STATE COUNCIL FOR TECHNICAL EDUCATION AND VOCATIONAL TRAINING, ODISHA									
TEACHING AND EVALUATION SCHEME FOR 5th Semester (AERONEUTICAL ENGG) .wef 2020-21									
Subject Number	Subject Code	Subject	Periods/week			Evaluation Scheme			
			L	T	P	Internal Assessment/ Sessional	End Sem Exams	Exams (Hours)	Total
		Theory							
Th.1		Entrepreneurship and Management & Smart Technology	4		-	20	80	3	100
Th.2		Aircraft piston engine	4		-	20	80	3	100
Th.3		Aircraft structure	4		-	20	80	3	100
Th.4		Aircraft system	4		-	20	80	3	100
Th.5		Aircraft maintenance & management	4		-	20	80	3	100
		Total	20			100	400	-	500
		Practical							
Pr.1		Aircraft propulsion Lab	-	-	6	50	50	3	100
Pr.2		Aircraft structure Lab	-	-	6	50	50	3	100
Pr.3		Project Phase-I			4	50	-	-	50
		Student Centred Activities(SCA)		-	3	-	-	-	-
		Total	-	-	*19*	*150*	*100*	-	*250*
		Grand Total	**20**	**-**	**19**	**250**	**500**	**-**	**750**
Abbreviations: L-Lecturer, T-Tutorial, P-Practical . Each class is of minimum 55 minutes duration									
Minimum Pass Mark in each Theory subject is 35% and in each Practical subject is 50% and in Aggregate is 40%									
SCA shall comprise of Extension Lectures/ Personality Development/ Environmental issues /Quiz /Hobbies/ Field visits/ cultural activities/Library studies/Classes on MOOCS/SWAYAM etc. ,Seminar and SCA shall be conducted in a section.									
There shall be 1 Internal Assessment done for each of the Theory Subject. Sessional Marks shall be total of the performance of individual different jobs/ experiments in a subject throughout the semester									

CURRICULLUM OF 5TH SEMESTER

For

DIPLOMA IN AERONAUTICAL ENGINEERING

(Effective FROM 2020-21 Sessions)

STATE COUNCIL FOR TECHNICAL EDUCATION & VOCATIONAL TRAINING, ODISHA, BHUBANESWAR

Th1. ENTREPRENEURSHIP and MANAGEMENT & SMART TECHNOLOGY

Theory	**4 Periods per week**	**Internal Assessment**	**20 Marks**
Total Periods	**60 Periods**	**End Sem Exam**	**80 Marks**
Examination	**3hours**	**Total Marks**	**100Marks**

Topic Wise Distribution of Periods

Sl No.	Topic	Periods
1	Entrepreneurship	10
2	Market Survey and Opportunity Identification(Business Planning)	8
3	Project report Preparation	4
4	Management Principles	5
5	Functional Areas of Management	10
6	Leadership and Motivation	6
7	Work Culture, TQM & Safety	5
8	Legislation	6
9	Smart Technology	6
	TOTAL	60

RATIONALE

In the present day scenario, it has become imperative to impart entrepreneurship and management concepts to students, so that a significant percentage of them can be directed towards setting up and managing their own small enterprises. It may be further added that an entrepreneurial mind set with managerial skill helps the student in the job market. The students can also be introduced with Startup and Smart Technology concept, which shall radically change the working environment in the coming days in the face of Industry 4.0

In this subject, the Students shall be introduced/ exposed to different concepts and Terminologies in brief only, so that he/she can have broad idea about different concepts/items taught in this subject. Solving numerical problem on any topic/item is beyond the scope of this subject.

OBJECTIVES

After undergoing this course, the students will be able to :

- Know about Entrepreneurship, Types of Industries and Startups
- Know about various schemes of assistance by entrepreneurial support agencies
- Conduct market survey
- Prepare project report
- know the management Principles and functional areas of management
- Inculcate leadership qualities to motivate self and others.
- Maintain and be a part of healthy work culture in an organisation.
- Use modern concepts like TQM
- Know the General Safety Rules
- Know about IOT and its Application in SMART Environment.

