010.
2. William Stallings, "Operating System- Internals and Design Principles", Pearson Education, 6th Edition, 2002.

Reference Books:

1. Andrew S Tanenbaum, "Modern Operating Systems", PHI, 3rd Edition, 2007.
2. D. M. Dhamdhere, "Operating Systems a Concept based Approach", Tata McGraw Hill, 2nd Edition, 2006.

Web References:

1. https://www.smartzworld.com/notes/operatingsystems
2. https://www.scoopworld.in
3. https://www.sxecw.edu.in
4. https://www.technofest2u.blogspot.com

E-Text Books:

1. https://it325blog.files.wordpress.com/2012/09/operating-system-concepts-7-th-edition.pdf
2. http://mpathinveco.blog.com/2014/11/25/operating-systems-william-stalling-6th-edition/
3. http://www.e-booksdirectory.com/details.php?ebook=10050
4. http://www.e-booksdirectory.com/details.php?ebook=9907
5. http://www.e-booksdirectory.com/details.php?ebook=9460

Course Home Page:

JAVA PROGRAMMING

VI Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACS552	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand fundamentals of object-oriented terminology and programming concepts in java.
II. Acquire basics of how to translate solution problem into object oriented form.
III. Develop programs in java for solving simple applications.
IV. Design and implement simple program that use exceptions and multithreads.

UNIT-I	**OOP CONCEPTS AND JAVA PROGRAMMING**	**Classes: 08**

OOP concepts: Classes and objects, data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism, constructors, methods, data types, variables, constants, scope and life time of variables, operators, operator hierarchy, expressions, type conversion and casting, enumerated types, control flow statements, arrays, parameter passing.

UNIT-II	**INHERITANCE**	**Classes: 10**

Inheritance: Inheritance hierarchies, super and subclasses, member access rules, Polymorphism**:** Dynamic binding, method overriding, abstract classes and methods.

UNIT-III	**EXCEPTION HANDLING AND MULTI THREADING**	**Classes: 08**

Exception Handling: Benefits of exception handling, the classification of exceptions, usage of try, catch, throw, throws and finally.

Multithreading: Differences between multiple processes and multiple threads, thread states, creating threads, interrupting threads.

UNIT-IV	**INTERFACES AND PACKAGES**	**Classes: 09**

Interface: Interfaces vs Abstract classes, defining an interface, implement interfaces, Packages: Defining, creating and accessing a package, importing packages.

UNIT-V	**FILES, AND CONNECTING TO DATABASE**	**Classes: 10**

Files: streams – byte streams, character stream, text input/output, binary input/output, file management; Connecting to Database: Connecting to a database, querying a database and processing the results, updating data with JDBC.

Text Books:

1. Herbert Schildt, Dale Skrien, "Java Fundamentals – A Comprehensive Introduction", McGraw-Hill, 1st Edition, 2013.
2. Herbert Schildt, "Java the Complete Reference", McGraw Hill, Osborne, 8thEditon, 2011.
3. T. Budd, "Understanding Object-Oriented Programming with Java", Pearson Education, Updated Edition (New Java 2 Coverage), 1999.

Reference Books:

1. P. J. Deitel, H. M. Deitel, "Java: How to Program", Prentice Hall, 6th Edition, 2005.
2. P. Radha Krishna, "Object Oriented Programming through Java", Universities Press, CRC Press, 2007.
3. Bruce Eckel, "Thinking in Java", Prentice Hall, 4th Edition, 2006.
4. Sachin Malhotra, Saurabh Chaudhary, "Programming in Java", Oxford University Press, 2nd Edition, 2014.

Web References:

1. http://www.javatpoint.com/java-tutorial
2. http://www.javatutorialpoint.com/introduction-to-java/

E-Text Books:

1.http://bookboon.com/en/java-programming-language-ebooks
2.https://en.wikibooks.org/wiki/Java_Programming

Course Home Page:

EMBEDDED SYSTEM DESIGN

VI SEMESTER: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEC551	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: 0	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Imbibe knowledge about the basic functions, structure, concepts and applications of Embedded Systems.
II. Understand Real time operating system concepts.
III. Analyze different tools for development of embedded software.
IV. Understand the architecture of advanced processors.

UNIT-I	EMBEDDED COMPUTING	Classes: 09

Definition of embedded system, embedded systems vs. general computing systems, history of embedded systems, complex systems and microprocessor, classification, major application areas, the embedded system design process, , formalisms for system design, design examples

UNIT-II	THE 8051 ARCHITECTURE	Classes: 09

Introduction, 8051 Micro controller Hardware, Input/output Ports and Circuits, External Memory, Counter and Timers, Serial data Input/output, Interrupts. The Assembly Language Programming Process, Instructions of 8051 Programming Tools and Techniques, Simple Programs.

UNIT-III	INTRODUCTION TO EMBEDDED C AND APPLICATIONS	Classes: 09

Embedded systems programming in C, binding and running embedded C program in Keil IDE, dissecting the program, building the hardware;

Basic techniques for reading and writing from I/O port pins, LED interfacing, interfacing with keyboards, displays, D/A and A/D conversions, using embedded C interfacing

UNIT-IV	INTRODUCTION TO REAL – TIME OPERATING SYSTEMS	Classes: 09

Tasks and Task States, Semaphores, and Shared Data; Message Queues, Mailboxes and Pipes, Timer Functions, Events, Semaphores and Queues, Hard Real-Time Scheduling Considerations, Interrupt Routines in an RTOS Environment. Embedded Software Development Tools: Host and Target machines, Linker/Locators for Embedded Software, Getting Embedded Software into the Target System; Debugging Techniques: Testing on Host Machine

UNIT-V	INTRODUCTION TO ADVANCED ARCHITECTURES	Classes: 09

ARM and SHARC, Processor and memory organization and Instruction level parallelism; Networked embedded systems: Bus protocols, I2C bus and CAN bus.

Text Books:

1. Wayne Wolf, “Principles of Embedded Computing System Design”, Elseveir., 2nd Edition 2014,

2. Kenneth J.Ayala, “The 8051 Microcontroller”, Thomson, 3rd Edition 2016,.
3. Dr. K V K K Prasad, “Embedded / Real-Time Systems : Concepts, Design And Programming”, Black Book , DreamTech Press, ISBN: 9788177224610

Reference Books:

1. Embedding system building blocks, Labrosse, via CMP publishers.
2. Embedded Systems, Raj Kamal, TMH.
3. Micro Controllers, Ajay V Deshmukhi, TMH.
4. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley
5. Microcontrollers, Raj kamal, Pearson Education.
6. An Embedded Software Primer, David E. Simon, Pearson Education.
7. 8051 Microcontroller and Embedded Systems, by Muhammad Ali Mazadi,Janice Mazidi,Janice Gillispie Mazdi

Web References:

1. https://www.smartzworld.com/notes/embedded-systems-es/
2. http://notes.specworld.in/embedded-systems-es/
3. http://education.uandistar.net/jntu-study-materials
4. http://www.nptelvideos.in/2012/11/embedded-systems.html

E-Text Books:

1. https://www.scribd.com/doc/233633895/Intro-to-Embedded-Systems-by-Shibu-Kv
2. http://www.ee.eng.cmu.ac.th/~demo/think/_DXJSq9r3TvL.pdf
3. https://www.scribd.com/doc/55232437/Embedded-Systems-Raj-Kamal
4. https://docs.google.com/file/d/0B6Cytl4eS_ahUS1LTkVXb1hxa00/edit
5. http://www.ecpe.nu.ac.th/ponpisut/22323006-Embedded-c-Tutorial-8051.pdf

INTRODUCTION TO AUTOMOBILE ENGINEERING

VI Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AME552	Elective	3	-	-	3	30	70	100
Contact Classes:45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the function of various parts of automobile, features of fuel supply systems for S.I and C.I engines.
II. Distinguish the features of various types of cooling, ignition and electrical systems.
III. Identify the merits and demerits of the various transmission and suspension systems.
IV. Recognize the working of various braking and steering systems.
V. Summarize the ways and means of reducing the emissions from automobiles.

UNIT-I	INTRODUCTION	Classes: 09

Introduction to automobile engineering, chassis and automobile components, automobile engines, otto cycle, diesel cycle, dual cycle, engine lubrication, lubricating oil, lubrication oil filter, engine servicing; Fuel supply system; Fuel tank, strainer, feed pump, fuel filter, injection pump, injector, filters, electronic controlled fuel injection, common rail direct injection systems.

UNIT-II	COOLING SYSTEM	Classes: 09

Cooling requirements, air cooling, liquid cooling, water forced circulation system, radiators, cooling fan, water pump, thermostat, pressure sealed cooling, antifreeze solutions, intelligent cooling; Ignition system: Function of an ignition system, battery ignition system, storage battery, condenser and spark plug, magneto coil ignition system, electronic ignition system, electronic ignition, spark advance mechanisms; Electrical system: Charging circuit, generator, current-voltage regulator, starting system, bendix drive mechanism solenoid switch, lighting systems, automatic high beam control, horn, wiper, fuel gauge, oil pressure gauge, engine temperature indicator.

UNIT-III	TRANSMISSION AND SUSPENSIONS SYSTEMS	Classes: 09

Transmission system: Clutches, principle, types, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel.

Gear boxes, types, constant mesh, synchro mesh gear boxes, epicyclic gear box, auto transmission, continuous variable transmission, propeller shaft, Hotch-Kiss drive, Torque tube drive, universal joint, differential, rear axles types, wheels and tyres; Suspension system: Objects of suspension systems, rigid axle suspension system, torsion bar, shock absorber, independent suspension system.

UNIT-IV	BRAKING AND STEERING SYSTEMS	Classes: 09

Braking system: Mechanical brake system, Hydraulic brakes system, Master cylinder, wheel cylinder, Requirements of brake fluid, pneumatic and vacuum brake, ABS; Steering system: Steering geometry, camber, castor, king pin, rake, combined angle toe-in, toe-out, types of steering mechanism, Ackerman steering mechanism, Davis steering mechanism, steering gears types, steering linkages.

UNIT-V	EMISSIONS FROM AUTOMOBILES	Classes: 09

Emissions from automobiles, pollution standards national and international, pollution control techniques, petrol injection, common rail diesel injection, variable valve timing; Energy alternatives, solar, photo-

voltaic, hydrogen, biomass, alcohols, LPG, CNG, liquid fuels and gaseous fuels, hydrogen as a fuel for internal combustion engines, their merits and demerits.

Text Books:

1. Willam H crouse, Donald L. Anglin, "Automobile Engineering", McGraw Hill, 10th Edition, 2006.
2. Manzoor, Nawazish Mehdi, Yosuf Ali, "A Text Book Automobile Engineering", Frontline Publications, 1st Edition, 2011.

Reference Books:

1. R. K. Rajput, "A Text Book of Automobile Engineering", Laxmi Publications, 1st Edition, 2015.
2. Joseph Heinter, "Automotive Mechanics", CBS, 2nd Edition, 2006.
3. K. Netwon, W. Steeds, T. K.Garrett, "Automotive Engineering", Butterworth-Heinamann, 13th Edition, 2016.
4. S. Srinivasan, "Automotive Engines", Tata McGraw-Hill, 2nd Edition, 2003.
5. Khalil. U. Siddiqui, "A Text Book of Automobile Engineering", New Age International, 1st Edition, 2012.

Web References:

1. http://www.nptel.kmeacollege.ac.in/syllabus/125106002/
2. http://www.nptel.ac.in/courses/125106002/

E-Text Books:

1. http:// www.engineeringstudymaterial.net/tag/automotive-engineering-books
2. https://www.studynama.com/.../299-Automobile-engineering-lecture-notes-ebook-pdf

Course Home Page:

INTRODUCTION TO ROBOTICS

VI Semester: Common for all Branches

Course Code	Category	Hours / Week	Credits	Maximum Marks

AME553	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes:45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Familiarize with the automation and brief history of robot and applications.
II. Understand the kinematics of robots and knowledge about robot end effectors and their design.
III. Apply robot actuators and feedback components to automation.

UNIT-I	**INTRODUCTION TO ROBOTICS**	**Classes: 09**

Introduction: Automation and robotic, an over view of robotics, classification by coordinate system and control systems; Components of the industrial robotics: Degrees of freedom, end effectors: Mechanical gripper, magnetic, vacuum cup and other types of grippers, general consideration on gripper selection and design.

UNIT-II	**MOTION ANALYSIS AND KINEMATICS**	**Classes: 09**

Motion analysis: Basic rotation matrices, composite rotation matrices, Euler angles, equivalent angle and axis, homogeneous transformation, problems; Manipulator kinematics: D-H notations, joint coordinates and world coordinates, forward and inverse kinematics, problems.

UNIT-III	**KINEMATICS AND DYNAMICS**	**Classes: 09**

Differential kinematics: Differential kinematics of planar and spherical manipulators, Jacobians, problems.

Robot dynamics: Lagrange, Euler formulations, Newton-Euler formulations, problems on planar two link manipulators.

UNIT-IV	**TRAJECTORY PLANNING AND ACTUATORS**	**Classes: 09**

Trajectory planning: Joint space scheme, cubic polynomial fit, avoidance of obstacles, types of motion**:** Slew motion, joint interpolated motion, straight line motion, problems; Robot actuators and feedback components; Actuators: pneumatic and hydraulic actuators.

UNIT-V	**ELECTRIC ACTUATORS AND ROBOTIC APPLICATIONS**	**Classes: 09**

Electric actuators: DC servo motors, stepper motors, feedback components: position sensors, potentiometers, resolvers and encoders, velocity sensors, tactile sensors; Robot application in manufacturing: Material handling, assembly and inspection.

Text Books:

1. Groover M. P, "Industrial Robotics", Tata McGraw-Hill, 1st Edition, 2013.
2. J. J Craig," Introduction to Robotic Mechanics and Control", Pearson, 3rd Edition, 2013.

Reference Books:

1. Richard D. Klafter, "Robotic Engineering", Prentice Hall, 1st Edition, 2013.
2. Fu K S, "Robotics", McGraw-Hill, 1st Edition, 2013.

