AEC-601
AIRCRAFT STABILITY & CONTROL

UNIT I
Historical perspective, Aerodynamic Nomenclature, Equilibrium conditions, Definition of static stability, Definition of longitudinal static stability, stability criteria, Contribution of airframe components: Wing contribution, Tail contribution, Fuselage contribution, Power effects Propeller airplane and Jet airplane Introduction, Trim condition. Static margin. stick fixed neutral points. Longitudinal control, Elevator power, Elevator angle versus equilibrium lift coefficient, Elevator required for landing, Restriction on forward C.G. range.

UNIT II
Static Longitudinal Stability& Static Directional Stability and Control-Stick free Introduction, Hinge moment parameters, Control surface floating characteristics and aerodynamic balance, Estimation of hinge moment parameters, The trim tabs, Stick-free Neutral point, Stick force gradient in unaccelerated flight, Restriction on aft C.G.Introduction, Definition of directional stability, Static directional stability rudder fixed, Contribution of airframe components, Directional control. Rudder power, Stick-free directional stability, Requirements for directional control, Rudder lock, Dorsal fin. One engine inoperative condition. Weather cocking effect.

UNIT III
Introduction, definition of Roll stability. Estimation of dihedral effect., Effect of wing sweep, flaps, and power, Lateral control, Estimation of lateral control power, Aileron control forces, Balancing the aileron. Coupling between rolling and yawing moments. Adverse yaw effects. Aileron reversal. Definition of Dynamic longitudinal stability. Types of modes of motion: long or phugoid motion, short period motion. Airplane Equations of longitudinal motion.

UNIT IV
Derivation of rigid body equations of motion, Orientation and position of the airplane, gravitational and thrust forces, Small disturbance theory. Aerodynamic force and moment representation, Derivatives due to change in forward speed, Derivatives due to the pitching velocity, Derivatives due to the time rate of change of angle of attack, Derivatives due to rolling rate, Derivatives due to yawing rate.

UNIT V
Routh's criteria. Factors affecting period and damping of oscillations. Effect of wind shear. Flying qualities in pitch. Cooper-Harper Scale. Response to aileron step-function, side-slip excursion. Dutch roll and Spiral instability. Auto- rotation and spin. Stability derivatives for lateral and directional dynamics.

TEXT BOOKS
1. Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley Son Inc, New York, 1988.
2. Nelson, R.C. "Flight Stability and Automatic Control", McGraw-Hill Book Co., 2007.

REFERENCE BOOKS

1. Bandu N. Pamadi, `Performance, Stability, Dynamics and Control of Airplanes`, AIAA 2nd Edition Series, 2004.

LIST OF EXPERIMENT

1. Introduction to flight testing (V-n diagram).
2. Evaluation of glider drag polar.
3. Evaluation of cruise and climb performance of a small airplane.
4. Observations of airplane dynamic modes and stall characteristics.
5. Introduction to GPS based navigation. 6. Introduction to auto-pilot.

AEC-602
INTRODUCTION TO MICROPROCESSOR

UNIT I
Introduction to microprocessors Architecture, block diagram of 8086, details of subblocks such as EU, BIU; memory segmentation and physical address computations, program relocation, addressing modes, instruction formats, pin diagram and description of various signals.

UNIT II
Instruction Sets Instruction execution timing, assembler instruction format, data transfer instructions, arithmetic instructions, branch instructions, looping instructions, NOP and HLT instructions, flag manipulation instructions, logical instructions, shift and rotate instructions, directives and operators, programming examples.

UNIT III
Introduction of Microcontroller: Different types of microcontrollers: Embedded, microcontrollers, External memory microcontrollers; Processor Architectures: Harvard V/S Princeton , CISC V/S RISC; microcontrollers memory types; microcontrollers features : clocking, i/o pins, interrupts, timers, peripherals. Introduction to PIC microcontrollers, Architecture and pipelining, program memory considerations, Addressing modes, CPU registers, Instruction set, simple operations.

UNIT IV
Microcontroller 8051 Architecture, Pin Diagram, I/O Ports, Internal RAM and Registers, Interrupts, Addressing Modes, Memory Organization and External Addressing, Instruction Set, Assembly Language Programming, Real Time Applications of Microcontroller- Interfacing with LCD, ADC, DAC, Stepper Motor, Key Board and Sensors.