DETAILED CONTENTS

1. **Entrepreneurship**
   - Concept /Meaning of Entrepreneurship

- Need of Entrepreneurship
- Characteristics, Qualities and Types of entrepreneur, Functions
- Barriers in entrepreneurship
- Entrepreneurs vrs. Manager
- Forms of Business Ownership: Sole proprietorship, partnership forms and others
- Types of Industries, Concept of Start-ups
- Entrepreneurial support agencies at National, State, District Level(Sources): DIC, NSIC,OSIC, SIDBI, NABARD, Commercial Banks, KVIC etc.
- Technology Business Incubators (TBI) and Science and Technology Entrepreneur Parks

2. **Market Survey and Opportunity Identification (Business Planning)**

- Business Planning
- SSI, Ancillary Units, Tiny Units, Service sector Units
- Time schedule Plan, Agencies to be contacted for Project Implementation
- Assessment of Demand and supply and Potential areas of Growth
- Identifying Business Opportunity
- Final Product selection

3. **Project report Preparation**

- Preliminary project report
- Detailed project report, Techno economic Feasibility
- Project Viability

4. **Management Principles**
- Definitions of management
- Principles of management
- Functions of management (planning, organising, staffing, directing and controlling etc.)
- Level of Management in an Organisation

5. **Functional Areas of Management**
   a) Production management
      - Functions, Activities
      - Productivity
      - Quality control
      - Production Planning and control
   b) Inventory Management
      - Need for Inventory management
      - Models/Techniques of Inventory management
   c) Financial Management
      - Functions of Financial management
      - Management of Working capital
      - Costing (only concept)
      - Break even Analysis
      - Brief idea about Accounting Terminologies: Book Keeping, Journal entry, Petty Cash book, P&L Accounts, Balance Sheets(only Concepts)
   d) Marketing Management
      - Concept of Marketing and Marketing Management

- Marketing Techniques (only concepts)
- Concept of 4P s (Price, Place, Product, Promotion)

e) Human Resource Management

- Functions of Personnel Management
- Manpower Planning, Recruitment, Sources of manpower, Selection process, Method of Testing, Methods of Training & Development, Payment of Wages

6. **Leadership and Motivation**

a) Leadership

- Definition and Need/Importance
- Qualities and functions of a leader
- Manager Vs Leader
- Style of Leadership (Autocratic, Democratic, Participative)

b) Motivation

- Definition and characteristics
- Importance of motivation
- Factors affecting motivation
- Theories of motivation (Maslow)
- Methods of Improving Motivation
- Importance of Communication in Business
- Types and Barriers of Communication

7. **Work Culture, TQM & Safety**

- Human relationship and Performance in Organization
- Relations with Peers, Superiors and Subordinates
- TQM concepts: Quality Policy, Quality Management, Quality system
- Accidents and Safety, Cause, preventive measures, General Safety Rules , Personal Protection Equipment(PPE)

8. **Legislation**

a) Intellectual Property Rights(IPR), Patents, Trademarks, Copyrights
b) Features of Factories Act 1948 with Amendment (only salient points)
c) Features of Payment of Wages Act 1936 (only salient points)

9. **Smart Technology**

- Concept of IOT, How IOT works
- Components of IOT, Characteristics of IOT, Categories of IOT
- Applications of IOT- Smart Cities, Smart Transportation, Smart Home, Smart Healthcare, Smart Industry, Smart Agriculture, Smart Energy Management etc.