Web References:

1. https://www.doc.ic.ac.uk/~ajd/Robotics/RoboticsResources/lecture1.pdf
2. http://opencourses.emu.edu.tr/course/view.php?id=32
3. https://www.researchgate.net/publication/277712686_Introduction_to_Robotics_class_notes_UG_level

E-Text Books:

1. http://*www.robot.bmstu.ru/*
2. http://www.robotee.com/index.php/download-free-robotic-e-books/

Course Home Page:

AEROSPACE PROPULSION AND COMBUSTION

VI Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE551	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Demonstrate with an overview of various aerospace propulsion systems and a sound foundation in the fundamentals of thermodynamics.
II. Distinguish the elementary principles of thermodynamic cycles as applied to propulsion analysis.
III. Prioritize an introduction to combustion& gas kinetic theory.
IV. Discover a working knowledge of and the tools to measure various flight propulsion systems such as turbojets, turbofans, ramjets, rockets, air turbo-rockets and nuclear/electric propulsion systems.

UNIT-I	ELEMENTS OF AIRCRAFT PROPULSION	Classes: 10

Classification of power plants, methods of aircraft propulsion, propulsive efficiency, specific fuel consumption, thrust and power, factors affecting thrust and power, illustration of working of gas turbine engine, characteristics of turboprop, turbofan and turbojet, ram jet, scram jet, methods of thrust augmentation, atmospheric properties, turbojet, turbofan, turboprop, turbo-shaft engine construction and nomenclature, theory and performance, introduction to compressors, turbines, combustors and after burners for aircraft engines.

UNIT-II	PROPELLER THEORY	Classes: 08

Momentum theory, Blade element theory, combined blade element and momentum theory, propeller power losses, propeller performance parameters, prediction of static thrust and in flight, negative thrust, prop fans, ducted propellers, propeller noise, propeller selection, propeller charts.

UNIT-III	INLETS, NOZZLES AND COMBUSTION CHAMBERS	Classes: 10

Subsonic and supersonic inlets, relation between minimum area ratio and external deceleration ratio, starting problem in supersonic inlets, modes of inlet operation, jet nozzle, efficiencies, over expanded, under and optimum expansion in nozzles, thrust reversal.

Classification of combustion chambers, combustion chamber performance flame tube cooling, flame stabilization.

UNIT-IV	THERMODYNAMICS OF REACTING SYSTEMS	Classes: 09

Chemical kinetics: equilibrium, analysis of simple reactions, steady, state and partial equilibrium approximations, explosion theories; Transport phenomena: Molecular and convective transports; Conservation equations of multicomponent, reacting systems.

UNIT-V	PREMIXED FLAMES	Classes: 08

Rankine hugoniot relations, theories of laminar premixed flame propagation, quenching and flammability limits; Diffusion flames: Burke-Schumann theory, laminar jet diffusion flame, droplet combustion, turbulent combustion, closure problem, premixed and non-premixed turbulent combustion, introduction to DNS and LES.

Text Books:

1. Stephen R. Turns, "An Introduction to Combustion", McGraw-Hill, 3rd Edition, 2012.
2. Thomas A. Ward, "Aerospace Propulsion Systems", John Wiley and Sons, 1st Edition, 2010.

Reference Books:

1. M. H. Sadd, "Elasticity: Theory, Applications, and Numerics", Academic Press, 2nd Edition, 2009.
2. R. G. Budynas, "Advanced Strength and Applied Stress Analysis", McGraw-Hill, 2nd Edition, 1999.

3. A. P. Boresi, R.J. Schmidt, "Advanced Mechanics of Materials", John Willey & Sons, 5th Edition, 2003.
Web References:
4. https://www.nptel.ac.in/courses/101101002/ 5. https://www.en.wikipedia.org/wiki/Airbreathing_jet_engine 6. https://www.en.wikipedia.org/wiki/Combustor 7. https://www.aero.iisc.ernet.in/page/propulsion
E-Text Books:
4. https://www.as.wiley.com/WileyCDA/WileyTitle/productCd-1118307984.html 5. https://www.sciencedirect.com/science/book/9781856179126 6. https://www.books.google.co.in/books?id=iUuPAQAAQBAJ&source=gbs_similarbooks
Course Home Page:

FUNDAMENTALS OF IMAGE PROCESSING

VII SEMESTER: Common for all Branches								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AEC552	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: 0**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Understand the image fundamentals and the relationship between pixels.
II. Understand the image enhancement techniques in spatial domain and frequency domain.
III. Analyze the image restoration technique from degraded image using various filtering techniques.
IV. Design segmentation of the image for boundary detection.
V. Differentiate redundancy techniques and apply for image compression.

UNIT-I	**INTRODUCTION**	**Classes: 09**

Digital image fundamentals and image transforms digital image fundamentals, sampling and quantization, relationship between pixels.

UNIT-II	**IMAGE ENHANCEMENT**	**Classes: 09**

Introduction, image enhancement in spatial domain, enhancement through point processing, types of point processing, histogram manipulation, linear and non-linear gray level transformation, local or neighborhood operation, median filter processing; Spatial domain high pass filtering, filtering in frequency domain, obtaining frequency domain filters from spatial filters, generating filters directly in the frequency domain, low pass (smoothing) and high pass (sharpening) filters in frequency domain

UNIT-III	**IMAGE RESTORATION**	**Classes: 9**

Image restoration degradation model, algebraic approach to restoration, inverse filtering.

Least mean square filters, constrained least square restoration, interactive restoration.

UNIT-IV	**IMAGE SEGMENTATION, MORPHOLOGICAL IMAGE PROCESSING**	**Classes: 9**

Image segmentation detection of discontinuities, edge linking and boundary detection, threshold, region oriented segmentation. Morphological image processing dilation and erosion, structuring element decomposition, the Strel function, erosion; Combining dilation and erosion: Opening and closing the hit and miss transformation.

UNIT-V	**IMAGE COMPRESSION**	**Classes: 09**

Image compression: Redundancies and their removal methods, fidelity criteria, image compression models, source encoder and decoder, error free compression, lossy compression, JPEG 2000 standard.

Text Books:

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing‖, Pearson", 3rd Edition, 2008.
2. S. Jayaraman, S. Esakkirajan, T. Veerakumar, "Digital Image Processing", TMH, 3rd Edition, 2010.

Reference Books:

1. Rafael, C. Gonzalez, Richard E woods, Stens L Eddings, "Digital Image Processing using MATLAB", Tata McGraw Hill, 2nd Edition, 2010.
2. A.K. Jain, "Fundamentals of Digital Image Processing", PHI, 1st Edition, 1989.
3. Somka, Hlavac, Boyle, "Digital Image Processing and Computer Vision", Cengage Learning, 1st Edition, 2008.

4. Adrain Low, “Introductory Computer vision Imaging Techniques and Solutions”, Tata McGraw-Hill, 2nd Edition, 2008.
5. John C. Russ, J. Christian Russ, “Introduction to Image Processing & Analysis”, CRC Press, 1st Edition, 2010.

Web References:

1. https://imagingbook.com/
2. https://en.wikipedia.org/wiki/Digital_image_processing
3. http://www.tutorialspoint.com/dip/
4. http://www.imageprocessingplace.com/
5. http://web.stanford.edu/class/ee368/
6. https://sisu.ut.ee/dev/imageprocessing/book/1
7. https://in.mathworks.com/discovery/digital-image-
8. https://processing.html?requestedDomain=www.mathworks.com

E-Text Books:

1. http://www.sci.utah.edu/~gerig/CS6640-F2010/dip3e_chapter_02.pdf
2. http://www.faadooengineers.com/threads/350-Digital-Image-Processing
3. http://newwayofengineering.blogspot.in/2013/08/anil-k-jain-fundamentals-of-digital.html
4. http://bookboon.com/en/digital-image-processing-part-one-ebook

FUNDAMENTALS OF DATABASE MANAGEMENT SYSTEMS

VII Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACS553	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Understand the role of database management system in an organization and learn the database concepts.
II. Design databases using data modeling and data normalization techniques.
III. Construct database queries using relational algebra and calculus.
IV. Understand the concept of a database transaction and related database facilities.
V. Learn how to evaluate set of queries in query processing.

UNIT-I	CONCEPTUAL MODELING	Classes: 10

Introduction to file and database systems: Database system structure, data models: entity relationship model, relational model.

UNIT-II	RELATIONAL APPROACH	Classes: 08

Relational algebra and calculus: Relational algebra, selection and projection, set operations, renaming, joins, division, examples of algebra queries, relational calculus, tuple relational calculus.

UNIT-III	BASIC SQL QUERY AND NORMALIZATION	Classes: 10

SQL data definition; Queries in SQL: updates, views, integrity and security, relational database design.

Normal Forms: 1NF, 2NF, 3NF and BCNF.

UNIT-IV	TRANSACTION MANAGEMENT	Classes: 09

Transaction processing: Introduction, need for concurrency control, desirable properties of transaction, schedule and recoverability, Serializability and schedules.

UNIT-V	CONCURRENCY CONTROL	Classes: 08

Concurrency control; Types of locks: Two phases locking, deadlock, timestamp based concurrency control, recovery techniques, concepts, immediate update, deferred update, shadow paging.

Text Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw-Hill, 4th Edition, 2002.

Reference Books:

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamental Database Systems", Pearson Education, 3rd Edition, 2003.
2. Raghu Ramakrishnan, "Database Management System", Tata McGraw-Hill Publishing Company, 3rd Edition, 2003.
3. Hector Garcia Molina, Jeffrey D. Ullman, Jennifer Widom, "Database System Implementation", Pearson Education, United States, 1st Edition, 2000.
4. Peter Rob, Corlos Coronel, "Database System, Design, Implementation and Management", Thompson Learning Course Technology, 5th Edition, 2003.

Web References:

1. https://www.youtube.com/results?search_query=DBMS+onluine+classes
2. http://www.w3schools.in/dbms/
3. http://beginnersbook.com/2015/04/dbms-tutorial/

E -Text Books:

1. http://www.e-booksdirectory.com/details.php?ebook=10166
2. http://www.e-booksdirectory.com/details.php?ebook=7400re

Course Home Page:

BASICS OF INFORMATION SECURITY AND CRYPTOGRAPHY

VII Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AIT551	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Learn the basic categories of threats to computers and networks.
II. Understand various cryptographic algorithms and be familiar with public-key cryptography.
III. Apply authentication functions for providing effective security.
IV. Analyze the application protocols to provide web security.
V. Discuss the place of ethics in the Information Security Area.

UNIT-I	ATTACKS ON COMPUTERS	Classes: 08

Attacks on computers and computer security: Introduction, the need for security, security approaches, types of security attacks and security services. \

UNIT-II	SYMMETRIC KEY CIPHERS	Classes: 10

Symmetric key ciphers: Block cipher principles and algorithms (DES, AES), differential and linear cryptanalysis, block cipher modes of operation, stream ciphers; Asymmetric key ciphers: Principles of public key cryptosystems, algorithms (RSA Diffie – Helman).

UNIT-III	MESSAGE AUTHENTICATION AND CRYPTOGRAPHY	Classes: 08

Message authentication algorithm and hash functions: Authentication requirements, functions, message, authentication codes, hash functions, secure hash algorithm, whirlpool, digital signatures.

Cryptography: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography.

UNIT-IV	E-MAIL SECURITY	Classes: 10

E-mail security: Pretty good privacy; S/MIMI IP Security: IP security overview, IP security architecture, authentication header, encapsulating security payload, combining security associations, key management.

UNIT-V	WEB SECURITY	Classes: 09

Web security: Web security considerations, secure electronic transaction intruders; Virus and firewalls: Intruders, intrusion detection password management, virus and related threats, firewall design principles; Types of firewalls.

Text Books:

1. William Stallings, "Cryptography and Network Security", Pearson Education, 4th Edition, 2005.
2. AtulKahate, "Cryptography and Network Security", McGraw-Hill, 2nd Edition, 2009.

Reference Books:

1. C K Shymala, N Harini, Dr. T R Padmanabhan, "Cryptography and Network Security", Wiley India, 1st Edition, 2016.
2. Behrouz A. Forouzan, Debdeep Mukhopadhyay , "Cryptography and Network Security", McGraw-Hill, 2nd Edition, 2010.

Web References:

1. http://bookboon.com/en/search?q=INFORMATION+SECURITY
2. https://books.google.co.in/books/about/Cryptography_Network_Security_Sie_2E.html?id=Kokjwdf0E7QC
3. https://books.google.co.in/books/about/Information_Security.html?id=Bh45pU0_E_4C

E-Text Books:

1. https://books.google.co.in/books/about/Information_Security.html
2. http://www.amazon.in/Cryptography-Network-Security-Behrouz-Forouzan/dp/007070208X

Course Home Page:

MODELING AND SIMULATION

VII Semester: Common to All Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHS551	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the basic system concept and definitions of system.
II. Study the techniques to model and to simulate various systems.
III. Analyze a system and to make use of the information to improve the performance.

UNIT-I	**INTRODUCTION**	**Classes: 08**

When simulation is the appropriate tool and when it is not appropriate; Advantages and disadvantages of simulation; Areas of application; Systems and system environment; Components of a system; Discrete and continuous systems; Model of a system; Types of models; Discrete event system simulation; Steps in a simulation study; The basics of spreadsheet simulation; Simulation example: Simulation of queuing systems in a spreadsheet.

UNIT-II	**GENERAL PRINCIPLES SIMULATION SOFTWARE**	**Classes: 10**

Concepts in discrete-event simulation: The event-scheduling / time-advance algorithm, world views, manual simulation using event scheduling; List processing, simulation in java; Simulation in GPSS review of terminology and concepts; Useful statistical models; Discrete distributions; Continuous distributions; Poisson process; Empirical distributions.

UNIT-III	**QUEUING MODELS AND RANDOM NUMBERS**	**Classes: 08**

Characteristics of queuing systems; Queuing notation; Long-run measures of performance of queuing systems; Steady-state behavior of M/G/1 queue; Networks of queues; Rough-cut modeling: An illustration.

Properties of random numbers: Generation of pseudo random numbers; Techniques for generating random numbers; Tests for random numbers random-variate generation: Inverse transforms technique; Acceptance-rejection technique; Special properties.

UNIT-IV	**INPUT MODELING**	**Classes: 10**

Data collection; Identifying the distribution with data; Parameter estimation; Goodness of fit tests; Fitting a non-stationary poisson process; Selecting input models without data; Multivariate and time-series input models.