UNIT V
Embedded System Introduction, Classification, Processors, Hardware Units, Software Embedded into System, Applications and Products of Embedded Systems, Structural Units in Processor, Memory Devices, I/O Devices, Buses, Interfacing of Processor Memory and I/O Devices, Case Study of an Embedded System for a Smart Card.

TEXT BOOKS
1. Muhammad Ali Mazidi, The 8051 Microcontroller, Pearson Education.
2. Kenneth J Ayala, The 8051 Microcontroller, Penram International.

REFERENCES
1. Ramesh S Goankar, Microprocessors and Architecture.
2.John Uffenbeck, Microcomputers and Microprocessors, PHI

LIST OF EXPERIMENT

1) Compute the factorial of a positive integer 'n' using recursive procedure.
2) Drive a stepper motor interface to rotate the motor in anti clockwise direction by N steps (N is specified by the examiner). Introduce suitable delay between successive steps (Any arbitrary value for the delay may be assumed by the student).
3) Search a key element in a list of 'n' 16-bit numbers using the binary search algorithm.
4) Perform the BCD up-down Counter functions using the Logic Controller Interface.
   Read an alphanumeric character and display its equivalent ASCII code at the center of the screen.

AEC-603
CONTROL ENGINEERING

UNIT I
Control system & Component Open loop and close loop control systems. Block diagram algebra and transfer function. Differential equations, Determination of transfer function by block diagram reduction technique & signal flow graph method. Mason gain formula and calculation of transfer function. Basic component of electrical control system, Armature and field control methods for Speed control.

UNIT II
Time response analysis Transient and steady state response analysis. Steady state error & error constants. Dynamic error and dynamic error coefficient, Performance Indices. Effects of pole and zero addition on transient and steady state response.

UNIT III
stability analysis Absolute stability and relative stability. Routh's and Hurwitz criterion of stability. Root locus method of analysis. Polar plots.

UNIT IV
Approaches to system design problem, types of compensation, design of phase-lag, phase lead and phase lead-lag compensators in time and frequency domain, proportional, derivative, integral and PID compensation.

UNIT V
Digital control systems System with digital controller, difference equations, the z-transform, pulse transfer function, inverse z-transform, the s and z domain relationship.

TEXT BOOKS
1.Ogata: Modern Control Engineering, PHI Learning.

REFERENCES BOOKS
1. Nagrath and Gopal: Control System Engineering, New Age International Publishers.
2. Manke: Linear Control System, Khanna Publishers.

LIST OF EXPERIMENT
1. Designing of transfer function for different type of control system
2. Designing and modeling of different control system.
3. Determination of stability with Root Local, Nyquest Criteria, Bode Plot etc.
4. Transient and steady state analysis of control system.
5. To implement a PID controller for temperature control of a pilot plant.
6. To study behavior of 1 order,2 order type 0,type 1 system.

AEC-604 (A)
HYPERSONIC AERODYNAMICS

UNIT I FUNDAMENTALS OF HYPERSONIC AERODYNAMICS
Introduction to hypersonic aerodynamics-differences between hypersonic aerodynamics and supersonic aerodynamics-concept of thin shock layers-hypersonic flight paths – hypersonic similarity parameters shock wave and expansion wave relations of inviscid hypersonic flows.

UNIT II SIMPLE SOLUTION METHODS FOR HYPERSONIC IN VISCID FLOWS
Local surface inclination methods-Newtonian theory-modified Newtonian law-tangent wedge and tangent cone and shock expansion methods-approximate theory-thin shock layer theory.

UNIT III VISCOUS HYPERSONIC FLOW THEORY
Boundary layer equation for hypersonic flow-hypersonic boundary layers-self similar and non self-similar boundary layers-solution methods for non-self-similar boundary layers aerodynamic heating.

UNIT IV VISCOUS INTERACTIONS IN HYPERSONIC FLOWS
Introduction to the concept of viscous interaction in hypersonic flows-strong and weak viscous interactions-hypersonic viscous interaction similarity parameter-introduction to shock wave boundary layer interactions.

UNIT V INTRODUCTION TO HIGH TEMPERATURE EFFECTS
Nature of high temperature flows-chemical effects in air-real and perfect gases-Gibb's free energy and entropy-chemically reacting mixtures-recombination and dissociation.

TEXT BOOKS
1. John. D. Anderson. Jr., "Hypersonic and High Temperature Gas Dynamics", AIAA Series, New York, 2006.