Syllabus to be covered upto IA: Chapter 1,2,3,4

RECOMMENDED BOOKS

1. Entrepreneurship Development and Management by R.K Singhal, Katson Books., New Delhi
2. Entrepreneurship Development and Management by U Saroj and V Mahendiratta, Abhishek Publications, Chandigarh

3. Entrepreneurship Development and Management by Vasant Desai, Himalaya Pub.House
4. Industrial Engineering and Management by O.P Khanna ,Dhanpat Rai and Sons
5. Industrial Engineering and Management by Banga and Sharma, Khanna Publications
6. Internet of Things by Jeeva Jose, Khanna Publications, New Delhi
7. Online Resource on Startups and other concepts
8. https://www.fundable.com/learn/resources/guides/startup

TH.2. AIRCRAFT PISTON ENGINE

Theory	4 Periods per week	Internal Assessment	20 Marks
Total Periods	60 Periods	End Sem Exam	80 Marks
Examination	3hours	Total Marks	100Marks

Topic-wise distribution of periods

S.L. No.	TOPICS	PERIODS
I	GENERAL REQUIREMENTS OF AIRCRAFT POWER PLANTS AND CLASSIFICATION	6
II	ENGINE OPERATING PRINCIPLES	12
III	ENGINE COMPONENTS AND THEIR CONSTRUCTION	8
IV	FUEL AND CARBURETION SYSTEM	10
V	INDUCTION, COOLING, LUBRICATION AND EXHAUST SYSTEMS	12
VI	STARTING SYSTEM, IGNITION SYSTEMS, FIRE DETECTION AND PROTECTION	12
	Total	60

Rationale:

This subject shall enable the students to gain a thorough knowledge about the working of Piston engines and to identify its different components, their location and function.

Course Objectives:

To understand the requirements of power plants used in aeronautical field and their types.
To understand various cycles, working principles, and performance parameters of reciprocating engines.
To identify various parts of piston engine and their functions.
To understand the fuel requirements and fuel systems.
To understand the various systems like induction, cooling, lubrication and exhaust of piston engines.
To understand engine starting, ignition systems and the requirement of fire protection.

UNIT I: GENERAL REQUIREMENTS OF AIRCRAFT POWER PLANTS AND CLASSIFICATION

1.1General requirements of aircraft power plants

1.1.1 Requirement of power for a type of aircraft keeping view of operational needs,

1.1.2 What altitude the aircraft operates, distance normally covered in each flight,

1.1.3 Conditions of operation, weight considerations of the power plant keeping in view of power to weight ratio, 1.1..4 Basic pay load of the aircraft that is to be carried-cargo/bombs/rockets/passengers.

1.2 Durability of power plants, its importance:

1.2.1 The importance of service life/durability of the power plant considering the economics of operation,

1.2.2 Mean time between servicing /failures and down time of the aircraft due to service life of aircraft.

1.3 Reliability of the power plant and its importance:

1.3.1 Explanation of the importance of reliable operation of the aircraft considering the safety of passengers

1.3.2 Assured operation under all adverse conditions/ability to deliver the payloads to the destinations

1.3.3 During air operations in defence requirements

1.4 Fuel economy of the power plant and its significance: Importance of fuel economy considering economics of operation

1.5 Operating flexibility of operation of power plants:

1.5.1 Explain the flexibility to operate the engine in all conditions of weather, in the assured altitudes

1.6 Compactness of power plants and its importance: Need for compactness of engine considering the wind resistance it will offer when it is fitted /streamlined into the structure of the aircraft.

1.7 Introduction to reciprocating engines Classification of reciprocating engines based on cylinder arrangement

1.7.1 In line type of reciprocating engines: Explanation of engine layout with all cylinders arranged linearly or with one cylinder block.

1.7.2 Opposed type of reciprocating engines: Explanation of horizontally opposed cylinder banks located in the same plane on opposite side of the crank shaft.

1.7.3 V-type of reciprocating engines: Description of engine which has two banks of cylinders inclined at an angle to each other and with one crank shaft.

1.74 Radial type of reciprocating engines: Explanation of engine which has more than two cylinders in each row ,which are equally spaced around the crank shaft.

