P.G. Diploma (Aerospace Structural Design): NSQF Level -8

Type	No. of hrs. per sem.	Credit
Theory	15	1
Practical	30	1
On- the Job Training (OJT)	45	1

TEACHING SCHEME FOR FIRST SEMESTER															
Code	**Subject Name**	**Credits**			**Marks**							**Total hrs. per course**			**NSQF L8**
					Theory			**Practical**			**Total**				
		Th.	**Pr.**	**To.**	**Int.**	**Ext.**	**To.**	**Int.**	**Ext.**	**To.**		**Th.**	**Pr.**	**To.**	
APAS-101 APAS-101P	Aircraft Basics and Systems	3	1	4	15	35	50	35	15	50	100	45	30	75	
APAS-103 APAS-103P	Basics of Aerodynamics	3	1	4	15	35	50	35	15	50	100	45	30	75	
APAS-105 APAS-105P	Aerospace Materials	3	1	4	15	35	50	35	15	50	100	45	30	75	
APAS-107 APAS-107P	Aerospace Fasteners	3	1	4	15	35	50	35	15	50	100	45	30	75	
APAS-109 APAS-109P	Aerospace Advanced Structural Design	3	1	4	15	35	50	35	15	50	100	45	30	75	
APAS-111 APAS-111P	Geometric Dimensioning and Tolerancing	3	1	4	15	35	50	35	15	50	100	45	30	75	
APAS-113 APAS-113P	Catia V5 (Basic and Advanced)	2	1	3	15	35	50	35	15	50	100	30	30	60	
Grand Total		20	7	27	105	245	350	245	105	350	700	300	210	510	

TEACHING SCHEME FOR SECOND SEMESTER															
Code	**Subject Name**	**Credits**			**Marks**							**Total hrs. per course**			**NSQF L8**
					Theory			**Practical**			**Total**				
		Th.	**Pr.**	**To.**	**Int.**	**Ext.**	**To.**	**Int.**	**Ext.**	**To.**		**Th.**	**Pr.**	**To.**	
APAS-102	Project Management	2	-	2	30	70	100	-	-	-	100	30	-	30	
APAS-104P	Project	-	4	4	-	-	-	70	30	100	100	-	120	120	
ASOJT-106P	NSQF- On The Job Training	-	24	24	-	-	-	490	210	700	700	-	1080	1080	
Grand Total		2	28	30	30	70	100	560	240	800	900	30	1200	1230	

Course Title: Aircraft Basics and Systems

Course Credit : 04 (3-1-0)

Course code APAS-101/ APAS-101P **Max. Marks : 100**
(30I+70E)

Objectives

To purpose of the course is to provide fundamental knowledge and exposure to the concepts, theories, and practices in the field of aviation. To ensure that all participants have the technical skills needed to perform the job efficiently and smoothly. It aims to understand the aviation industry and aircraft systems.

Learning Outcomes

- Able to understand aviation as an industry (Theory)
- Able to know publication and standards. (Theory)
- Able to describe types of aircraft structures (Theory)
- Able to explain the importance of the flight control system (Theory)
- Able to evaluate aircraft mechanical systems (Theory)
- Able to learn aircraft electrical and avionics systems (Theory)

Unit	Topic	Key Learning	Hours
I - Aircraft Orientation	Evolution of aircraft, Aviation as an industry, globalization, Future of aviation, Opportunities in aviation, ATA standards, human factors	• Identify the aviation as an industry for the various opportunity.	10
II - Introduction to Aircraft Structures	Aircraft Classification, lighter than air aircraft, heavier than air aircraft, Fixed wing aircraft, Rotary wing aircraft, Aircraft Structural Components, monocoque design, Semi monocoque, Structural components of Wing and Fuselage.	• Differentiate the aerospace and aircraft structures and components	10
III – Basic Aircraft Systems	Flight control system, Mechanical Flight control system, hydro mechanical flight control system, fly by wire system, aircraft hydraulic system, aircraft fuel system, Air-conditioning system.	• Understand basic aircraft mechanical systems' functions	10
IV – Advanced Aircraft System	Aircraft powerplants, reciprocating engine, jet engine, turbo prop, turbo fan, turbojet, turbo shaft, scramjet, ramjet, rocket engine, Engine control system, landing gear system, aircraft fire protection system, Equipment furnishing.	• Learn the advance functions of aircraft systems	15
V – Electrical and avionics systems	Introduction to electrical systems, basic Aircraft electrical systems, modern aircraft electrical systems, aircraft lighting system, ice and rain protection system. Introduction to avionics, Aircraft instruments, communication, navigation, Display system, flight management system, GPS, Autopilot system, Weather radar system, Collision avoidance, Flight data recorder, Instrument landing system, aircraft oxygen system	• Able to explain aircraft electrical and avionics system	15