REFERENCES
1. John. D. Anderson. Jr., "Modern compressible flow with historical perspective", McGraw Hill Publishing Company, New York, 1996.
2. John. T Bertin, "Hypersonic Aerothermodynamics", published by AIAA Inc., Washington. D.C., 1994.

AEC- 604 (B)
AEROSPACE BIO – MEDICAL AND LIFE SUPPORT ENGINEERING

UNIT I INTRODUCTION
Physiological problems associated with human space flight – review of terminologies.

UNIT II BIO – MECHANICS IN SPACE FLIGHT
Bone Mechanics, Muscle Mechanics, Musculoskeletal Dynamics, and the Cardiovascular System during space flight – their equations of motion.

UNIT III BIO – MECHANICAL MODELING
Structural idealizations – mechanical and electrical modeling of muscle groups – musculoskeletal groups – joints, electrical analogies to model astronaut performance.

UNIT IV LIFE SUPPORT SYSTEMS
Onboard environment control systems – waste product management and recycling system – bio – monitoring and control.

UNIT V EXTRA – VEHICULAR ACTIVITY
Extra Vehicular activity – challenges – specialties of space suits – life support system for EVA.

TEXT BOOKS
1. "Space Physiology", Beckers, Frank, Bart Verheyden, Andre E Aubert, Wiley Encylopaedia of Bio – medical engineering, John Wiley and Sons, Inc., 2006.
2. "Fundamentals of Space Life Sciences", Diamandis, Peter H. Edited by Susanne Churchill. Malabar, FL: Krieger Publishing Co., 1997.

REFERENCE BOOK
1. "Human Anatomy Manual: The Skeleton", Gatesville, TX, Medical Plastics Laboratory, Inc., 1997
2. Gomi, Hiroaki, and MitsuoKawato. "Equilibrium-Point Control Hypothesis Examined by Measured Arm Stiffness during Multijoint Movement." Science 272, no. 5258 (1996): 117-120.
3. Aubert, A.E., F. Beckers, and B. Verheyden. "Cardiovascular Function and Basics of Physiology in Microgravity." ActaCardiol 60, no. 2 (2005): 129-151

AEC-604 (C)
WIND TUNNEL TECHNIQUES

UNIT I PRINCIPLES OF MODEL TESTING
Buckingham Theorem – Non-Dimensional Numbers – Scale Effect Types of Similarity.

UNIT II WIND TUNNELS
Classification – Special problems of Testing in Subsonic, Transonic, supersonic and hypersonic speed regions – Layouts – sizing and design parameters.

UNIT III CALIBRATION OF WIND TUNNELS
Test section speed – Horizontal buoyancy – Flow angularities – Turbulence measurements – Associated instrumentation – Calibration of supersonic tunnels.

UNIT IV WIND TUNNEL MEASUREMENTS
Pressure and velocity measurements – Force measurements – Three component and six component balances – Internal balances.

UNIT V FLOW VISUALIZATION TECHNIQUES
Smoke and Tuft grid techniques – Dye injection special techniques – Optical methods of flow visualization.

TEXT BOOK
1. Rae, W.H. and Pope, A. "Low Speed Wind Tunnel Testing", John Wile Publication, 1914.

REFERENCE BOOK
1. Pope, A., and Goin, L., "High Speed wind Tunnel Testing", John Wiley, 1915

AEC 605 (A)
THEORY OF ELASTICITY

UNIT I DEFINITION AND NOTATION
Stress, Stress at a Point, Equilibrium Equations, Principal Stresses, Mohr's Diagram, Maximum Shear Stress, Boundary Conditions.

UNIT II STRAIN AT A POINT
Compatibility Equations, Principal Strains, Generalized Hooke's law, Methods of Solution of Elasticity Problems – Plane Stress-Plane Strain Problems.

UNIT III TWO DIMENSIONAL PROBLEMS
Cartesian co-ordinates – Airy's stress functions – Investigation of Airy's Stress function for simple beam problems – Bending of a narrow cantilever beam of rectangular cross section under edge load – method of Fourier analysis – pin ended beam under uniform pressure.

UNIT IV GENERAL EQUATIONS IN CYLINDRICAL CO-ORDINATES
Thick cylinder under uniform internal and / or external pressure, shrink and force fit, stress concentration.

UNIT V STRESSES IN AN INFINITE PLATE
Stresses in an Infinite Plate (with a circular hole) subjected to uniaxial and biaxial loads, stress concentration, stresses in rotating discs and cylinders.