UNIT II: ENGINE OPERATING PRINCIPLES

2.1.Know how the energy conversion takes place: 1Explanation of working principles of internal combustion engine and the sequence of events that have to take place for chemical energy conversion in the fuel into mechanical work.

2.2 Understand the basic energy conversion laws:

2.2.1 Basic laws-gas law,

2.2.2 First and second laws of thermodynamics,

2.2.3 Constant pressure process, constant volume process ,Isothermal process adiabatic process ,

2.2.4 Steady flow energy equation and operating principles of external and internal combustion engines are explained giving examples of a steam engine, internal combustion engine. Simple application problems

2.3 Understand the basic Piston engine terminology: A brief description of important components of the
internal combustion engine are given.

2.4 Understand the basics of an Otto cycle and its efficiency: T

2.4.1 The various processes in the spark ignition(SI) internal combustion engine,

2.4.2 compression ignition engine are explained with the help of Otto cycle and Diesel cycle.

2.4.3 The terms like thermal efficiency, work ratio and mean effective pressures are also explained.

2.5 Understand the basic operation of two stroke and four stroke operating cycles:

2.5.1 Explanation of working cycles, principles of two stroke,

2.5.2 four stroke spark ignition, compression ignition engines are given and

2.5.3 A comparison of two stroke engine and four stroke engine is done for various parameters

2.5.4 A comparison of SI and CI engines are made and explained for the various parameters of the engines.

2.6 Understanding concepts of Valve timing-lead, lag and overlap in timing: Explanation with simple diagram for the valve opening /closing cycles ,importance of valve timings-lead, lag, and overlap is explained.

2.7 Understanding the concept of Engine firing order-opposed, inline ,v-type and radial engines: Engine

firing order for opposed , in-line, V-type and radial type of engines are explained, giving practical reasons for the firing order in an engine.

2.8 Understanding basics of Engine power, engine rating, engine efficiency: Following engine performance parameters are explained with simple application problems:

2.81 Indicated power of an engine, Brake power of an engine,

2.8.2 Thermal efficiency,

2.8.3 Mechanical efficiency,

2.8.4 Volumetric efficiency,

2.8.5 Compression ratio ,

2.8.6 Specific fuel consumption.

2.8.7 Explanation of important factors affecting engine performance:

2.8.8Density altitude ,

2.8.9 Humidity

2.8.10 Carburettor air temperature,

2.8.11 Exhaust back pressure,

2.8.12 Super charging,

2.8.12 Compression ratio

2.8.13 Fuel-air mixture ratio

2.9 Understanding the importance of Critical altitude of operation for piston engine aircrafts:

Explanation of requirement air for charging /supercharging the fuel-air mixture Is given to the students bringing out the limits and critical altitude up to which piston Engine aircrafts can operate reliably.

UNIT III: ENGINE COMPONENTS AND THEIR CONSTRUCTION

3.1 Construction details of various engine sections/components are explained with diagrams:

3.1.1 Crank case-function, basic constructional features

3.1.2 Basic constructional features of crankshaft

3.1.3 Purpose and features of connecting rods

3.1.4 Basic constructional features of engine cylinder

3.1.5 Basics of valves and valve operating mechanism

3.2 Basics of propeller reduction gear, accessories case:

3.2.1 Explanation is given for the requirement of propeller reduction gear and Accessories case ,

3.3.3functions of propeller reduction gear and accessories case are explained.

3.3 Types of propeller reduction gear: brief study in spur gear and Planetary gear system

UNIT IV: FUEL AND CARBURETION SYSTEM

4.1Explanation of important characteristics of Aviation fuel: Basic explanation of aviation fuel(gasoline) and its properties ,Gasoline rating and its significance

4.2 Vapour lock in engine fuel system-reasons for the vapour lock: phenomenon of vapour lock in aircraft fuel system is explained
4.3 Explanation of carburetion principles: fuel, air mixture requirements: Carburetion –principles, venturi effect,fuel air mixture requirement ,variation of air in the mixture with increase in altitude, supercharging.
4.4. Explanation of types of carburettors, principle of operation:
4.4.1Float type
4.4.2 Pressure injection type
4.4.3Direct injection type and direct fuel injection system
4.5 Explanation of Carburettor icing and reasons for carburettor icing
4.6 Explanation of a basic fuel system of an aircraft: Description of basic fuel system of a piston engine type of aircraft is given and explained with the help of a diagram.