Books Recommended

Text Books

1. Aircraft Structures for Engineering Students: Megson T. H. G.
2. Aircraft systems: Ian Moir & Allan Seabridge
3. Aircraft Gas Turbine Engine Technology: Irwin E Treager
4. Avionics training: Len Buckwalter

Reference Books

1. Airframe Structural Design: Practical Design Information and Data on Aircraft Structures: Michael Chun-Yung Niu
2. ATA Specification 2200 (iSpec 2200)
3. Aviation instructor's handbook

Web Links

Course Title: Basics of Aerodynamics

Course Credit: 04 (3-1-0)

Course code APAS-103/ APAS-103P **Max. Marks: 100**
(30I+70E)

Objectives
To purpose of the course is to provide fundamental knowledge and exposure to the concepts, theories and practices in the field of aviation. It aims to understand the importance of aerodynamics and performance parameters used in aircraft design.

Learning Outcomes

- Apply the concepts of fundaments of flight physics
- Understand the importance of aerodynamics during the development of an aircraft (Theory)
- Comprehend the complexities involved during development of flight vehicles (Theory)
- Demonstrates basics laws of aerodynamics (Theory)
- Identify the basic functions of wing and aerofoil nomenclature Learn about lift and drag components (Theory)
- Understand aircraft mechanical systems functions (Theory)
- Appreciate Prandtl's lifting line theory and boundary layer theory (Theory)
- Learn about aircraft performance parameters (Theory)

Unit	Topic	Key Learning	Hours
I - Laws governing aerodynamics	Significance of speed of sound; airspeed and groundspeed; standard atmosphere; Bernoulli's theorem and its application for generation of lift and measurement of airspeed; forces over wing section, aerofoil nomenclature, pressure distribution over a wing section.	• Demonstrates basics laws of aerodynamics • Identify the basic functions of wing and aerofoil nomenclature	10
II – Basic Aircraft Systems	Lift and drag components – generation of lift and drag; lift curve, drag curve, types of drag, factors affecting lift and drag; center of pressure and its significance; aerodynamic center, aspect ratio, Mach number and supersonic flight effects; simple problems on lift and drag	• Learn about lift and drag components	10
III – Aircraft Stability	Forces on an aircraft in flight; static and dynamic stability; longitudinal, lateral and roll stability; necessary conditions for longitudinal stability; basics of aircraft control systems. Effect of flaps and slats on lift, control tabs, stalling, gliding, landing, turning, aircraft manoeuvers; stalling, gliding, turning. Simple problems on these.	• Understand aircraft mechanical systems functions	10
V – Aircraft performance	Subsonic, transonic, and supersonic Mach number regimes; Prandtl's lifting line theory, Downwash. Boundary - Layer Theory Introduction to compressible flow; normal and oblique shock waves.	• Appreciate Prandtl's lifting line theory and boundary layer theory	15
V – Aircraft performance	Performance of aircraft – power curves, maximum and minimum speeds for horizontal flight at a given altitude; effect of changes in engine power and altitude on performance; correct and incorrect angles of bank; aerobatics, inverted manoeuvers, maneuverability.	• Learn about aircraft performance parameters	15

Books Recommended

Text Books

1. Introduction to Flight John D. Anderson, McGraw-Hill Education 2011,
2. Fundamentals of Flight Vol-I toVol-IV, Lalit Gupta and O P Sharma Himalayan Books 2006

Reference Books

1. Flight without formulae A.C. Kermode Pearson Education India 1989
2. Flight stability and automatic control Nelson R.C McGraw-Hill International Editions 1998
3. Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration Ian Moir, Allan Seabridge John Wiley & Sons 2011

Web Links

Course Title: Aerospace Materials

Course Credit: 04 (3-1-0)

Course code APAS-105/ APAS-105P **Max. Marks: 100**
(30I+70E)

Objectives
To purpose of the course is to provide fundamental knowledge and exposure to the concepts, theories and practices in the field of aviation. It aims to understand importance of aircraft materials.