TEXT BOOKS
1. Mathematical Foundation of Elasticity – Marsden and Hughes Theoretical Elasticity – Green and Zerna

REFERENCE BOOKS
1. Aspects of Invariance in solid mechanics – Hill Introduction to Mechanics of Continuous Medium – Malvern

AEC-605 (B)
THEORY OF PLATES AND SHELLS

UNIT I INTRODUCTION TO CLASSICAL PLATE
THEORY Classical Plate Theory – Assumptions – Differential Equation – Boundary Conditions.

UNIT II PLATES OF VARIOUS SHAPES
Navier's Method of Solution for Simply Supported Rectangular Plates – Leavy's Method of Solution for Rectangular Plates under Different Boundary Conditions. Governing Equation – Solution for Axi - symmetric loading – Annular Plates – Plates of other shapes.

UNIT III STABILITY ANALYSIS
Stability and free Vibration Analysis of Rectangular Plates.

UNIT IV APPROXIMATE METHODS
Rayleigh – Ritz, Galerkin Methods – Finite Difference Method–Application to Rectangular Plates for Static, Free Vibration and Stability Analysis.

UNIT V THEORY OF SHELLS
Basic Concepts of Shell Type of Structures – Membrane and Bending Theories for Circular Cylindrical Shells.

TEXT BOOK
1. Timoshenko, S.P. Winowsky S., and Kreger, "Theory of Plates and Shells", McGraw-Hill Book Co. 1990.

REFERENCE BOOKS
1. Flugge, W. "Stresses in Shells", Springer – Verlag, 1985. 2. Timoshenko, S.P. and Gere, J.M., "Theory of Elastic Stability", McGraw-Hill BookCo. 1999.

AEC-605 (C)
UNMANNED AERIAL VEHICLE

UNIT I INTRODUCTION TO UNMANNED AIRCRAFT SYSTEMS
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
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
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
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
HTOL Aircraft - Helicopters - OTE/OTE/SPH - Convertible Rotor Aircraft - Payload Control - Sensors – salmon filter- Autonomy.

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

REFERENCES BOOK
1. Milman&Halkias, “Integrated Electronics”, McGraw Hill, 1999.
2. Malvino& Leach, “Digital Principles & Applications”, McGraw Hill, 1986

AEC-606 (A)
OPERATION RESEARCH

UNIT I INTRODUCTION & SOLUTION OF LINEAR PROGRAMMING PROBLEMS
Evolution of OR, definition of OR, scope of OR, application areas of OR, steps (phases) in OR study, characteristics and limitations of OR, models used in OR, linear programming (LP) problem formulation and solution by graphical method. The simplex method canonical and standard form of an LP problem, slack, surplus and artificial variables, big M method and concept of duality, dual simplex method.

UNIT II TRANSPORTATION PROBLEM
Formulation of transportation problem, types, initial basic feasible solution using different methods, optimal solution by MODI method, degeneracy in transportation problems, application of transportation problem concept for maximization cases. Assignment Problem-formulation, types, application to maximization cases and travelling salesman problem.

UNIT III INTEGER PROGRAMMING & PERT-CPM TECHNIQUES
Pure and mixed integer programming problems, solution of Integer programming problems-Gomory's all integer cutting plane method and mixed integer method, branch and bound method, ZeroOne programming. Introduction, network construction - rules, Fulkerson's rule for numbering the events, AON and AOA diagrams; Critical path method to find the expected completion time of a project, floats; PERT for finding expected duration of an activity and project, determining the probability of completing a project, predicting the completion time of project; crashing of simple projects.

UNIT IV QUEUING THEORY &GAME THEORY
Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), empirical queuing models – M/M/1 and M/M/C models and their steady state performance analysis. Formulation of games, types, solution of games with saddle point, graphical method of solving mixed strategy games, dominance rule for solving mixed strategy games.

UNIT V SEQUENCING
Basic assumptions, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing 2 jobs on 'm' machines using graphical method.

TEXT BOOKS
P K Gupta and D S Hira ,Operations Research, Chand Publications, New Delhi , Revised.