UNIT-V	**ESTIMATION OF ABSOLUTE PERFORMANCE**	**Classes: 09**

Types of simulations with respect to output analysis; Stochastic nature of output data; Absolute measures of performance and their estimation; Output analysis for terminating simulations; Output analysis for steady-state simulations; Model building, verification and validation; Verification of simulation models; Calibration and validation of models, optimization via simulation.

Text Books:

Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, "Discrete-Event System Simulation", Pearson Education, 5th Edition, 2010.

Reference Books:

1. Lawrence M. Leemis, Stephen K. Park, "Discrete – Event Simulation: A First Course", Pearson Education, 1st Edition, 2006.
2. Averill M., "Law: Simulation Modeling and Analysis", Tata McGraw-Hill, 4th Edition, 2007.

Web References:

1. https://storage.googleapis.com/northwestern14-edu/Vtu-Notes-For-System-Modeling-And Simulation.pd.
2. http://www.slideshare.net/qwerty626/system-simulation-modeling-notessjbit.

E-Text Books:

1. http://www.e-booksdirectory.com/listing.php?category=100
2. https://www.google.co.in/?gfe_rd=cr&ei=YGRCWOWMKuPx8AfQqaaoCg#q=simulation+and+modeling+e+books&start=30

Course Home Page:

RESEARCH METHODOLOGIES

VII Semester: Common for All Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AHS552	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Orient the student to make an informed choice from the large number of alternative methods and experimental designs available.
II. Empower the student with the knowledge and skills they need to undertake a research project, to present a conference paper and to write a scientific article.
III. Develop a thorough understanding of the fundamental theoretical ideas and logic of research.
IV. Identify various sources of information for literature review and data collection.

UNIT-I	INTRODUCION TO RESEARCH AND PHILOSOPHIES	Classes: 07

Introduction to research: The role of research, research process overview; Philosophies and the language of research theory building: Science and its functions, what is theory, the meaning of methodology.

UNIT-II	A RESEARCHER PROBLEMS AND HYPOTHESES	Classes: 10

Thinking like a researcher: Understanding concepts, constructs, variables, and definitions; Problems and hypotheses: Defining the research problem, formulation of the research hypotheses, the importance of problems and hypotheses.

UNIT-III	RESEARCH DESIGN AND DATA COLLECTION	Classes: 09

Research design: Experimental and no experimental research design, field research, and survey research.

Methods of data collection: Secondary data collection methods, qualitative methods of data collection, and survey methods of data collection.

UNIT-IV	ATTITUDE MEASUREMENT , SCALING AND SAMPLING TECHNIQUES	Classes: 09

Attitude measurement and scaling: Types of measurement scales; Questionnaire designing, reliability and validity; Sampling techniques: The nature of sampling, probability sampling design, non probability sampling design, and determination of sample size.

UNIT-V	PROCESSING AND ANALYSIS OF DATA,ETHICAL ISSUES	Classes: 10

Processing and analysis of data ; Ethical issues in conducting research; Report generation, report writing, and APA format; Title page, abstract, introduction, methodology, results, discussion, references, and appendices.

Text Books:

1. Bryman, Alan, Bell, Emma, "Business Research Methods", Oxford University Press, 3rd Edition, 2011.
2. Kerlinger, F.N., Lee, H.B.,"Foundations of Behavioral Research", Harcourt Inc., 4th Edition, 2000.
3. Rubin, Allen, Babbie, Earl, "Essential Research Methods for Social Work", Cengage Learning Inc., USA, 2009.

Reference Books:

1. Anantasi A., Urbina S., "Psychological Testing", Pearson Education, 2004.
2. Chawla, Deepak, Sondhi, Neena, "Research Methodology: Concepts and Cases", Vikas Publishing House Pvt. Ltd. Delhi, 2011.

3. Pawar B. S., “Theory Building For Hypothesis Specification In Organizational Studies”, Response Books, New Delhi, 2009.
4. NeumanW.L., “Social Research Methods: Qualitative and Quantitative Approaches”, Pearson Education, 2008.

Web References:

1. https://en.wikipedia.org/wiki/Online_research_methods
2. https://www.prescott.edu/library/resources/research-bibliography.php

E-Text Books:

1. https://www.hcmuaf.edu.vn/.../Research%20Methodology%20-%20Methods%20and%20T...
2. https://www.federaljack.com/ebooks/My%20collection%20of%20medical%20books,%2020...

Course Home Page:

ENERGY FROM WASTE

VII Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEE551	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understand the principles associated with effective energy management and to apply these principles in the day to day life.
II. Develop insight into the collection, transfer and transport of municipal solid waste.
III. Explain the design and operation of a municipal solid waste landfill.
IV. Device key processes involved in recovering energy from wastes, systematically evaluate the main operational challenges in operating thermal and biochemical energy from waste facilities.

UNIT - I	INTRODUCTION TO WASTE AND WASTE PROCESSING	Classes: 08

Solid waste sources solid waste sources, types, composition, properties, global warming; Municipal solid waste: Physical, chemical and biological properties, waste collection and, transfer stations, waste minimization and recycling of municipal waste, segregation of waste, size reduction, managing waste, status of technologies for generation of energy from waste treatment and disposal aerobic composting, incineration, furnace type and design, medical waste / pharmaceutical waste treatment technologies, incineration, environmental impacts, measures to mitigate environmental effects due to incineration .

UNIT - II	WASTE TREATMENT AND DISPOSAL	Classes: 10

Land fill method of solid waste disposal land fill classification, types, methods and sitting consideration; Layout and preliminary design of landfills: Composition, characteristics, generation, movement and control of landfill leach ate and gases, environmental monitoring system for land fill gases.

UNIT - III	BIO-CHEMICAL CONVERSION	Classes: 09

Energy generation from waste bio-chemical conversion: Sources of energy generation, anaerobic digestion of sewage and municipal waste, direct combustion of MSW-refuse derived solid fuel.

Industrial waste, agro residues and anaerobic digestion.

UNIT - IV	THERMO-CHEMICAL CONVERSION	Classes: 10

Biogas production, land fill gas generation and utilization, thermo-chemical conversion: Sources of energy generation, gasification of waste using gasifies briquetting, utilization and advantages of briquetting, environmental benefits of bio-chemical and thermo- chemical conversion.

UNIT - V	E-WASTE MANAGEMENT	Classes: 08

E-waste: E-waste in the global context: Growth of electrical and electronics industry in India, environmental concerns and health hazards; Recycling e-waste: A thriving economy of the unorganized sector, global trade in hazardous waste, impact of hazardous e-waste in India; Management of e-waste: E-waste legislation, government regulations on e-waste management, international experience, need for stringent health safeguards and environmental protection laws of India.

Text Books:

1. Nicholas P Cheremisinoff, "Handbook of Solid Waste Management and Waste Minimization Technologies", An Imprint of Elsevier, New Delhi, 2003.
2. P Aarne Vesilind, William A Worrell and Debra R Reinhart, "Solid Waste Engineering", 2nd edition 2002.
3. M Dutta , B P Parida, B K Guha and T R Surkrishnan, "Industrial Solid Waste Management and Landfilling practice", Reprint Edition New Delhi, 1999.
4. Rajya Sabha Secretariat, "E-waste in India: Research unit", Reprint Edition, June, 2011.
5. Amalendu Bagchi Design, "Construction and Monitoring of Landfills", John Wiley and Sons, New York, 1994.
6. M. L. Davis and D. A. Cornwell, "Introduction to environmental engineering", International Edition, 2008.
7. C. S. Rao, "Environmental Pollution Control Engineering", Wiley Eastern Ltd. New Delhi, 1995.
8. S. K. Agarwal, "Industrial Environment Assessment and Strategy", APH Publishing Corporation, New Delhi, 1996.
9. Sofer, Samir S. (ed.), Zaborsky, R. (ed.), "Biomass Conversion Processes for Energy and Fuels", New York, Plenum Press, 1981.
10. Hagerty, D.Joseph; Pavoni, Joseph L; Heer, John E., "Solid Waste Management", New York, Van Nostrand, 1973.
11. George Tchobanoglous, Hilary Theisen and Samuel Vigil Prsl: Tchobanoglous, George Theisen, Hillary Vigil, Samuel, "Integrated Solid Waste management: Engineering Principles and Management issues", New York, McGraw Hill, 1993.

Reference Books:

1. C Parker and T Roberts (Ed), "Energy from Waste", An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985.
2. KL Shah, "Basics of Solid and Hazardous Waste Management Technology", Prentice Hall, Reprint Edition, 2000.
3. M Datta, "Waste Disposal in Engineered Landfills", Narosa Publishing House, 1997.
4. G Rich et.al, Hazardous, "Waste Management Technology", Podvan Publishers, 1987.
5. AD Bhide, BB Sundaresan, "Solid Waste Management in Developing Countries", INSDOC, New Delhi, 1983.

Web References:

1. https://www.e-waste Management: From waste to Resource Klaus Hieronymi, Ramzy Kahnat, Eric williams Tech. & Engg.-2013 (Publisher: Earthscan 2013
2. https://www.What is the impact of E-waste: Tamara Thompson
3. https://www. E-waste poses a Health Hazard: Sairudeen Pattazhy

E-Text Books:

1. https://www.unep.org
2. https://www.outledge.com
3. https://www.bookdepository.com
4. https://www.ecoactiv.com

Course Home Page:

FINITE ELEMENT ANALYSIS

VII Semester: Common for all branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE552	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Possess a good understanding of the theoretical basis of the weighted residual finite element method.
II. Use the commercial finite element package ANSYS to build finite element models and solve a selected range of engineering problems.
III. Communicate effectively in writing to report (both textually and graphically) the method used, the implementation and the numerical results obtained.

UNIT-I	INTRODUCTION	Classes: 10

Review of various approximate method, variational approach and weighted residual approach application to structural mechanics problems; Finite difference methods- governing equation and convergence criteria of finite element method.

UNIT-II	DISCRETE ELEMENTS	Classes: 10

Bar elements, uniform section, mechanical and thermal loading, varying section, 2D and 3D truss element. Beam element, problems for various loadings and boundary conditions 2D and 3D Frame elements, longitudinal and lateral vibration; Use of local and natural coordinates.

UNIT-III	CONTINUUM ELEMENTS	Classes: 09

Plane stress, plane strain and axi-symmetric problem; Derivation of element matrices for constant.

Linear strain triangular elements and axi-symmetric element.

UNIT-IV	ISOPARAMETRIC ELEMENTS	Classes: 08

Definitions, Shape function for 4, 8 and 9 nodal quadrilateral elements, stiffness matrix and consistent load vector, evaluation of element matrices using numerical integration.

UNIT-V	FIELD PROBLEM AND METHODS OF SOLUTIONS	Classes: 08

Heat transfer problems, steady state fin problems, derivation of element matrices for two dimensional problems, torsion problems. Bandwidth, elimination method and method of factorization for solving simultaneous algebraic equations, features of software packages, sources of error.

Text Books:

1. Tirupathi. R. Chandrapatha, Ashok D. Belegundu, "Introduction to Finite Elements in Engineering", Printice Hall India, 3rd Edition, 2003.
2. Rao. S.S., "Finite Element Methods in Engineering", Butterworth and Heinemann, 5th Edition 2010.
3. Reddy J.N., "An Introduction to Finite Element Method", McGraw-Hill, 3rd Edition, 2005.

Reference Books:

1. Krishnamoorthy C.S, "Finite Element Analysis", Tata McGraw Hill, 2nd Edition 2001.
2. K. J. Bathe, E. L. Wilson, "Numerical Methods in Finite Elements Analysis", Prentice Hall of India, 1985.
3. Robert D Cook, David S Malkus, Michael E Plesha, "Concepts and Applications of Finite Element Analysis", John Wiley and Sons, Inc., 4th Edition, 2003.
4. Larry J Segerlind, "Applied Finite Element Analysis", John Wiley and Sons, Inc, 2nd Edition, 1984.

Web References:

1. http://home.iitk.ac.in/~sbasu/me623_2006/fem_notes_me623.pdf
2. http://nptel.ac.in/courses/112104116/
3. http://www.me.berkeley.edu/~lwlin/me128/FEMNotes.pdf

E-Text Books:

1. http://www.civilenggforall.com/2015/09/finite-element-analysis-by-ss-bhavikatti-free-download-pdf-civilenggforall.com.html
2. https://books.google.co.in/books/about/Finite_Element_Analysis_For_Engineering.html?id=3XJoK4x5fZwC

Course Home Page:

VI Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AME554	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Analyze and understand various concepts and laws of thermodynamics.
II. Understand the concepts of refrigeration and air refrigeration.
III. Understand vapour compression refrigeration system and also vapour absorption refrigeration system.
IV. Identify various psychometric properties and processes.

UNIT-I	**RECAPITULATION OF THERMODYNAMICS**	**Classes : 09**

Recapitulation of thermodynamics: Thermodynamic systems, laws of thermodynamics, phase, state, process, cycle, concepts of enthalpy, entropy, specific heat, sensible heat, latent heat, dryness fraction, correlations involving enthalpy, entropy and dryness fraction, types of various processes and their representation on T-s, P-V and P-h diagrams, carnot cycle, reversed carnot cycle.

UNIT-II	**INTRODUCTION AND AIR REFRIGERATION**	**Classes : 09**

Introduction to Refrigeration: Basic concepts, unit of refrigeration; C.O.P: Refrigerators, heat pump, Carnot refrigerators and applications of refrigerator; Air refrigeration cycle: Bell Coleman cycle, open and dense air system – ideal and actual refrigeration, applications, aircraft refrigeration cycles; Refrigerants: Desirable properties, nomenclature and selection of refrigerants, effects of refrigerants on ozone depletion and global warming, alternate refrigerants.

UNIT-III	**VAPOUR COMPRESSION REFRIGERATION**	**Classes: 09**

Vapor compression refrigeration, ideal cycle, effect of variation in evaporator pressure, condenser pressure, super heating of vapor, sub cooling of liquid.

Evaporator and condenser temperatures, deviations of practical (actual cycle) from ideal cycle, construction and use of p-h chart problems.