UNIT V: INDUCTION, COOLING, LUBRICATION AND EXHAUST SYSTEMS

5.1Explanation of a basic induction system: The basic theory of induction is explained and discussed
5.2 Principles of supercharging and turbo charging and blower charging:
- 5.2.1The density of available per given volume will reduce with the increase of altitude.
- 5.2.2 The effect of this reduced air on the fuel air mixture is discussed and methods available for compensation
- 5.2.3 Principle of super ---charging and turbo charging and blower charging are explained to the students.

5.3 Various types of Engine cooling system:
- 5.3.1 The purpose and requirements of engine cooling system,
- 5.3.2 effect of improper cooling on the engine performance are discussed.
- 5.3.3 Two common methods available for engine cooling are discussed .They are:
  - 5.3.3.1 Air cooling system
  - 5.3.3.2 Liquid cooling system

5.4 Lubrication system: Introduction, effect of improper lubrication is explained
- 5.4.1 Necessity of engine lubrication-basic explanation
- 5.4.2 Explanation of Important functions of lubricant, characteristics of lubricant
- 5.4.3 Explanation of Contamination of lubricants and its control
- 5.4.4 Lubrication system: dry sump system and wet sump system
- 5.4.5 Properties of Lubrication oil
- 5.4.6 Explanation of basic Components of lubrication system

5.5 Explanation of basic Engine exhaust systems

UNIT VI: STARTING SYSTEM, IGNITION SYSTEMS, FIRE DETECTION AND PROTECTION

6.1 Explanation of principle of operation of starter:
6.2 Description various types of starters: Cartridge starter, Hand inertia starter, Electric inertia starter,
Combination inertia starter, Direct- cranking electric starter and its advantages and disadvantages are discussed.
6.3 Types of ignition systems used in aircraft piston engine: Battery ignition system and Magneto ignition system discussed in detail.
- 6.3.1 Explanation of timing devices
- 6.3.2 Explanation of Auxiliary ignition unit
- 6.3.3 Explanation of Spark plugs and their general construction

6.4 Engine fire detection and protection systems

6.4.1 Introduction and Description of fire detection and protection system in piston engines

Syllabus to be covered upto IA: Chapter 1,2,3

TEXT BOOKS AND REFERENCES

1. Internal combustion engine, V Ganesh, Tata Mc graw hill
2. Internal combustion engine, Mathur & Sharma
3 Aircraft piston engine, Daewoo

TH.3. AIRCRAFT STRUCTURES

Theory	**4 Periods per week**	**Internal Assessment**	**20 Marks**
Total Periods	**60 Periods**	**End Sem Exam**	**80 Marks**
Examination	**3hours**	**Total Marks**	**100Marks**

S.L. No.	**TOPICS**	**PERIODS**
I	AIR FRAME CONSTRUCTION AND INTRODUCTION TO FIXED WING AIRCRAFT,AND LOCATION NUMBERING SYSTEM	**10**
II	FUSELAGE OF AIRCRAFT	**12**
III	WING STRUCTURES	**12**
IV	BASICS OF NACELLES/PODS	**12**
V	MAIN CONTROL SURFACES	**6**
VI	LOADS ON AIRCRAFT	**8**
	Total	**60**

Topic-wise distribution of periods

Rationale:

It aims at enabling the student to understand & analyze the structural construction of the aircraft and the various loads acting on the structure.

Course Objectives:

To know the basics of airframe construction ,configurations and location numbering systems in use.