Learning Outcomes

- Identify appropriate aircraft materials for a given application. (Theory)
- Able to understand the concepts of super alloys, ablative materials and high energy material. (Theory)
- Able to demonstrates requirements of aircraft materials (Theory)
- Acquire the knowledge destructive and NDT testing of metallic materials (Theory)
- Appreciate composite advantages over metalics (Theory)
- Acquire the knowledge composite manufacturing process (Theory)
- Learn about NDT testing methodologies (Theory)
- Appreciate the difference between thermosets and thermoplastics (Theory)

Unit	Topic	Key Learning	Hours
I - Properties of materials	General properties of materials, Definition of terms, Requirements of aircraft materials, Testing of aircraft materials, Inspection methods, Application and trends in usage in aircraft structures and engines, Selection of materials for use in aircraft	• Demonstrates requirements of aircraft materials • Learn about destructive and NDT testing of metalics	10
II - Basics of linear elasticity	The concept of stress& strain, state of stress & Strain at a point, Equilibrium equations, The state of plane stress and plane strain. Compatibility equations, Constitutive Laws (Hooke's Law), Stress-strain curves for brittle and ductile materials, Allowable stress, Material selection for structural performance.	• Identify the basic functions of stress and strain acting on continuum • Appreciate material selection and structural performance	10
III – Aircraft Metal Alloys	Aluminum alloys, Magnesium alloys, Titanium alloys, Plain carbon and Low carbon Steels, Corrosion and Heat resistant steels, Maraging steels, Copper alloys, Producibility and Surface treatments aspects for each of the above Super Alloys : introduction to super alloys, Nickel based super alloys, Cobalt based super alloys, and Iron based super alloys, manufacturing processes associated with super alloys, Heat treatment and surface treatment of super alloys**.**	• Understand importance of aerospace alloys • To gain knowledge about super alloys	10
IV – Composite Material	Definition and comparison of composites with conventional monolithic materials. Composite Manufacturing (Hand layup, pressure-bag, vacuum bag, Autoclave, RTM, filament winding, pultrusion), Advantages of Composite, NDT testing methodologies.	• Appreciate composite advantages over metalics • Understand composite manufacturing process • Learn about NDT testing methodologies	15
V – Polymers, Polymeric Materials & Plastics and Ceramics & Glass	Knowledge and identification of physical characteristics of commonly used polymeric material: plastics and its categories, properties and applications; commonly used ceramic, glass and transparent plastics, properties and applications, adhesives and sealants and their applications in aircraft	• Appreciate the difference between thermosets and thermoplastics	15

Books Recommended

Text Books

1. Aircraft Material and Processes Titterton G F English Book Store, New Delhi 1998
2. Advanced Aerospace Material H Buhl Spring Berlin 1992

Reference Books

1. Handbook of Aircraft materials C G Krishnadas Nair Interline publishers, Bangalore 1993
2. Aerospace material Balram Gupta, S Vol. 1,2,3 ARDB, Chand & Co 1996
3. Materials for Missiles and Space Parker E R John Wiley, McGraw-Hill 1963
4. Materials of Aircraft Construction Hill E T Pitman London

Web Links

Course Title: Aerospace Fasteners

Course Credit : 04 (3-1-0)

Course code APAS-107/ APAS-107P **Max. Marks : 100**
(30I+70E)

Objectives
To purpose of the course is to provide fundamental knowledge and exposure to the concepts, theories, and practices in the field of aviation.. It aims to understand the aerospace design concepts and aerospace grade fasteners.