UNIT-IV	**VAPOUR ABSORPTION REFRIGERATION**	**Classes: 09**

Vapor absorption refrigeration: description, working of NH3-Water, Li Br–water system, calculation of HCOP, principle and operation of three fluid vapor absorption refrigeration systems, steam jet refrigeration system, working principle, basic operation, principle and operation of thermo electric and vortex tube or hilsch tube refrigeration systems.

UNIT-V	**INTRODUCTION TO AIR CONDITIONING**	**Classes : 09**

Psychometric properties and processes, sensible and latent heat loads, characterization, need for ventilation, consideration of infiltration, load concepts of RSHF, ASHF, ESHF and ADP; Concept of human comfort and effective temperature, comfort air conditioning, industrial air conditioning and requirements, air conditioning load calculations.

Text Books:
1. S. C. Arora, Domkundwar, "A Course in Refrigeration and Air-conditioning", Dhanpatrai Publications, 2nd Edition, 2014. 2. C. P. Arora, "Refrigeration and Air Conditioning", Tata McGraw-Hill, 17th Edition, 2006.
Reference Books:
1. Manohar Prasad, "Refrigeration and Air Conditioning", New Age International, 3rd Edition, 2015. 2. P. N Ananthanarayanan, "Basic Refrigeration and Air Conditioning", Tata McGraw-Hill, 2015.
Web References:
1. http://www.engineeringstudymaterial.net/tag/air-conditioning-and-refrigeration-books/ 2. https://www.en.wikipedia.org/wiki/Air_conditioning
E-Text Book:
1. http://www.mechanicalgeek.com/refrigeration-and-air-conditioning-by-rs-khurmi-pdf/ 2. http://www.engineeringstudymaterial.net/tag/air-conditioning-and-refrigeration-books/
Course Home Page:

LAUNCH VEHICLES AND CONTROLS

VII Semester: Common to all branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE553	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the various configurations of launch vehicles and application of controls.
II. Identify different tracking systems for launch vehicles.
III. Distinguish between different errors associated with navigation system and compensation errors.
IV. Compare the guidance systems for short medium and long range missile.

UNIT-I	INTRODUCTION	Classes: 10

Types of rockets and missiles, various configurations, components forces on the vehicle during atmospheric flight, nose cone design and drag estimation; Concepts of navigation ADF, VOR/DME, Doppler, LORAN and OMEGA, guidance and control; Introduction to basic principles; Air data information; Guidance trajectories; Radar systems; Principle of working of radar; Radar equations and applications; MTI and pulse Doppler radar; moving target detector; limitation of MTI performance.

UNIT-II	TRACKING WITH RADAR	Classes: 10

Mono pulse tracking: Conical scan and sequential lobbing; Automatic tracking with surveillance radar (ADT); CW radar; Applications; Other guidance systems; Gyros and stabilized platforms; Inertial guidance and laser based guidance; Components of inertial navigation system; imaging infrared guidance; Satellite navigation; GPS; Accelerometers.

UNIT-III	INERTIAL NAVIGATION SYSTEM	Classes: 09

INS transfer function and errors; Different coordinate system, compensation errors, schuler loops; Cross coupling; Missile control system; Guided missile concept; Augmented systems.

Control of aerodynamic missile; Missile parameters for dynamic analysis; Missile autopilot schematics; Longitudinal and Lateral autopilots.

UNIT-IV	MISSILE GUIDANCE	Classes: 08

Missile guidance laws, short and medium range missiles; Proportional navigation guidance; Command guidance; Comparison of guidance system performance; Bank to turn missile guidance; Terminal guidance; Weapon control missile guidance.

UNIT-V	INTEGRATED FLIGHT/FIRE CONTROL SYSTEM	Classes: 08

Director fire control system; Fire control modes; Tracking control laws; Longitudinal flight control system; Lateral flight control system; Rate of change of Euler angle, auto pilot; Integrated flight and fire control (IFFC) flight testing.

Text Books:

1. Merrilh I. Skolnik, " Introduction to Radar Systems", Tata McGraw-Hill, 3rd Edition, 2001.
2. John H Blakelock, "Automatic control of Aircraft and Missiles", Wile –Inter Science Publication, 2nd Edition, May 1990.

Reference Books:

1. R.B. Underdown, Tony Palmer, "Navigation", Black Well Publishing, 6th Edition, 2001.
2. R P G Collinson, "Introduction to Avionics Systems", Kulwar Academic Publishers, 3rd Edition, 2003.

Web References:

1. http://home.iitk.ac.in/~sbasu/me623_2006/fem_notes_me623.pdf
2. http://nptel.ac.in/courses/112104116/
3. http://www.me.berkeley.edu/~lwlin/me128/FEMNotes.pdf

E-Text Books:

1. http://www.civilenggforall.com/2015/09/finite-element-analysis-by-ss-bhavikatti-free-download-pdf-civilenggforall.com.html
2. https://books.google.co.in/books/about/Finite_Element_Analysis_For_Engineering.html?id=3XJoK4x5fZwC

Course Home Page:

INTELLECTUAL PROPERTY RIGHTS

IV Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHS601	Perspective	-	-	-	-	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: Nil		

OBJECTIVES:

The course should enable the students to:

I. Explore the knowledge in determination of trade secrets status.
II. Adequate knowledge in New Developments in trade law.
III. Understand the complexities involved in the process of attributing intellectual property rights to people.
IV. Learn the legalities of intellectual property to avoid plagiarism and other IPR relates crimes like copyright, infringements, etc.
V. Learn the fundamental principles and the application of those principles to factual, real-world disputes.

UNIT-I	INTRODUCTION TO INTELLECTUAL PROPERTY

Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT-II	TRADE MARKS

Purpose and function of trademarks, acquisition of trademarks rights, protectable matter, selecting and evaluating trademark, trademark registration processes.

UNIT-III	LAW OF COPYRIGHTS AND LAW OF PATENTS

Fundamentals of copyrights law, originality of material, rights to reproduction, rights to perform the work publicly, copyright ownership issues.

Copyright registration, notice of copyright, international copyright law, foundation of patent law, patent searching process, ownership rights and transfer.

UNIT-IV	TRADE SECRETS AND UNFAIR COMPETITION:

Trade secrets law, determination of trade secrets status, liability for misappropriations of trade secrets, protection for submission, trade secrets litigation, misappropriation of right of publicity and false advertising.

UNIT-V	NEW DEVELOPMENTS OF INTELLECTUAL PROPERTY

New developments in trade law, copyright law, patent law, intellectual property audits international overview of intellectual property, international-trademark law, copyright law, international patent law, international development in trade secrets law.

Text Books:

1. Deborah.E.Bouchoux, “Intellectual Property Right”, Cengage Learning, 4th Edition, 2013.
2. Prabuddha Ganguli, “Intellectual Property Right: Unleashing the Knowledge Economy”, Tata McGraw- Hill Publishing Company Ltd., 3rd Edition, 2005.

Reference Books:

1. Catherine J. Holland, “Intellectual Property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, CDR Edition, 2007.
2. Stephen Elias, “Patent, Copyright & Trademark: A Desk Reference to Intellectual Property Law”, Lisa Goldoftas Publishers, Nolo Press, 1996.

Web References:

1. https://en.wikipedia.org/wiki/Intellectual_property
2. http://sokogskriv.no/en/sources-and-references/why-cite-sources/intellectual-property-rights/

E-Text Books:

1. http://www.e-booksdirectory.com/listing.php?category=269
2. http://www.lexisnexis.com/store/catalog/catalog.jsp?id=80

Course Home Page:

TOTAL QUALITY MANAGEMENT

IV Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHS602	Perspective	-	-	-	-	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: Nil		

OBJECTIVES:

The course should enable the students to:

I. Understand the philosophy and core values of Total Quality Management (TQM).
II. Determine the voice of the customer and the impact of quality on economic performance and long-term business success of an organization.
III. Apply and evaluate best practices for the attainment of total quality.
IV. Utilize Statistical Process Control (SPC) techniques as a means to diagnose, reduce and eliminate causes of variation.
V. Describe and apply the development and nature of quality control charts.

UNIT-I **PRINCIPLES AND PRACTICES-1**

Introduction, gurus of TQM, historic review, benefits of TQM leadership, characteristics of quality leaders, the deming philosophy, quality councils, strategic planning, customer satisfaction, customer perception of quality service quality, customer retention, employee involvement, employee survey-empowerment, gain sharing, performance appraisal.

UNIT-II **PRINCIPLES AND PRACTICES-2**

Continuous process improvement, the juran trilogy, the PDCA cycle-kaizen, reengineering; Supplier partnership, partnering, sourcing, supplier selection, supplier rating, performance measures, basic concept, strategy quality cost bench marking, reasons for bench marking, process understanding current performance, pitfalls and criticism of benchmarking.

UNIT-III **TOOLS AND TECHNIQUES-1**

Information technology, computers and the quality functions, information quality issues, quality management system, benefits of ISO registration, ISO 9000 series standards, and internal audits.

Environmental management system, ISO 14000series, benefits of EMS, relation to healthy and safety quality function deployment, the voice of the customer, building a house of quality, QFD process.

UNIT-IV **TOOLS AND TECHNIQUES-2**

Quality by design benefits, communication model, failure mode and effective analysis, failure rate, FMEA documentation, the process of FMEA documentation, product liability, proof and expert witness; Total productive maintenance, promoting the philosophy and training-improvements and needs, autonomous work groups.

UNIT-V **MANAGEMENT TOOLS**

Management tools introduction-forced field analysis, tree diagram, process decision program chart statistical process control, cause and effect diagram-histogram, state of control, process capability, experimental design, hypothesis, orthogonal design two factors and full factors-quality strategy for Indian industries, quality management in India.

Text Books:

1. Joel E Ross, “Total Quality Management”, CRC Press, 3rd Edition,2015

Reference Books:

1. Dale H.Besterfeild, Carlon Besterfeild, “Total Quality Management”, Pearson Education, 1st Edition, 2015.
2. Sridhara Bhatt, “Total Quality Management Texts and Cases”, Himalaya, 1st Edition, 2015.
3. Poornima M Charantimath, “Total Quality Management”, Pearson Education, 1stEdition, 2015.

Web References;

http://managementhelp.org/quality/total-quality-management.htm
2. http://www.tandfonline.com/toc/ctqm20/current

E-Text Books:

1. https://www.scribd.com/doc/19378602/Quality-Management-eBook
2. http://bookboon.com/en/quality-management-ebook

Course Home Page:

PROFESSIONAL ETHICS AND HUMAN VALUES

IV Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHS603	Perspective	-	-	-	-	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: Nil		

OBJECTIVES:

The course should enable the students to:

I. Understand the fundamental theoretical and historic graphical topics of professional ethics and human values.
II. Study independence and self-evaluation professional ethics and human values, so that they can grasp the core values as independent thinkers.
III. Develop their analytical and pragmatic abilities & situational reasoning aligned towards right and wrong.

UNIT-I	INTRODUCTION TO PROFESSIONAL ETHICS

Basics of profession: Engineering and professionalism, two models of professionalism, three types of ethics or morality, the negative face of engineering ethics, the positive face of engineering ethics, responsibility in engineering, engineering standards, the standard care, blame responsibility and causation.

UNIT-II	PROFESSIONAL ETHICS IN ENGINEERING

Engineering ethics , variety of moral issues, types of inquiry moral dilemmas, moral autonomy, the problems of many hands, Kohlburg's theory, Gilligan's theory impediments to responsible action, engineering as social experimentation, framing the problem, determining the facts, codes of ethics, clarifying concepts application issues, common ground, general principles, utilitarian thinking respect for persons.

UNIT-III	ETHICS AND HUMAN VALUES

Human values, morals, values, and ethics, integrity, work ethic, service learning, civic virtue, respect for others, living peacefully.

Caring, sharing, honesty, courage, valuing time, co-operation, commitment, empathy, self-confidence, spirituality, character.

UNIT-IV	MORAL RESPONSIBILITIES & RIGHTS

Ethics consensus, controversy, models of professional roles, theories about right action, self, interest, customs and religion, uses of ethical theories, responsibility for rights, respect for authority, conflicts of interest, occupational crime, professional rights and employee rights, communicating risk and public policy, collective bargaining.

UNIT-V	GLOBAL ETHICS & VALUES

Global issues, multinational corporations, environmental ethics, engineers as managers, advisors, and experts witnesses, moral leadership sample codes of ethics problem of bribery, extortion and grease payments, problem of nepotism, excessive gifts, paternalism, different business practices, negotiating tax, global trends.

Text Books:

1. PSR Murthy, “Indian Culture Values and Professional Ethics”, BS Publications, 1st Edition, 2013.
2. Mike Martin, Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, 3rd Edition, 2003.
3. Charles D Fleddermann, “Engineering Ethics”, Prentice Hall, 4th Edition, 2012.
4. George Reynolds, “Ethics in Information Technology”, Cengage Learning, 5th Edition, 2012.

Reference Books:

1. Mike Martin, Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, 4th Edition, 2004.
2. Charles E Harris, Micheal J Rabins, “Engineering Ethics”, Cengage Learning, 5th Edition, 2014.
3. Edmund G Seebauer, Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, 1st Edition, 2000.

Web References:

1. http://www.imd.inder.cu/adjuntos/article/524/Professional%20Ethics%20and%20Human%20Values.pdfhttp://bit.ly/29SyL7i
2. https://books.google.com/books/about/Textbook_on_Professional_Ethics_and_Huma.html?id=-dPiHmlV_

E-Text Books:

1. https://www.amazon.com/Professional-Ethics-Human-Values-Govindarajan-ebook/dp/B00K6GSSUW
2. http://bookboon.com/en/business-ethics-ebook

Course Home Page:

LEGAL SCIENCES

IV Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHS604	Perspective	-	-	-	-	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: Nil		

OBJECTIVES:

The course should enable the students to:

I. Acquaint the student with the scientific method of social science research.
II. Provide the knowledge of the technique of selection, collection and interpretation of primary and secondary data in socio legal research.
III. Emphasis would be laid on practical training in conducting research.

UNIT-I **CONCEPT OF LEGAL SCIENCE**

Fundamentals of legal science, law systems in India, comparative public law, law and justice in a globalizing world; Impact of the human rights instruments on domestic law.