REFERENCE BOOK
1. A P Verma ,Operations Research, S K Kataria &Sons, 2012,ISBN-13: 978-9350142400

AEC-606 (B)
PRODUCT DESIGN & DEVELOPMENT

UNIT I
Introduction to Product Design, Applications, Relevance, Product Definition, Scope, Design definitions, the role and nature of design, Old and new design methods, Design by evolution vs design by innovation. Examples such evolution of bicycle, safety razor etc. Need based development, Technology based developments. Physical reliability& Economic feasibility of design concepts.

UNIT II
Morphology of Design, Divergent, Transformation and Convergent phases of product design, Identification of need, Analysis of need, Design criteria, Functional aspects, Aesthetics, ergonomics, form (structure). Shape, size, color, Creativity, Mental blocks in creativity, Removal of blocks, Ideation Techniques.

UNIT III
Transformations stage of design, Brainstorming &Synaptic, Morphological techniques, Utility concept, Utility value, Utility index, Economic aspects of design, Fixed and variable costs, Break-even analysis, Product Appraisal Information and literature search, patents, standards and codes, Environment and other safety considerations in product design.

UNIT IV
Reliability, Reliability considerations in product design, Bath tub curve, Reliability of systems in series and parallel. Failure rates, MTTF and MTBF, Optimum spares from reliability consideration.

UNIT V
Design of displays and controls, Man-Machine interface, Compatibility of displays and controls, Ergonomic aspects of design, Anthropometric data and its importance in design

TEXT BOOKS
1. Product Design & Manufacturing - A.K.Chitale & R.C.Gupta, Prentice Hall.
2. Engg . Product Design -C .D. Cain, Bussiness Books.

REFERENCES BOOKS
1. Industrial design for Engineers –W .H. Mayall, Itiffe.
2. Product Design & Decision Theory - M.K. Starr - Prentice Hall

AEC - 606 (C)
MANAGEMENT AND ENTERPERNERSHIP

UNIT I MANAGEMENT & PLANNING
Definition, Importance – Nature and Characteristics of Management, Management Functions, Roles of Manager, Levels of Management, Managerial Skills, Management & Administration, Management as a Science, Art & Profession Nature, Importance and Purpose Of Planning, Types of Plans, Steps in Planning, Limitations of Planning, Decision Making – Meaning, Types of Decisions- Steps in Decision Making.

UNIT II ORGANIZING AND STAFFING
Meaning, Nature and Characteristics of Organization – Process of Organization, Principles of Organization, Departmentalization, Committees –meaning, Types of Committees, Centralization Vs Decentralization of Authority and Responsibility, Span of Control (Definition only), Nature and Importance of Staffing, Process of Selection and Recruitment.

UNIT III ENTREPRENEURSHIP
Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Entrepreneur – An Emerging Class, Comparison between Entrepreneur and Entrepreneur, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship.

UNIT IV MODERN SMALL BUSINESS ENTERPRISES
Role of Small Scale Industries, Concepts and definitions of SSI Enterprises, Government policy and development of the Small Scale sector in India, Growth and Performance of Small Scale Industries in India, Sickness in SSI sector, Problems for Small Scale Industries, Impact of Globalization on SSI, Impact of WTO/GATT on SSIs, Ancillary Industry and Tiny Industry.

UNIT V PROJECT MANAGEMENT
Meaning of Project, Project Objectives & Characteristics, Project Identification- Meaning & Importance; Project Life Cycle, Project Scheduling, Capital Budgeting, Generating an Investment Project Proposal, Project Report-Need and Significance of Report, Contents, Formulation, Project Analysis-Market, Technical, Financial, Economic, Ecological, Project Evaluation and Selection, Project Financing, Project Implementation Phase, Human & Administrative aspects of Project Management, Prerequisites for Successful Project Implementation.

TEXT BOOKS
1. Principles of Management–P. C. Tripathi, P. N. Reddy–Tata McGraw Hill,
2. Dynamics of Entrepreneurial Development & Management Vasant Desai Himalaya Publishing House

REFERENCE BOOKS

1. Management Fundamentals- Concepts, Application, Skill Development-Robers Lusier Thomson
2. Entrepreneurship Development -S. S. Khanka -S. Chand & Co.

AEC- 607
INDUSTRIAL TRAINING PROJECT – I

Students should work in the industry/laboratories as trainees so that they are able to acquire different learning out comes to demonstrate following course outcomes.(Students should be able to demonstrate these skills on the type of metallurgical process or parameters affecting, the following list is suggestive only, some more skills may be acquired by student depending upon the opportunities they get and in some cases some of the following skills may not be applicable on which they have undergone training)