Learning Outcomes

- Comprehend the basic concepts of strength of materials.
- Acquire the knowledge of stress, strain under different loadings.
- Learn about Sheetmetal operations and importance of Sheetmetal hand calculations
- Acquire the knowledge of stress, strain under different loadings.
- Understand the importance of failure theories
- Comprehend the importance of sheet metal forming and hand calculations
- Able to understand importance of aerospace grade fasteners

Unit	Topic	Key Learning	Hours
I - Design for Static Strength	Introduction: Normal, shear, biaxial and tri-axial stresses, Principal Stresses, Stress Analysis, Design considerations, Static Strength: Static loads, factor of safety and margin of Safety.	• Acquire the knowledge of stress, strain under different loadings.	10
II - Riveted joints	Riveted Joints: Single and double riveted lap joints, butt joints with single/double cover straps, Edge distance on sheet metal for fasteners, Problems related to rivets. Joints and Fittings-Riveted joints, accuracy of fitting analysis, eccentrically loaded connections, welded joints, and concept of effective width.	• Understand the importance of riveted joints	10
III – Failure theories	Theories of failure: Maximum normal stress theory, Maximum shear stress theory, Maximum strain theory, Strain energy theory, and Distortion energy theory, failure of brittle and ductile materials.	• Understand the importance of failure theories	10
IV – Aerospace Sheetmetal	Sheet metal manufacturing operations (bending, lancing, notching, blanking, parting, Bend allowance, Bend deduction. Sheetmetal handing calculation (bend deduction & bend Allowance), edge distance.	• Learn the importance of sheet metal forming and hand calculations	15
V – Aerospace grade Fasteners	Types of fasteners used in aircraft structure design (Solid Rivets, Blind Rivets, Hi-loks, Lockbolts, Taper-lock, Blind Bolts, Shear Bolts, Tension screws & High-Tension Bolt).	• Able to understand importance of aerospace grade fasteners	15

Books Recommended

Text Books

1. Aircraft Structures for Engineering Students Megson, T.M.G Edward Arnold 1995
2. Design of Machine Elements V.B. Bhandari Tata McGraw Hill Publishing Company, Ltd., New Delhi,2nd Edition 2007.
3. Strength of Materials S. Ramamrutham Dhanapath Rai, Publishing Company,2012

Reference Books

1. Strength of Materials Timoshenko, S Princeton D Von Nostrand Co.,1990
2. Aircraft Structures Peery, D.J., and Azar, J.J McGraw, Hill 2nd edition,1993

Web Links

Course Title: Aerospace Advanced Structural Design

Course Credit : 04 (3-1-0)

Course code APAS-109/ APAS-109P **Max. Marks : 100**
(30I+70E)

Objectives
To purpose of the course is to provide fundamental knowledge and exposure to the concepts, theories, and practices in the field of aviation. It aims to understand the aerospace design principles and design methodologies

Learning Outcomes

- Acquire the knowledge of design process. (Theory)
- Comprehend the importance aircraft manoeuvers. (Theory)
- Able to understand the importance of loads acting on aircraft structure. (Theory)
- Acquire the knowledge of regulatory bodies financial factors and market, Airworthiness. (Theory)
- Understand skin frames and bracket design. (Theory)

Unit	Topic	Key Learning	Hours
I – Overview of Design Process:	Introduction, Requirements, general types of construction; monocoque, semi-monocoque and geodesic structures; Phases of design, Conceptual Design Process, Initial Sizing, Take-off weight build up, Empty weight estimation, Fuel fraction estimation, Take- off weight calculation. Thrust to Weight	• Understand the design phases and weight estimations	10
II – Thrust to Weight Ratio & Wing Loading:	Thrust to Weight Definitions, Statistical Estimate of T/W., Wing Loading and its effect on Stall speed, Take-off Distance and Landing Distance. Wing Loading for Cruise, Loiter, Endurance, Instantaneous Turn rate, Sustained Turn rate, Climb, & Glide, Maximum ceiling.	• Comprehend the importance aircraft maneuvers	10
III – Design of Structural Components	Design Criteria, Safety Factor, Design life criteria, Analysis method, Life Assessment procedures, Design Principle, Two bay crack criteria, Widespread Fatigue damage. Loads on Structure. V-n Diagram, Gust Envelope. Loads distribution	• Able to understand the importance of loads acting on aircraft structure	10
IV – Wing and Fuselage design	Overview regulatory bodies FAR, EASA & ICAO, financial factors and market, Airworthiness, Loads acting on Aircraft, Aircraft wing design, typical wing and fuselage structure; metallic and non-metallic materials for aircraft application, Importance of swept wing	• Acquire the knowledge of regulatory bodies financial factors and market, Airworthiness	15
V – Skins Frames & Bracket Design	Empennage design, types of engine placement, rake angle in landing gear, Skin design, stringer design, frames and brackets (mechanical and electrical)	• Understand skin frames and bracket design	15