UNIT-II **TECHNOLOGY & LEGAL SYSTEMS**

Principles of corporate law conjunction, temporal, subordinate clauses complex sentences, intellectual property rights, contract law, cyber law.

UNIT-III **CONSTITUTION AND ADMINISTRATIVE LAW**

Minorities law, human rights, international and national sphere, media law.

Health law, globalization vis-à-vis human rights, significance of human rights.

UNIT-IV **HUMAN RIGHTS INTERNATIONAL AND NATIONAL SPHERE**

Human rights with special reference to right to development, rights of disadvantaged and vulnerable groups, critical analysis, cultural relativism and human rights, human rights in the Indian sphere, an over view, constitution and the analysis of preamble, social action litigation and the role of Indian judiciary, critical examination of the human rights council and human rights commission, treaty mechanism with respect to covenants ICESCR and ICCPR, convention on the elimination of discrimination against women and child rights convention.

UNIT-V **SCIENTIFIC METHODOLOGY IN LEGAL SYSTEMS**

The science of research and scientific methodology ,analysis of law with scientific methods, scientific approach to socio legal problems, interrelation between speculation, fact and theory building fallacies of scientific methodology with reference to socio legal research ,inter-disciplinary research and legal research models, arm chair research vis-a-vis empirical research, legal research-common law and civil law legal systems.

Text Books:

1. Robert Watt, "Concise book on Legal Research", Abe Books publishers, 1st Edition, 2015.
2. Ram Ahuja, "Research Method", News Way Publishers, 1st Edition, 2012.
3. Goode and Hatt, "Research Methodology", Eastern Limited Publication, 1st Edition reprinted, 2006.

Reference Books:

1. B. Somekh & C. Lewin, "Research Methods", Vistaar Publications, 1st Edition, 2005.
2. Bhandarkar, "Research Methods, Research styles and Research Strategies", Wilkinson Publishers, 1st Edition, 2009.

Web References:

1. http://humansecurityconf.polsci.chula.ac.th/Documents/Presentations/Shanawez.pdf
2. http://www.lexisnexis.com/documents/pdf/20080806034945_large.pdf
3. http://www.theglobaljusticenetwork.org/journal
4. http://humansecurityconf.polsci.chula.ac.th/Documents/Presentations/Shanawez.pdf
5. http://as.nyu.edu/docs/IO/1172/globaljustice.pdf

E-Text Books:

www.bookboon.com/en/natural-sciences-eBooks

Course Home Page:

CLINICAL PSYCHOLOGY

IV Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHS605	Perspective	-	-	-	-	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: Nil		

OBJECTIVES:

The course should enable the students to:

I. Develop the knowledge pertinent to the organism, developmental, social and situational factors those are relevant to the initiation and maintenance of human behavior.
II. Understand the present and implement effective strategies to deal with these issues during work with patients.
III. Study the professional identity and practice as clinical psychologists through fundamental knowledge of psychology, commitment to professional ethics.
IV. Understand the multiculturalism, diversity and participation in life-long learning.

UNIT-I BASIC PSYCHOLOGY

Introduction: Psychology, definition, psychology as a science, early schools of psychology, modern perspectives, methods of psychology, experimental method, systematic observation, case study method, survey method, fields of psychology.

UNIT-II BIOLOGY OF BEHAVIOR AND SENSORY PROCESS

Neurons and synapses: Nervous system , peripheral and central nervous system: brain and sleep: importance of fore brain, association cortex, left and right hemisphere functions; Some general properties of senses, subliminal stimuli, the visual sense, auditory sense, the other senses; Consciousness, meaning, functions, divided consciousness, stages of sleep, dreams, meditation, hypnosis.

UNIT-III ATTENTION AND PERCEPTION

Selective attention; physiological correlates of attention, internal influences on perception, learning set, motivation and emotion, cognitive styles.

External influences on perception, figure ground, movement, illusions, perceptual organization, constancy, depth perception, binocular and monocular cues.

UNIT-IV MOTIVATION AND EMOTION MOTIVES

Definitions, motivation cycle, theories of motivation, biological motivation, social motives, frustration and conflicts of motives, defense mechanism, emotion, expression and judgment of emotion, the physiology of emotion, theories of emotion.

UNIT-V CLINICAL PSYCHOLOGY & MENTAL HEALTH

History of clinical psychology and its role in understanding and alleviation of mental illness, promotion of mental health and rehabilitation of the mentally ill, role and functions of clinical psychologists in DMHP, professional code of conduct and ethical issues

Text Books:

1. M. S. Bhatia, “Clinical Psychology”, B J Publishers,1st Edition, 2008.
2. Paul Bennett, “Abnormal and Clinical Psychology: An Introductory Textbook”, Pearson Publishers, 2nd Edition, 2006.

Reference Books:

1. Robert A. Baron, Girishwar Misra, "Psychology: Indian Subcontinent Edition", Pearson Education, 5th Edition, 2009.
2. Hill Gard, E. R., C.A. Richard, L.A.Rita, "Introduction to Psychology", Oxford & IBH, New Delhi, 6th Edition, 1976.

Web References:

1. https://www.amazon.com/Clinical-Psychology-Counseling-Books/b?ie=UTF8&node=11143
2. https://global.oup.com/academic/content/series/o/oxford-textbooks-in-clinical-psychology-otcp/?cc=in&lang=en&

E-Text Books:

1. https://www.amazon.com/Clinical-Psychology-Counseling-Books/b?ie=UTF8&node=11143
2. https://books.google.co.in/books/about/Clinical_Psychology.html?id=u4aDPdw0Fi4C&redir_esc=y

Course Home Page:

ENGLISH FOR SPECIAL PURPOSES

IV Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHS606	Perspective	-	-	-	-	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: Nil		

OBJECTIVES:

The course should enable the students to:

I. Learn the structure and style of effective sentences, paragraphs, and essays.
II. Focus on diction and spelling, punctuation and mechanics, and functional grammar in direct relation to students' own writing.
III. Understand and apply the basic conventions of syntax and mechanics; and proofread competently and prepare acceptable manuscripts.
IV. Emphasize the importance of language in academic and employability
V. Empower the communicative skills which enhance the employability skills with self-confidence.

UNIT-I	PRESENTATION SKILLS

English presentation, effective presentation, live presentation, web access, language orientation, classifications, method of presentations, declarations ,impact, concepts of presentation, skill oriented presentations, analysis of presentation, types of presentations.

UNIT-II	NON-VERBAL COMMUNICATION

Overview, this unit includes body language, posture, distance different levels of physical closeness appropriate to different types of relationship, right usage of gestures, open and closed postures, to be aware of facial expressions and their importance in non-verbal communication.

UNIT-III	INTERPERSONAL SKILLS

To build rapport, handling the criticism, giving and receive the feedback, be assertive, influencing and negotiation skills.

Methods of interpersonal skills, problem solving, decision making, verbal communication, peer negotiation, effective participating.

UNIT-IV	LISTENING

Listen effectively, how to make notes, the difference between active listening and passive listening to understand different dialects. Initiating the contact, the important context in communicating. the reluctant speaker, appendices, problems in listening.

UNIT-V	SPEAKING AND READING

Actively participate in GDs and debates, deal with JAM topics, answer questions in interviews, vocabulary section, useful information, discussing, socializing the effectiveness; How to read critically, to understand the main idea and tone of the author to understand complex ideas.

Text Books:

1. Susan E. Boyer, "Word Building Activities for Beginners of English" Birrong Book Publishers, 1st Edition, 2009.
2. Clive Oxenden, Christina Latham-Koenig, Paul Seligson, "New English File Intermediate Workbook", Oxford Publications, 1st Edition, 2006.
3. P Peter Bullions, "Practical Lessons in English Grammar and Composition", ESL Publications, 1st Edition, 1849.

Reference Books:

1. Wren and Martin, "High school English Grammar and Composition", S Chand Publications,1st Edition, 2013.
2. Ron Cowan, "The Teacher's Grammar of English, Cambridge University Press, 1st Edition, 2008.

Web References:

1. http://www.cde.ca.gov/be/st/ss/documents/englangdevstnd.pdf
2. http://ell.stanford.edu/sites/default/files/ELP_task_force_report_rev.pdf

E-Text Books:

1. http://www.linguistik-online.org/40_09/dahmardeh.pdf
2. http://bookboon.com/en/english-language-ebooks

Course Home Page:

ENTREPRENEURSHIP

IV Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHS607	Perspective	-	-	-	-	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: Nil		

OBJECTIVES:

The course should enable the students to:

I. Identify and apply the elements of entrepreneurship and to entrepreneurial processes;
II. Recognize the importance of entrepreneurship and identify the profile of entrepreneurs and their role in economic growth.
III. Analyze the business environment, opportunity recognition, and the business idea-generation process;
IV. Develop an idea on the legal framework and also understand strategic perspectives in entrepreneurship.

UNIT-I UNDERSTANDING ENTREPRENEURIAL MINDSET

The revolution impact of entrepreneurship-The evolution of entrepreneurship-Approaches to entrepreneurship-Process approach-Twenty first centaury trend s in entrepreneurship.

UNIT-II THE INDIVIDUAL ENTREPRENEURIAL MINDSET

The individual entrepreneurial mind set and personality, the entrepreneurial journey, stress and the entrepreneur, the entrepreneurial ego, entrepreneurial motivation, corporate entrepreneurial mindset the nature of corporate entrepreneur, conceptualization of corporate entrepreneurship strategy sustaining corporate entrepreneurship

UNIT-III LAUNCHING ENTREPRENEURIAL VENTURES

Opportunities identification, entrepreneurial imagination and creativity, the nature of the creativity process, innovation and entrepreneurship, methods to initiate ventures.

Creating new ventures acquiring an established entrepreneurial venture, franchising-hybrid disadvantage of franchising.

UNIT-IV LEGAL CHALLENGES OF ENTREPRENEURSHIP

Intellectual property protection, patents, copyrights trademarks and trade secrets-avoiding trademark pitfalls, formulation of the entrepreneurial plan, the challenges of new venture start-ups, poor financial understanding, and critical factors for new venture development-the evaluation process-feasibility criteria approach.

UNIT-V STRATEGIC PERSPECTIVES IN ENTREPRENEURSHIP

Strategic planning, strategic actions, strategic positioning business stabilization, building the adaptive firms-understanding the growth stage, unique managerial concern of growing ventures.

Text Books:

1. D F Kuratko,T V Rao, "Entrepreneurship: A South Asian Perspective", Cengage Learning, 1st Edition,2012.
2. Gordon, K .Natarajan, "Entrepreneurship Development", Himalaya, 4th Edition, 2008.
3. Coulter, "Entrepreneurship in Action", PHI, 2nd Edition, 2002.
4. S.S. Khanka, "Entrepreneurial Development", S. Chand & Co. Ltd, 5th Edition, 2007.

Reference Books:

1. Vijay Sathe, "Corporate Entrepreneurship", Cambridge, 1st Edition, 2009.
2. Vasanth Desai, "Dynamics of Entrepreneurial Development and Management", HPH, Millenium Edition, 2007.
3. P. Narayana Reddy, "Entrepreneurship – Text and Cases", Cengage Learning", 1st Edition, 2010.
4. David H. Hott, "Entrepreneurship New Venture Creation", PHI, 1st Edition, 2004.

Web References:

1. http://www.tutorialspoint.com/entrepreneurship_development/entrepreneurship_development_tutorial.pdf
2. http://www.advalue-project.eu/content_files/EN/33/AdValue_Personal_Effectiveness_EN.pdf

E-Text Books:

1. http://www.freebookcentre.net/Business/Entrepreneurship-Books.html
2. http://www.e-booksdirectory.com/listing.php?category=390
3. http://www.bookboon.com/en/entrepreneurship-ebooks

Course Home Page:

GERMAN LANGUAGE

IV Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHS608	Perspective	-	-	-	-	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: Nil		

OBJECTIVES:

The course should enable the students to:

I. Complete reading, writing, speaking, and listening assignments with ever increasing proficiency and accuracy.
II. Increase grammatical accuracy on written assignments.
III. Implement the language skills in listening, speaking, reading and writing in German language.

UNIT-I	GERMAN SOUNDS

Vowels, consonants, diphthongs, umlaut, the nouns, gender distinctions, cases, definite and indefinite articles, conjugation of verbs, verbs with separable and inseparable prefixes, modal verbs, personal pronouns, possessive pronouns, reflexive pronouns, cases nominative, accusative and dative; Structure of sentence and categories of sentences, subordinate clause, causative and conditional sentences; A very interesting slideshow presentation is held to enlighten the students about the culture, people, and lifestyle in Germany.

UNIT-II	SENTENCES FORMATION

Infinite sentences, use of conjunctive and conjunctive ii (contd.) plusquam perfect, modal verb (contd.) conjunction, temporal, subordinate clauses complex sentences.

UNIT-III	GERMAN BASIC GRAMMAR

Verbs: Different forms, past tense and present perfect tense, adjectives and their declension, degrees of comparison; Prepositions, genitive case, conjunctive.

Different conjunctions (co-coordinating and subordinating), simple, complex and compound sentences, active and passive voice, relative pronouns.

UNIT-IV	PURPOSE OF LANGUAGE STUDY

Pictures and perceptions, conflicts and solutions, change and the future, the purpose of the study of the German language, listening, understanding, reacting, speaking, communicating, use of language, pronunciation and intonation ,reading, reading and understanding, writing, text writing, text forming, use of language, language reflection, building up the language, language comparison, culture reflection, other cultures and cultural identity.

UNIT-V	GERMAN ADVANCED COMMUNICATION LEVEL-1

The significance of language study 1. Speaking and thinking 2. Self – discovery 3. Communication 4. Language Competence 5. Language and culture 6. Language changes 7. Connection with other areas of study 8. The mother—language 9. Other languages.

Text Books:

1. Korbinian, Lorenz Nieder Deutschals Fremds prache IA. Ausländer, "German Language", Perfect Paperback Publishers, 1st Edition, 1992.
2. Deutsch als Fremdsprache, IB, Ergänzungskurs,"German Language", Front Cover. Klett, Glossar Deutsch-Spanish Publishers, 1st Edition, 1981.