To identify various types of fuselage construction

To know various wing structures and its types

To understand nacelles and honeycomb structures

To Illustrate various flight control surfaces and its significance and uses

To Differentiate between various loads acting on aircraft and appreciate the flight envelope through V-n diagram.

UNIT I: AIR FRAME CONSTRUCTION AND INTRODUCTION TO FIXED WING AIRCRAFT, AND LOCATION NUMBERING SYSTEM

1.1 AIR FRAME CONSTRUCTION:
1.1.1 Structural members
1.2. FIXED WING AIRCRAFT
1.2.1 Identification and explanation of aircraft structural components for
a. typical fixed wing, single engine, propeller driven aircraft.
b. typical fixed wing, multi engine aircraft
1.3 LOCATION AND NUMBERING SYSTEM
1.3.1 Purpose of the location numbering system
1.3.2 Station diagram for an aircraft fuselage.

UNIT II: FUSELAGE OF AIRCRAFT

2. FUSELAGE OF AIRCRAFT
2.1 Fuselage-Basic explanation of fuselage
2.2 TYPES OF FUSELAGE WITH DIAGRAMS
2.2.1 Truss type fuselage
2.2.2 Monocoque type fuselage
2.2.3 Semi-monocoque type

UNIT III: WING STRUCTURES

3. WING STRUCTURES
3.1 Wing structures -general explanation of three fundamental designs for wing structure:-
3.1.1 Mono spar
3.1.2 Multi spar
3.1.3 Box Beam
3.2 Wing configurations-Introduction
3.2.1 No of wings
3.2.2 position of wings
3.2.3 wing support
3.2.4 wing plan form (aspect ratio, wing sweep, chord variation, asymmetrical)
3.2.5 tail plane and fore plane
3.2.6 dihedral / anhedral
3.2.7 leading edge / trailing edge shapes
3.3 SPARS AND RIBS
3.3.1 Purpose and general explanation of spars with types and construction
3.3.2 Purpose and general explanation of ribs with types and construction

UNIT IV: BASICS OF NACELLES/PODS,

4. BASICS OF NACELLES/PODS,
4.1 Explanation of Nacelles / pods, engine mounts
4.2 Cowlings
4.3 Skin & Fairing
4.4 Access and inspection doors.
4.5 Aircraft painting and finishing
4.5.1 Explanations of importance and requirements of painting of aircraft,
4.5.2 Types of paints
4.5.3 methods of painting
4.5.4 defects in painting
4.6 BASICS OF HONEY COMB SECTION WINGS
4.6.1 Basic diagram & Explanation
4.6.2 types of honeycomb structures
4.6.3 Areas of application

UNIT V. MAIN CONTROL SURFACES

5.1 Explanation and purpose of main control surfaces
5.2 classification of main control surfaces
5.3 primary control surfaces (explanation of ailerons, elevator and rudder)
5.4 Secondary control surfaces (explanation of tabs etc..)

UNIT VI. LOADS ON AIRCRAFT

6.1 concept of basic loads and other Types of loads on the aircraft

6.2 Load factor ,Limit load and Design load and its implications
6.3 Concept of gust loads
6.4Load factor –velocity V-n diagram, explanation and its importance

Syllabus to be covered upto IA: Chapter 1,2,3

TEXT BOOKS AND REFERENCES:
Aircraft structures vol II By Dr. Lalit Gupta and O.P.Sharma
FAA Airframe and powerplant mechanics airframe hand book: AC65:15A Fundamental of aircraft structure By. Barton Millard

TH.4. AIRCRAFT SYSTEMS

Theory	**4 Periods per week**	**Internal Assessment**	**20 Marks**
Total Periods	**60 Periods**	**End Sem Exam**	**80 Marks**
Examination	**3hours**	**Total Marks**	**100Marks**

Topic-wise distribution of periods

S.L. No.	**TOPICS**	**PERIODS**
I	INTRODUCTION TO AIRCRAFT SYSTEM	**8**
II	AIRCRAFT FUEL SYSTEM	**12**
III	AIRCRAFT FLIGHT CONTROL SYSTEM	**12**
IV	AIRCRAFT REMOTE CONTROL SYSTEMS MEDIA, UNDERCARRIAGE SYSTEM	**16**
V	AIRCRAFT ENVIRONMENT SYSTEMS	**6**
VI	AIRCRAFT EMERGENCY SYSTEMS	**6**
	Total	**60**

Rationale:
It aims at enabling the student to understand & analyze the operations of various types of aircraft systems.