Books Recommended

Text Books

1. Aircraft Structures for Engineering Students Megson, T.M.G Edward Arnold 1995
2. Aircraft Design - A Conceptual Approach Daniel P. Raymer AIAA Education Series IV Edition, 2006
3. Design of Aircraft Thomas C Corke Pearson Edition. Inc. 2003
4. Aircraft Structures Peery D J & Azar J J McGraw Hill N.Y 2nd edition,1993

Reference Books

1. Introduction to Aircraft Design John Fielding Cambridge University Press 2009
2. Standard Handbook for Aeronautical & Astronautical Engineers Editor Mark Davies Tata McGraw Hill 2010

Web Links

Course Title: Geometric Dimensioning and Tolerancing

Course Credit : 04 (3-1-0)

Course code APAS-111/ APAS-111P **Max. Marks : 100**
(30I+70E)

Objectives

To purpose of the course is to provide fundamental knowledge and exposure to the concepts, theories, and practices in the field of aviation. To ensure that all participants have the technical skills needed to perform the job efficiently and smoothly. It aims to understand the importance Geometric Dimensioning and Tolerancing (GD&T)

Learning Outcomes

- Comprehend the standards of measurement, system of limits, fits, tolerances and gauging. (Theory)
- Acquire the principles of measuring instruments. (Theory)
- Learn about the knowledge on measurement and measurement systems. (Theory)
- Acquire the knowledge of tolerance, inter changeability and definition of fits. (Theory)
- Apply the standards of measurement, system of limits, fits, tolerances and gauging. (Theory)
- Identify and use appropriate measuring instruments. (Theory)
- Acquire the knowledge on measurement and measurement systems. (Theory)

Unit	Topic	Key Learning	Hours
I - Standards of measurement:	Definition and Objectives of metrology, Standards of length – International prototype meter, Imperial standard yard, Wave length standard, subdivision of standards, line and end standard, comparison, transfer from line standard to end standard, calibration of end bars (Numerical), Slip gauges, Wringing phenomena, Indian Standards (M-81, M-112), Numerical problems on building of slip gauges.	• Acquire the knowledge of objectives and standards of metrology	10
IV – Measurement instrument and gauges	Screw thread gear measurement: Terminology of screw threads, measurement of major diameter, minor diameter pitch, angle and effective diameter of screw threads by 2-wire and 3-wire methods, Best size wire. Gear tooth vernier. Types of gauges -plain plug gauge, ring Gauge, snap gauge, limit gauge and gauge materials.	• Acquire knowledge on different standards of length, calibration of End Bars, linear and angular measurements, Screw thread.	10
II - Measurements and Measurement systems	Definition, Significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response-times delay. Errors in Measurements, Classification of Errors.	• Understand the importance Significance of measurement system.	10
III – System of limits, Fits, Tolerances	Definition of tolerance, Specification in assembly, Principle of inter changeability and selective assembly limits of size, Indian standards, concept of limits of size and tolerances, compound tolerances, accumulation of tolerances, definition of fits, types of fits geometrical tolerance, positional - tolerances, hole basis system, shaft basis of system, Hand Calculation.	• Equip with knowledge of limits, fits, tolerances and gauging	15
V – GD&T	Maximum Material Condition, Least Material Condition Datum control, Form tolerance, orientation tolerance, profile tolerance, location tolerance, runout tolerances, Surface roughness tolerance.	• Able to understand importance of MMC, LMC and various tolerance parameters.	15

Books Recommended

Text Books

1. Mechanical Measurements Beckwith Marangoni and Lienhard, John H. Lienhard V 6th Ed., 2006.
2. Engineering Metrology R.K.Jain Khanna Publishers 1994
3. Robert L. Norton “Machine Design- an integrated approach”, Pearson Education, 2nd edition.
4. Spotts M.F., Shoup T.E “Design and Machine Elements”, Pearson Education, 8th edition,2006