Reference Books:

1. Griesbach, "Moderner Gebrauch der deutschen Sprache", Schulz Publishers,10th Edition, 2011.
2. Anna Quick , Hermann Glaser U.A, "Intermediate German: A Grammar and workbook", Paperback, 1st Edition, 2006.

Web References:

1. http://www.prsformusicfoundation.com/docs/408/Schenke%20-%20Seago%20-%20Basic%20German.pdf
2. https://upload.wikimedia.org/wikipedia/commons/2/2d/German.pdf

E-Text Books:

1. http://www.staidenshomeschool.com/files/Learning_German_Ebook.pdf
2. http://weblearn.ox.ac.uk/access/content/group/modlang/general/handbooks/09-10/prelims/german_language_guide_0910.pdf

Course Home Page:

DESIGN HISTORY

IV Semester: Common for all Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHS609	Perspective	-	-	-	-	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: Nil		

OBJECTIVES:

The course should enable the students to:

I. Understand the fundamental theoretical and historic graphical topics of design, from the fifties of the twentieth century to the present day.
II. Use methodological tools and develop their analytical and critical capacities, so that they can grasp the bonds that link works of design with their respective social, economic and cultural backdrop.
III. Identify the influences at work between the various different creative disciplines.
IV. Develop their analytical and critical abilities, focusing on their search for their own expressive design language.

UNIT-I **INTRODUCTION TO DESIGN HISTORY**

Materials and techniques of design, design in the machine age, design body, environmental design.

UNIT-II **DESIGN PRODUCTS**

Innovative ideas of design products, intellectual and creative research, commercial and critical perspectives on design products, social, ethical and economic impact of your design.

UNIT-III **GLOBAL INNOVATION IN DESIGN**

Styles of global innovation design, the service design basics.

Concepts of vehicle design, techniques of design engineering (IDE).

UNIT-IV **THE DESIGN INTERACTIONS**

Interaction design, digital media, fine art, products, graphic and furniture design, architecture, life sciences, biotech, social sciences, and computer science, human consequences of different technological design futures.

UNIT-V **RESEARCH IN DESIGN HISTORY**

Research in craftsmanship and artisanal cultures, design, trade and exchange, design exhibitions, curatorial practice, history and theory, design and national, global identities ,the design and material culture of the domestic interior, material history and the history of materiality, Asian design history.

Text Books:

1. R.S. Khurmi, "A Textbook of Machine Design", Eurasia Publishing House (pvt.) Ltd., 14th Edition, 2005.
2. Nicolas, "Beyond", Nova Publishers, 2nd Edition, 2014.
3. Mariana Amatullo**, "**Career Pathways in Design for Social Innovation; Design matters at Art Center College of Design", LEAP Dialogues, 1st Edition, 2016.

Reference Books:
1. Max Bruinsma, “Design for the Good Society”, Paperback, 1st Edition, 2015. 2. Beppe Finessi, “How to Break the Rules of Brand Design”, Global Publishers, 1st Edition, 2009.
Web References:
1. https://en.wikipedia.org/wiki/Web_design 2. https://en.wikipedia.org/wiki/Responsive_web_design
E-Text Books:
1.http://www.creativebloq.com/design/free-ebooks-designers-7133700 2.https://www.amazon.com/Designing-History-East-Asian-Textbooks/dp/0415855586
Course Home Page:

GENDER SENSITIVITY

III Semester: Common to All Branches

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHS017	Perspective	-	-	-	-	-	-	-
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: Nil		

OBJECTIVES:

The course should enable the students to:

I. Understand the basic concepts relating to gender and to provide logical understanding of gender roles.
II. Analyze present various perspective of body and discourse on power relationship.
III. Develop cultural construction of masculinity and femininity.
IV. Study the evolution of gender studies from women's studies

UNIT-I INTRODUCTION

Sex and gender; types of gender, gender roles and gender division of labour, gender stereotyping and gender discrimination the other and objectification, male gaze and objectivity.

UNIT-II GENDER PERSPECTIVES OF BODY

Biological-phenomenological and socio-cultural perspectives of body, body as a site and articulation of power relations- cultural meaning of female body and women's lived experiences -gender and sexual culture.

UNIT-III SOCIAL CONSTRUCTION OF FEMININITY

Bio-social perspective of gender, gender as attributional fact, essentialism in the construction of femininity, challenging cultural notions of femininity.

Butler, Douglas, Faucault and Haraway, images of women in sports, arts, entertainment and fashion industry, media and feminine identities.

UNIT-IV SOCIAL CONSTRUCTION OF MASCULINITY

Definition and understanding of masculinities, sociology of masculinity, social organization of masculinity and privileged position of masculinity, politics of masculinity and power, media and masculine identities.

UNIT-V WOMEN'S STUDIES AND GENDER STUDIES

Evolution and scope of women's studies, from women's studies to gender studies: A paradigm shift, women's studies vs. gender studies, workshop, gender sensitization through gender related.

Text Books

1. Gender," How Gender Inequality Persists in the Modern World", Oxford University Press, Reprinted Edition, 2011.
2. William M Johnson "Recent reference books in religion", Duke University Publications, Reprinted Edition, 2014.

Reference Books

4. Alolajis. Mustapha, Sara Mils, “Gender representation in learning materials”, Pearson Publications, 1st Edition, 2015.

Web References:

1. https://www.google.co.in/search?q=clinical++pscyology+ebooks&ie=utf-8&oe=utf-8&client=firefox-b-ab&gfe_rd=cr&ei=xPmJV6OhFcuL8Qf3qam4Cw#q=gender+sensitivity+web+references
2. https://en.wikipedia.org/wiki/Gender_sensitization

E-Text Books:

1. http://ebooklibrary.org/articles/gender_sensitization
2. http://cbseacademic.in/publication_ebooks.html

Course Home Page:

VI Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE801	SKILL	-	-	-	-	-	-	-
Contact Classes:	Tutorial Classes: Nil		Practical Classes: Nil			Total Classes:		

OBJECTIVES:

The course should enable the students to:

I. Apply knowledge of computing and mathematics appropriate to the discipline.
II. Illustrate the concepts of machine learning and related algorithms.
III. Understand the dimensionality problems using linear discriminants.
IV. Study various statistical models for analyzing the data.
V. Learn clustering algorithms for unlabeled data.

UNIT - I **TYPES OF MACHINE LEARNING**

Concept learning: Introduction, version spaces and the candidate elimination algorithm; Learning with trees: Constructing decision trees.

UNIT - II **LINEAR DISCRIMINANTS**

Perceptron (MLP): Going forwards, backwards, MLP in practices, deriving back; Propagation support vector Machines: Optimal separation, kernels.

UNIT - III **BASIC STATISTICS**

Averages, variance and covariance, the Gaussian; The bias-variance tradeoff Bayesian learning: Introduction, Bayes theorem, Bayes optimal classifier, naïve Bayes classifier. Graphical models: Bayesian networks, approximate inference, making Bayesian networks.

UNIT - IV **EVOLUTIONARY LEARNING**

Genetic Algorithms, genetic operators; Genetic programming; Ensemble learning: Boosting, bagging; Dimensionality reduction: Linear discriminate analysis.

UNIT - V **CLUSTERING**

Similarity and distance measures, outliers, hierarchical methods, partitional algorithms, clustering large databases, clustering with categorical attributes, comparison.

Text Books:

1. Tom M. Mitchell, "Machine Learning ", McGraw Hill, 1st Edition, 2013.
2. Stephen Marsland, "Machine Learning - An Algorithmic Perspective ", CRC Press, 1st Edition, 2009.

Reference Books:

1. Margaret H Dunham, "Data Mining", Pearson Edition, 2nd Edition, 2006.
2. Galit Shmueli, Nitin R Patel, Peter C Bruce, "Data Mining for Business Intelligence", John Wiley and Sons, 2nd Edition, 2007.
3. Rajjal Shinghal, "Pattern Recognition and Machine Learning", Springer-Verlag, New York, 1st Edition, 2006.

Web References:

1. Httd://ww.udemy.com/MachineLearning/Online_Course
2. https://en.wikipedia.org/wiki/Machine_learning

E-Text Books:

1. http://www.e-booksdirectory.com/details.php?ebook=1118
2. http://www.otexts.org/sfml

AIRCRAFT MODELING

VI Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE802	SKILL	-	-	-	-	-	-	-
Contact Classes:	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes:			

OBJECTIVES:

The course should enable the students to:

I. Understand the basic ideas Conservation of the Angular Momentum Equations.
II. Learn the Modeling of the Longitudinal Steady-State Aerodynamic Forces and Moment.
III. Understand the technology and basic components modelling.
IV. Discuss the Modeling of Lateral Directional Aerodynamic Forces and Moments.

UNIT - I	AIRCRAFT EQUATIONS OF MOTION

Introduction, Reference Frames and Assumptions, Conservation of the Linear Momentum Equations (CLMEs), Conservation of the Angular Momentum Equations (CAMEs), Conservation of the Angular Momentum Equations (CAMEs) with Rotor Effects, Euler Angles, Flight Path Equations (FPEs), Kinematic Equations (KEs), Gravity Equations (GEs), Summary of the Aircraft Equations of Motion, Definition of Steady-State and Perturbation Conditions, Aircraft Equations of Motion at Steady-State Conditions, Aircraft Equations of Motion at Perturbed Conditions, Small Perturbation Equations from a Steady-State Level Flight.

UNIT - II	MODELING OF LONGITUDINAL AERODYNAMIC FORCES AND MOMENTS

Introduction, Aircraft Stability Axes, Modeling of the Longitudinal Steady-State Aerodynamic Forces and Moment, Modeling of Fax, Modeling of FAz' 83, Modeling of MA, Aircraft Aerodynamic Center, Summary of the Longitudinal Steady-State Aerodynamic Forces and Moment, Modeling of the Longitudinal Small Perturbation Aerodynamic Forces and Moments, Modeling of (CD&, CL., Cm1), Modeling of (cD., cLu, em.), Modeling of (CD.;, CL (Cll\0) and (CDq, CLq, Cmq).

UNIT - III	MODELING OF LATERAL DIRECTIONAL AERODYNAMIC FORCES AND MOMENTS

Introduction, Modeling of Fay, Conceptual Modeling of Cyp, Mathematical Modeling of cyp, Modeling of Cr6A, Modeling of ey6, Modeling of LA1, Conceptual Modeling of C/fJ, Mathematical Modeling of CIIJ, Modeling of C; A, Modeling of c16, Modeling of NA1, Conceptual Modeling of C11J, Mathematical Modeling of C11J, Modeling of c106A, Modeling of c116.

UNIT - IV	MODELING OF THE SMALL PERTURBATION LATERAL DIRECTIONAL AERODYNAMIC FORCE AND MOMENTS

Modeling of Cyβ' qiβ' Cnβ, Modeling of cyP, Modeling of clp, Modeling of Cnp,. Modeling of Cyr, Modeling of Clr Modeling of Cnr.

UNIT - V	REVIEW OF BASIC AIRCRAFT PERFORMANCE AND MODELING OF THRUST FORCES AND MOMENTS

Introduction, Review of Different Aircraft Propulsion Systems: Piston Engine (Propeller) Aircraft Engines, Turboprop Aircraft Engines, Turbojet Aircraft Engines, Turbofan Aircraft Engines, RamjetAircraft Engines. Power at Level Flight: Maximum Aerodynamic Efficiency, Minimum Aerodynamic Drag, Minimum Power Required. Determination of Power Required, Determination of Power Available,Modeling of the Thrust Forces and Moments: Modeling of the Steady-State Thrust

Forces and Moments, Modeling of the Small Perturbation Thrust Forces and Moments.
Text Books:
1. Marcello R. Napolitano "Aircraft Dynamics from Modeling to Simulation", John Wiley & Sons, 2011, ISBN, 0470626674, 9780470626672.
Reference Books:
1. Brett Green "Aircraft Modelling (Modeling Master class)" Bloomsbury USA, 2010, ISBN 1846039320, 9781846039324. 2. Ranjan Vepa "Flight Dynamics Simulation and Control For Rigid and Flexible Aircraft" CRC Press , 18, 1st Edition, 2014 , ISBN 9781466573352 - CAT# K16647.
Web References:
1. https://books.google.co.in/books 2. https://www.amazon.co.uk/Aircraft-Modelling-Masterclass-Brett-Green/dp/1846039320
E-Text Books:
1. https://books.google.co.in/books?id=jmG6dXpa7A0C&printsec=frontcover&dq=aircraft+modeling&hl=en&sa=X&ved=0ahUKEwixqrzXmNvgAhXJro8KHRgtBYwQ6AEIOjAE#v=onepage&q=aircraft%20modeling&f=false 2. https://books.google.co.in/books?id=VMij4rR-zoC&dq=Marcello+R.+Napolitano+-+Aircraft+Dynamics++From+Modeling+to+Simulation-Wiley+(2011)&hl= en&sa= X&ved=0ahUKEwj5vNrkptvgAhULuI8KHQoWBrkQ6AEIKDAA

AIRCRAFT INTERIOR DESIGN

VI Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE803	SKILL	-	-	-	-	-	-	-
Contact Classes:	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes:			

OBJECTIVES:

The course should enable the students to:

I. Understand the basic ideas about comfort requirements for the passengers.
II. Learn the Interior design parameters.
III. Understand the required technology to design Interior of aircraft.
IV. Discuss the various types of New Demands for Aircraft seats and other interior components.

UNIT - I **AIRCRAFT INTERIOR COMFORT**

Comfort Stories, Role of Comfort in Sales, The Difficulty of Making People Feel Comfortable, The Good News: It Is Possible to Make People, Feel More Comfortable, Comfort Theory, Comfort Manifestations, Inputs Leading to (Dis)comfort, History, State of Mind, Visual Input, Smell, Noise, Temperature and Humidity, Pressure and Touch, Posture and Movements, Persons Influencing theInput.

UNIT - II **AIRCRAFT INTERIOR COMFORT STUDIES**

Lack of Many Substantial Studies on Aircraft Comfort -A Classic Study, German Study on Aircraft Interior Comfort, Experience Preceding the Flight, Experience during the Flight Experience after the Flight, A Study Regarding Service, Perceived Value, and Satisfaction in Taiwan, A German Study of Noise, A Dutch Study Regarding Aircraft Interior Comfort ,A U.S. Study Regarding Passenger Experience.

UNIT - III **THE VOICES OF CUSTOMERS**

Technology Versus Passenger, Innovations Have Their Effects, Study Methodology, Factors Correlating with Comfort, Leg Room, Hygiene, Crew, Luggage Room, Neighbor, Seat Flying Time, In-Flight Entertainment, Delay, Lost Luggage, Aircraft Type, Direct versus No Direct Flight.

UNIT - IV **NEW DEMANDS FOR AIRCRAFT SEATS**

Using Research for Seat Design, Seat Design and Health, Aircraft Seats Should Fit, Pitch Watchers, Designing an Aircraft Seat Is Difficult, Ideal Pressure Distribution, Seating and Shear Forces, Comfort and Seating, Specific Dynamic Seat Characteristics, Comfort and "Wow", Feet off the Ground, Backrest Angle, Seating and Electronics, Other Features: Headrests and Massage, Opportunity for Designers.

UNIT - V **THE ULTRA COMFORTABLE FLIGHT EXPERIENCE AND ANALYSIS ON AIRCRAFT INTERIOR COMFORT AND DESIGN**

Introduction, The Flight Experience: At Home, Forty-Eight Hours before the Flight, To the Airport, At the Airport, The Lounge, Airport Plus, At the Gate, The Plane Entrance, The Long Haul Flight, Business Class, Inexpensive Flight, In-Flight Entertainment (IFE), Cleanliness, Crew, Arrival.
Introduction, Leg Room, Service, Hygiene, Luggage Room, Neighbor, Seat, IFE, Delay/Waiting.

Text Books:

1. Peter Vink and Klaus Brauer "Aircraft Interior Comfort And Design" CRC Press Taylor & Francis Group 6000 Broken Sound Parkway NW, Suite 300.

Reference Books:

1. B. Spicer “Introduction to Aircraft Interiors: Volume 1” Create space Independent Pub, 10th June 2009,ISBN-10: 1448601894
2. B. Spicer “Introduction to Aircraft Interiors: Volume 2” Create space Independent Pub, 10th June 2009, ISBN-13: 978-1448601899

Web References:

1. https://www.priestmangoode.com/project/latam
2. http://www.jetaviation.com/basel/completions/designstudio

E-Text Books:

1. https://books.google.co.in/books/about/Aircraft_Interior_Comfort_and_Design.html?id=WaWNp0fK8G0C&printsec=frontcover&source=kp_read_button&redir_esc=y#v=onepage&q&f=false
2. https://www.amazon.in/Introduction-Aircraft-Interiors-B-Spicer/dp/1448601894

AIRCRAFT NAVIGATION SYSTEMS

VII Semester: AERO

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE805	SKILL	-	-	-	-	-	-	-
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes:			

OBJECTIVES:

The course should enable the students to:

I. Describe the aircraft navigation systems and system used.
II. Explain the external navigation system and its techniques.
III. Understand the navigation tracking and safety system.
IV. Distinguish among missile, UAV and satellite Navigation system.

UNIT-I NAVIGATION SYSTEMS & SENSORS

Introduction to aircraft navigation systems– Introduction to Inertial Sensors – Mechanical – Ring Laser gyro – Accelerometers, Fiber optic gyro – MEMS system, Multi-sensors navigation.

UNIT-II INERTIAL NAVIGATION SYSTEMS

INS components: transfer function and errors- Earth in inertial space – coriolis effect – INS Mechanization. Platform and Strap down – Navigation algorithms - INS system block diagram, Different co-ordinate systems – Transformation Techniques - Schuler Tuning - compensation errors.

UNIT-III NAVIGATION, TRACKING AND SAFETY SYSTEMS

Different types of radio navigation- ADF, VOR, DME - Doppler – Hyperbolic Navigations-LORAN, DECCA and Omega – TACAN, ILS, MLS, GLS - Ground controlled approach system – surveillance Systems-radio altimeter, TCAS, ATC transponder, Regional Navigation Systems- Distress and Safety-Cospas- Sarsat- Inmarsat Distress System- Location-Based service, Emergency locator transmitters.

UNIT-IV MISSILE AND UAV NAVIGATION

Tactical Guidance Intercept Techniques, Proportional Navigation, Augmented and 3D Proportional Navigation, Optimal Control of Linear Feedback system, Way-point Navigation, UAV Control Stations, Path Planning, Collision Avoidance and Mid-air Collision (MAC) Avoidance.

UNIT-V SATELLITE NAVIGATION & HYBRID NAVIGATION

Introduction to Global Navigation Satellite Systems, Concepts of GPS, DGPS, Introduction to Kalman Filtering - Estimation and mixed mode navigation Integration of GPS and INS-utilization of navigation systems in aircraft.

Text Books:

1. Mike Tooley, David Wyatt "Aircraft Communications and Navigation Systems", 2nd Edition 1998.
2. Myron Kyton, Walfred Fried, 'Avionics Navigation Systems', John Wiley & Sons, 2nd Edition, 1997.
3. Mohinder S. Grewal, Angus P. Andrews, Chris G. Bartone. "Global Navigation Satellite Systems", Inertial Navigation, and Integration, 3rd Edition 1998.
4. Nagaraja, N.S. "Elements of Electronic Navigation", Tata McGraw-Hill Pub. Co., New Delhi, 2nd Edition, 1975.

Reference Books:

1. Reg Austin, "Unmanned Aircraft Systems: UAVS Design, Development and Deployment", Wiley, 2010.
2. George M. Siouris, Missile Guidance and Control Systems, Springer New York, 2010.
3. Antonios Tsourdos, Brian A White, Madhavan Shanmugavel, "Cooperative Path Planning of Unmanned Aerial Vehicles", Wiley, 2010.
4. George M Siouris, "Aerospace Avionics System; A Modern Synthesis", Academic Press Inc., 1993.

Web References:

4. http://nptel.ac.in/courses/101108056/

E-Text Books:

1. https://www.faa.gov/regulations_policies/handbooks_manuals/aircraft/amt_airframe_handbook/media/ama_Ch11.pdf

HIGH TEMPERATURE MATERIALS

VII Semester: AERO

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE806	SKILL	-	-	-	-	-	-	-
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes:			

OBJECTIVES:

The course should enable the students to:

I. Explain the creep behaviour, mechanisms and effect of different parameters like stress, temporary, strain rate on creep.
II. Learn laws that would be beneficial in determining the rupture life of a component.
III. Identify the various types of fracture and its occurrence.
IV. Understand the Oxidation and Corrosion, behaviour of super alloys and other high temperature materials.

UNIT-I CREEP

Creep – Creep Strength, Creep Limit, Creep Curve - Stages of Creep, Creep Fracture, Factors influencing creep property of a material, Factors Affecting Creep – Temperature, Stress, Time, Grain Size, Mechanism of Creep – Diffusion Creep & Dislocation Creep, Metallurgical Factors Influencing Creep at High Temperature, Creep Test, Creep resistant materials.

UNIT-II LAWS TO DETERMINE CREEP

Laws of Creep- Andrade's law, Logarithmic Law, Hyperbolic Law of Transient creep, Secondary creep law, Laws to determine rupture life of component – Larson –Miller Parameter, Monkman Grant Relationship, Creep Mechanism Maps.

UNIT-III HIGH TEMPERATURE FRACTURE

Fracture – Types of Fracture –Ductile fracture, Brittle fracture, Shearing Fracture, Factors Affecting Fracture, Fracture toughness, Griffith Theory of Brittle Fracture, Blue Brittleness, Orange Peel Effect, Cleavage Fracture, Micro void Coalescence and Dominant Void Growth Modes, Ductile to Brittle Transition (DBT), Bauchinger's effect.

UNIT-IV OXIDATION & CORROSION

Oxidation –Nature of Oxides formed on Metal Surface, Types of Corrosion, Kinetic laws of Oxidation – Parabolic rate law, Linear rate law and Logarithmic rate law, Pilling- Bedworth ratio, Corrosion – Types of Corrosion, Factors Influencing Corrosion, Fluxing Mechanisms – Acidic and Basic Fluxing, Effect of Alloying Element on Hot Corrosion, Corrosion Control - Methods to Combat Hot Corrosion.

UNIT-V HIGH TEMPERATURE RESISTANT MATERIALS

Super Alloys – Cobalt Base, Nickel base, Iron Base. Ultra High Temperature Ceramics, Intermetallics, Thermal Barrier Coatings, Hydrogen Embrittlement, Refractory Metals, Structural Heat Resistant Composites.

Text Books:

1. Norman E Dowling, "Mechanical Behaviour of Materials" Pearson Publisher, 4th Edition, 2012.
2. Jun-Shan Zhang, "High Temperature Deformation and Fracture of Materials", Publishing 1st Edition, Woodhead, 2010.

Reference Books:
1. J. Betten, “Creep Mechanics” Springer, 3rd Edition 2008.
Web References:
1. https://books.google.co.in/books?id=e-51AgAAQBAJ&printsec=frontcover#v=onepage&q&f= false 2. https://www.crcpress.com/High-Temperature-Materials-and-Mechanisms/Bar-Cohen/p/book/9781138071544
E-Text Books:
1. https://www.coursera.org/learn/materials-science/lecture/Fpo4U/mechanisms-for-creepdeformation 2. https://www.doitpoms.ac.uk/tlplib/creep/index.php

AEROSPACE STRUCTURAL HEALTH MONITORING SYSTEM

VII Semester: AERO

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE807	SKILL	-	-	-	-	-	-	-
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes:		

OBJECTIVES:

The course should enable the students to:

I. Understand the concept of new type of smart sensor for health monitoring system.
II. Evaluation of the damage detection using different technique.
III. Discuss the development of sensor using smart materials for aerospace application.
IV. Demonstrate the difference between theoretical developments and engineering applications.

UNIT-I AIRCRAFT STRUCTURAL HEALTH AND USAGE MONITORING

Introduction - aircraft structural damage - ageing aircraft problem - lifecycle cost of aerospace structures - aircraft structural design - damage monitoring systems in aircraft - non-destructive testing - structural health monitoring - emerging monitoring techniques and sensor technologies.

UNIT-II OPERATIONAL LOAD MONITORING USING OPTICAL FIBRE SENSORS

Introduction - Fibre Optics - Sensor Target Specifications - Reliability of Fibre Bragg Grating Sensors - Fibre Coating Technology - Example of Surface Mounted Operational Load Monitoring Sensor System - Optical Fibre Strain Rosette - Example of Embedded Optical Impact Detection System.

UNIT-III DAMAGE DETECTION USING STRESS AND ULTRASONIC WAVES

Acoustic Emission – Ultrasonics - Acousto-ultrasonics - Guided Wave Ultrasonics - Piezoelectric Transducers - Passive Damage Detection Examples - Active Damage Detection Examples.

UNIT-IV SIGNAL PROCESSING FOR DAMAGE DETECTION

Introduction - Data Pre-processing - Signal Features for Damage Identification - Time–Domain Analysis - Spectral Analysis - Instantaneous Phase and Frequency - Time–Frequency Analysis - Wavelet Analysis - Dimensionality Reduction Using Linear and Nonlinear Transformation - Data Compression Using Wavelets.

UNIT-V STRUCTURAL HEALTH MONITORING EVALUATION TESTS

Introduction - Large-scale Metallic Evaluator - Large-scale Composite Evaluator - Flight Tests - Summary.

Text Books:

1. Staszewski, W., Boller, C., & Tomlinson, G. R. “Health Monitoring of Aerospace Structures: Smart Sensor Technologies and Signal Processing. John Wiley & Sons, (Eds.). (2004).

Reference Books:

1. Andrei Zagrai (Editor), Brandon Arritt (Editor), Derek Doyle (Editor), “Structural Health Monitoring for Space Systems (Aerospace Series)”, Wiley-Blackwell ISBN-10: 1118729641.

Web References:

1. https://play.google.com/store/books/details?id=nzSPVBZ_Yg0C&rdid=booknzSPVBZ_Yg0C&rdot=1&source=gbs_vpt_read&pcampaignid=books_booksearch_viewport

2. https://play.google.com/store/books/details/Victor_Giurgiutiu_Structural_Health_Monitorig_wit?id=AG5h8Hu-MdUC
E-Text Books:
1. https://onlinecourses.nptel.ac.in/noc18_oe05/preview 2. http://www.cism.it/courses/A1102/ 3. http://courses.ce.metu.edu.tr/ce5802/2015/02/11/hello-world/

AIRBORNE RADAR SYSTEM

VII Semester: AERO

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAE808	SKILL	-	-	-	-	-	-	-
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes:			

OBJECTIVES:

The course should enable the students to:

I. Understand the concepts of Phased array antennas and detection of moving targets.
II. Analyse the Radars requirements and waveforms.
III. Identify the Advantages and constraints of tracking radars.
IV. Learn the concepts of radar systems for aircraft in landing and other aids.

UNIT-I **INTRODUCTION TO RADAR**

Basic Radar –The simple form of the Radar Equation- Radar Block Diagram- Radar Frequencies – Applications of Radar- Receiver noise and signal to noise ratio- Radar cross section (RCS) – Radar system –system losses- Radar Antennas types.

UNIT-II **TYPES OF RADARS**

CW and FMCW radars-Tracking radars-MTI radar -Principles of coherent MTI radars - Digital MTI, Synthetic Aperture radar, Principles of Pulsed Doppler Radar, Low-, High-, and medium-PRF Mode.

UNIT-III **RADAR SIGNAL PROCESSING**

Radar requirements –Matched filters- Radar ambiguity function – Optimum waveforms for detection in clutter – Classes of waveforms – Digital representation of signals -Pulse compression.

UNIT-IV **TRACKING RADAR**

Tracking with radar – Monopulse Tracking – conical scan and sequential lobing – limitations to tracking Accuracy- Kalman Tracker -Fundamentals of Airborne radar.

UNIT-V **FLIGHT RADAR SYSTEM**

History of flight radar-Role of radar in military and civil aircraft-Airborne Radars-Aircraft Doppler Stabilization and Navigation- Applications of Doppler Weather Radar-Air Traffic Control radar beacon system- Applications of microwave radar.