Reference Books

1. Engineering Metrology I.C.Gupta Dhanpat Rai Publications 2013
2. Industrial Instrumentation Alsutko, Jerry. D.Faulk Thompson Asia Pvt. Ltd 2002

Web Links

Course Title: Tool Training-Catia V5 (Basic and Advanced)

Course Credit : 04 (3-1-0)

Course code APAS-113/ APAS-113P **Max. Marks : 100**
(30I+70E)

Objectives
To purpose of the course is to provide fundamental knowledge engineering drawing and to enable individual to understand advance CATIA V5 operations to create aircraft stringers, frames, ribs, brackets and also create propeller assembly

Learning Outcomes

- To interpret drawings of machine and aircraft components. (Theory)
- Able to understand importance of assembly and industrial drafting methodologies. (Practical)
- To create title block and use GD&T symbols on engineering drafting sheet (Practical)
- To perform of folding and stamping in Sheetmetal workbench. (Practical)
- To perform models using 3D wire frame and surface modelling interface. (Practical)

Unit	Topic	Key Learning	Hours
I - Projection of solids and Sketcher module	Orthographic Views: Conversion of pictorial views into orthographic projections of simple machine parts with or without section. (Bureau of Indian Standards conventions are to be followed for the drawings) Hidden line conventions. Precedence of lines and orthographic to isometric conversions. Introduction to CATIA, Workbenches System Requirements Getting Started with CATIA The sketcher workbench, applying geometrical constraints, analyzing and deleting over-defined constraints	• Acquire the knowledge of CATIA workbench • Understand the importance sketch geometric and dimensional constraints	10
II - Part body Workbench	Reference elements, reference planes, creating new planes, creating points, creating reference lines, other sketch-based features, creating drafted filleted pad features, creating multi-pad features, pocket features Creating drafted filleted pocket features creating multi-pocket features, creating groove features extruding and revolving planar and non-planar faces projecting 3d elements, Part body drafting in 1st and 3rd angle of projection and GD &T	• Comprehend the importance of sketch-based features and transformation features • Able to understand importance of Boolean operations	10
III – Assembly Workbench	Assembly modeling, top down assembly and bottom up assembly editing components inside an assembly, editing subassemblies inside an assembly, editing assembly constraints, simplifying the assembly, interference detection, sectioning an as Generating Drawing Views Generating Views Automatically Generating Individual Drawing Views assembly, exploding an assembly, Assembly drafting, title block creation and BOM creation	Able to understand importance of assembly and drafting	10
IV – Sheetmetal Workbench	Setting sheet metal parameters tab, bend extremities tab bend allowance tab introduction to sheet metal walls, flanges, hems, tear drop, user flange. Conical bend, bend from flat, rolled walls, bead stamp, curve stamp, louver stamp, bridge stamp, flanged hole stamp, circular stamp, stiffening rib stamp dowel stamp	• Creation of Sheetmetal walls and flanges Learn the importance of folding and stamping	15
V – Wireframe and Surface Workbench	Need of surface modeling, wireframe and surface design workbench starting the wireframe and surface design workbench creating, wireframe elements creating surfaces creating, extruded surfaces, revolved surfaces spherical surfaces, cylindrical surfaces, creating offset surfaces creating sweep surfaces creating fill surfaces creating multi-sections surfaces creating blended surfaces operations on shape geometry joining surfaces splitting surfaces, trimming surfaces	• Acquire the knowledge of Wire frame and surface modelling • Understand the importance surface operations	15

Books Recommended

Text Books

1. Ibrahim Zeid, "CAD/CAM – Theory & Practice", McGraw Hill, 1998
2. CATIA V5R20 for Designers – 6 Jan 2010 by Purdue Univ., Prof. Sham Tickoo
3. CATIA V5 Design Fundamentals: A Step by Step Guide– July 22, 2012 by Jaecheol Koh

Reference Books

4. CATIA V5-6R2014 Surface Design: A Step By Step Guide – April 1, 2015 by Jaecheol Koh
5. CATIA V5 Tutorials Mechanism Design & Animation Release 19 – January 27, 2010 by Nader G. Zamani