Text Books:

1. Merrill I. Skolnik , “Introduction to Radar Systems”, Tata Mc Graw-Hill, 3rd Edition, 2003.
2. N.S.Nagaraja, “Elements of Electronic Navigation Systems”, Tata Mc Graw-Hill 2nd Edition, 2000.

Reference Books:

1. Peyton Z. Peebles:, “Radar Principles”, John Wiley, 2004.
2. J.C Toomay, “Principles of Radar”, PHI, 2nd Edition 2004.

VISION AND MISSION OF THE INSTITUTE

VISION

To bring forth professionally competent and socially sensitive engineers, capable of working across cultures meeting the global standards ethically.

MISSION

To provide students with an extensive and exceptional education that prepares them to excel in their profession, guided by dynamic intellectual community and be able to face the technically complex world with creative leadership qualities.

Further, be instrumental in emanating new knowledge through innovative research that emboldens entrepreneurship and economic development for the benefit of wide spread community.

B.TECH - PROGRAM OUTCOMES (POS)

PO-1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems (**Engineering Knowledge**).

PO-2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences **(Problem Analysis).**

PO-3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations **(Design/Development of Solutions).**

PO-4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions **(Conduct Investigations of Complex Problems).**

PO-5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations **(Modern Tool Usage).**

PO-6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice **(The Engineer and Society).**

PO-7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development **(Environment and Sustainability).**

PO-8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **(Ethics).**

PO-9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **(Individual and Team Work).**

PO-10: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions **(Communication).**

PO-11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change **(Life-long learning).**

OBJECTIVES OF THE DEPARTMENT

DEPARTMENT OF AERONAUTICAL ENGINEERING

Programme Educational Objectives (PEO's)

The current Aeronautical Engineering program educational objectives were developed as part of the program's ongoing efforts to maintain through innovation in undergraduate program that meets the needs of our constituents. The current educational objectives of the Aeronautical Engineering program are:

PEO – I: To prepare and provide student with an academic environment for students to excel in postgraduate programs or to succeed in industry / technical profession and the life-long learning needed for a successful professional career in Aeronautical Engineering and related fields (Preparation & Learning Environment).

PEO – II: To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve engineering problems and also to pursue higher studies (Core Competence).

PEO – III: To train students with good scientific and engineering breadth so as to comprehend, analyze, design, and create novel products and solutions for the real life problems (Breadth).

PEO – IV: To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate engineering issues to broader social context (Professionalism).

PROGRAM SPECIFIC OUTCOMES (PSO's)

PSO – I: **Professional skills:** Able to utilize the knowledge of aeronautical/aerospace engineering in innovative, dynamic and challenging environment for design and development of new products

PSO – II: **Problem solving skills:** Imparted through simulation language skills and general purpose CAE packages to solve practical, design and analysis problems of components to complete the challenge of airworthiness for flight vehicles

PSO – III: **Practical implementation and testing skills:** Providing different types of in house and training and industry practice to fabricate and test and develop the products with more innovative technologies

PSO – IV: **Successful career and entrepreneurship:** To prepare the students with broad aerospace knowledge to design and develop systems and subsystems of aerospace and allied systems and become technocrats.

FREQUENTLY ASKED QUESTIONS AND ANSWERS ABOUT AUTONOMY

1. Who grants Autonomy? UGC, Govt., AICTE or University

In case of Colleges affiliated to a university and where statutes for grant of autonomy are ready, it is the respective University that finally grants autonomy but only after concurrence from the respective state Government as well as UGC. The State Government has its own powers to grant autonomy directly to Govt. and Govt. aided Colleges.

2 Shall IARE award its own Degrees?

No. Degree will be awarded by Jawaharlal Nehru Technological University, Hyderabad with a mention of the name IARE on the Degree Certificate.

3 What is the difference between a Deemed University and an Autonomy College?

A Deemed University is fully autonomous to the extent of awarding its own Degree. A Deemed University is usually a Non-Affiliating version of a University and has similar responsibilities like any University. An Autonomous College enjoys Academic Autonomy alone. The University to which an autonomous college is affiliated will have checks on the performance of the autonomous college.

4 How will the Foreign Universities or other stake – holders know that we are an Autonomous College?

Autonomous status, once declared, shall be accepted by all the stake holders. The Govt. of Telangana mentions autonomous status during the First Year admission procedure. Foreign Universities and Indian Industries will know our status through our website.

5 What is the change of Status for Students and Teachers if we become Autonomous?

An autonomous college carries a prestigious image. Autonomy is actually earned out of our continued past efforts on academic performances, our capability of self- governance and the kind of quality education we offer.

6 Who will check whether the academic standard is maintained / improved after Autonomy? How will it be checked?

There is a built in mechanism in the autonomous working for this purpose. An Internal Committee called Academic Programme Evaluation Committee, which will keep a watch on the academics and keep its reports and recommendations every year. In addition the highest academic council also supervises the academic matters. The standards of our question papers, the regularity of academic calendar, attendance of students, speed and transparency of result declaration and such other parameters are involved in this process.

7 Will the students of IARE as an Autonomous College qualify for University Medals and Prizes for academic excellence?

No. IARE has instituted its own awards, medals, etc. for the academic performance of the students. However for all other events like sports, cultural on co-curricular organized by the University the students shall qualify.

8 Can IARE have its own Convocation?

No. Since the University awards the Degree the Convocation will be that of the University, but there will be Graduation Day at IARE.

9 Can IARE give a provisional degree certificate?

Since the examinations are conducted by IARE and the results are also declared by IARE, the college sends a list of successful candidates with their final Grades and Grade Point Averages including CGPA to the University. Therefore with the prior permission of the University the college will be entitled to give the provisional certificate.

10 Will Academic Autonomy make a positive impact on the Placements or Employability?

Certainly. The number of students qualifying for placement interviews is expected to improve, due to rigorous and repetitive classroom teaching and continuous assessment. Also the autonomous status is more responsive to the needs of the industry. As a result therefore, there will be a lot of scope for industry oriented skill development built-in into the system. The graduates from an autonomous college will therefore represent better employability.

11 What is the proportion of Internal and External Assessment as an Autonomous College?

Presently, it is 70 % external and 30% internal. As the autonomy matures the internal assessment component shall be increased at the cost of external assessment.

12 Is it possible to have complete Internal Assessment for Theory or Practicals?

Yes indeed. We define our own system. We have the freedom to keep the proportion of external and internal assessment component to choose.

13 Why Credit based Grade System?

The credit based grade system is an accepted standard of academic performance the world over in all Universities. The acceptability of our graduates in the world market shall improve.

14 What exactly is a Credit based Grade System?

The credit based grade system defines a much better statistical way of judging the academic performance. One Lecture Hour per week of Teaching Learning process is assigned One Credit. One hour of laboratory work is assigned half credit. Letter Grades like A, B,C,D, etc. are assigned for a Range of Marks. (e.g. 91% and above is A+, 80 to 90 % could be A etc.) in Absolute Grading System while grades are awarded by statistical analysis in relative grading system. We thus dispense with sharp numerical boundaries. Secondly, the grades are associated with defined Grade Points in the scale of 1 to 10. Weighted Average of Grade Points is also defined Grade Points are weighted by Credits and averaged over total credits in a Semester. This process is repeated for all Semesters and a CGPA defines the Final Academic Performance

15 What are the norms for the number of Credits per Semester and total number of Credits for UG/PG programme?

These norms are usually defined by UGC or AICTE. Usually around 25 Credits per semester is the accepted norm.

16 What is a Semester Grade Point Average (SGPA)?

The performance of a student in a semester is indicated by a number called SGPA. The SGPA is the weighted average of the grade points obtained in all the courses registered by the student during the semester.

$$SGPA = \sum_{i=1}^{n} (C_i G_i) / \sum_{i=1}^{n} C_i$$

Where, C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course and i represent the number of courses in which a student registered in the concerned semester. SGPA is rounded to two decimal places.

17 What is a Cumulative Grade Point Average (CGPA)?

An up-to-date assessment of overall performance of a student from the time of his first registration is obtained by calculating a number called CGPA, which is weighted average of the grade points obtained in all the courses registered by the students since he entered the Institute.

$$CGPA = \sum_{j=1}^{m} \left(C_j S_j \right) / \sum_{j=1}^{m} C_j$$

Where, S_j is the SGPA of the j^{th} semester and C_j is the total number of credits upto the semester and m represent the number of semesters completed in which a student registered upto the semester. CGPA is rounded to two decimal places.

18 Is there any Software available for calculating Grade point averages and converting the same into Grades?

Yes, The institute has its own MIS software for calculation of SGPA, CGPA, etc.

19 Will the teacher be required to do the job of calculating SGPAs etc. and convert the same into Grades?

No. The teacher has to give marks obtained out of whatever maximum marks as it is. Rest is all done by the computer.

20 Will there be any Revaluation or Re-Examination System?

No. There will double valuation of answer scripts. There will be a make up Examination after a reasonable preparation time after the End Semester Examination for specific cases mentioned in the Rules and Regulations. In addition to this, there shall be a 'summer term' (compressed term) followed by the End Semester Exam, to save the precious time of students.

21 How fast Syllabi can be and should be changed?

Autonomy allows us the freedom to change the syllabi as often as we need.

22 Will the Degree be awarded on the basis of only final year performance?

No. The CGPA will reflect the average performance of all the semester taken together.

23 What are Statutory Academic Bodies?

Governing Body, Academic Council, Examination Committee and Board of Studies are the different statutory bodies. The participation of external members in every body is compulsory. The institute has nominated professors from IIT, NIT, University (the officers of the rank of Pro-vice Chancellor, Deans and Controller of Examinations) and also the reputed industrialist and industry experts on these bodies.

24 Who takes Decisions on Academic matters?

The Governing Body of institute is the top academic body and is responsible for all the academic decisions. Many decisions are also taken at the lower level like Boards of Studies. Decisions taken at the Boared of Studies level are to be ratified at the Academic Council and Governing Body.

25 What is the role of Examination committee?

The Examinations Committee is responsible for the smooth conduct of internal, End Semester and make up Examinations. All matters involving the conduct of examinations spot valuations, tabulations preparation of Grade Cards etc fall within the duties of the Examination Committee.

26 Is there any mechanism for Grievance Redressal?

The institute has grievance redressal committee, headed by Dean - Student affairs and Dean - IQAC.

27 How many attempts are permitted for obtaining a Degree?

All such matters are defined in Rules & Regulation

28 Who declares the result?

The result declaration process is also defined. After tabulation work wherein the SGPA, CGPA and

final Grades are ready, the entire result is reviewed by the Moderation Committee. Any unusual deviations or gross level discrepancies are deliberated and removed. The entire result is discussed in the Examinations and Result Committee for its approval. The result is then declared on the institute notice boards as well put on the web site and Students Corner. It is eventually sent to the University.

29 Who will keep the Student Academic Records, University or IARE?

It is the responsibility of the Dean, Academics of the Autonomous College to keep and preserve all the records.

30 What is our relationship with the JNT University?

We remain an affiliated college of the JNT University. The University has the right to nominate its members on the academic bodies of the college.

31 Shall we require University approval if we want to start any New Courses?

Yes, It is expected that approvals or such other matters from an autonomous college will receive priority.

32 Shall we get autonomy for PG and Doctoral Programmes also?

Yes, presently our PG programmes also enjoying autonomous status.

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

S.No	Nature of Malpractices/Improper conduct	Punishment
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculator, cell phone, pager, palm computer or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the Controller of Examinations.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.

4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Controller of Examinations /Additional Controller of Examinations/any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the COE or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the COE or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the Institute premises or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears off the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already

		appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

UNDERTAKING BY STUDENT / PARENT

"To make the students attend the classes regularly from the first day of starting of classes and be aware of the College regulations, the following Undertaking Form is introduced which should be signed by both student and parent. The same should be submitted to the Dean, Academic".

I, Mr./Ms. ---------- joining I Semester / III Semester for the academic year 2016-2017 / 2017-2018 in Institute of Aeronautical Engineering, Hyderabad, do hereby undertake and abide by the following terms, and I will bring the ACKNOWLEDGEMENT duly signed by me and my parent and submit it to the Dean, Academic.

1. I will attend all the classes as per the timetable from the starting day of the semester specified in the institute Academic Calendar. In case, I do not turn up even after two weeks of starting of classes, I shall be ineligible to continue for the current academic year.
2. I will be regular and punctual to all the classes (theory/practical/drawing) and secure attendance of not less than 75% in every course as stipulated by Institute. I am fully aware that an attendance of less than 65% in more than three theory courses will make me lose one year.
3. I will compulsorily follow the dress code prescribed by the college.
4. I will conduct myself in a highly disciplined and decent manner both inside the classroom and on campus, failing which suitable action may be taken against me as per the rules and regulations of the institute.
5. I will concentrate on my studies without wasting time in the Campus/Hostel/Residence and attend all the tests to secure more than the minimum prescribed Class/Sessional Marks in each course. I will submit the assignments given in time to improve my performance.
6. I will not use Mobile Phone in the institute premises and also, I will not involve in any form of ragging inside or outside the campus. I am fully aware that using mobile phone to the institute premises is not permissible and involving in Ragging is an offence and punishable as per JNTUH/UGC rules and the law.
7. I declare that I shall not indulge in ragging, eve-teasing, smoking, consuming alcohol drug abuse or any other anti-social activity in the college premises, hostel, on educational tours, industrial visits or elsewhere.
8. I will pay tuition fees, examination fees and any other dues within the stipulated time as required by the Institution / authorities, failing which I will not be permitted to attend the classes.
9. I will not cause or involve in any sort of violence or disturbance both within and outside the college campus.
10. If I absent myself continuously for 3 days, my parents will have to meet the HOD concerned/ Principal.
11. I hereby acknowledge that I have received a copy of IARE - R16 Academic Rules and Regulations, Syllabus copy and hence, I shall abide by all the rules specified in it.

ACKNOWLEDGEMENT

I have carefully gone through the terms of the undertaking mentioned above and I understand that following these are for my/his/her own benefit and improvement. I also understand that if I/he/she fail to comply with these terms, shall be liable for suitable action as per Institute/JNTUH/AICTE/UGC rules and the law. I undertake that I/he/she will strictly follow the above terms.

Signature of Student with Date

Signature of Parent with Date
Name & Address with Phone Number