Course Objectives:

- To **know** about various aircraft systems
- To **understand** various aircraft fuel systems
- To **understand** and differentiate various flight control systems
- To **know** about various remote control systems and to **understand** the working of undercarriage system
- To **know** about environmental and pressurization systems and **apply** the knowledge to select proper fire extinguishers
- To **understand** the ice and rain protection system

UNIT I. INTRODUCTION TO AIRCRAFT SYSTEM

1. Systems concept-Introduction
1.1. Requirements of a system:
1.1.1Stability
1.1.2 Reliability
1.1.3 Flexibility
1.1.4 Maintainability
1.2 AIRCRAFT SYSTEMS
1.2.1 Primary performance systems:
1.2.1.1 Aircraft structural system
1.2.1.2 Propulsion system
1.2.1.3 Primary flying control surface system
1.2.1.4 Under carriage System
1.2.2 Performance Aid systems:

1.2.2.1 Secondary and tertiary flying control Surfaces
1.2.3 Active air Induction system
1.2.4 Augmentation & Thrust reversal systems
1.2.5Environmental Systems:
1.2.5.1 Ventilation system
1.2.5.2 Air conditioning system
1.2.5.3 Oxygen system
1.2.5.4Pressurisation system
1.2.6 Safety systems:
1.2.6.1 Fire warning & extinguishing systems
1.2.6.2 Escape Aid systems
1.2.7 Media systems;
1.2.7.1 Mechanical
1.2.7.2 Hydraulic
1.2.7.3 Pneumatic
1.2.7.4 Electro-Hydraulic
1.2.7.5 Electro-Pneumatic
1.2.7.6Electrical

UNIT II. AIRCRAFT FUEL SYSTEM

2.1 AIRCRAFT FUEL SYSTEM- Classification based on functional basis-
2.1.1 Airframe fuel system
2.1.2Power plant fuel system
2.2 Basic airframe fuel system
2.3 Additional features of airframe fuel system
2.4 Venting-Basic purpose of venting system.
2.5 Booster Pump- need for booster pump and limitations of gravity fuel feed system
2.6 Filter-Need for strict quality control for aviation fuel.
2.7 Information system-
2.7.1 Fuel contents
2.7.2 Fuel Pressure
2.7.3 Low/critical fuel level warning
2.8 Modern airframe fuel systems-
2.8.1 Explanation with basic schematic for a multi -engine fuel system
2.9 Weight of dispersed fuel :- Affect on stability & manoeuvrability of aircraft
2.10 Flexibility-minimum vulnerability to total system failure by any one of the components.
2.11 Safety-Protection of the systems from hazards of requirement, various operating conditions.

UNIT III. AIRCRAFT FLIGHT CONTROL SYSTEM

3Introduction to flight control systems
3.1 Axes of Motion- Vertical - Longitudinal -Lateral
3.2 PRIMARY CONTROL SURFACES-Elevator/Stabilizer, Aileron & Rudder.
3.3 SECONDARY CONTROL SURFACES-Flaps, slats, spoilers dive brakes
3.4 Tertiary Control Surfaces-Trim Tabs.
3.5 Primary flight controls:-Pitch-Roll- Yaw - Throttle
3.6 Secondary effects of controls:
3.6.1 Pitch-elevator-how speed is controlled by Secondary effects of elevator.
3.6.2 Roll-Aileron-how yaw is achieved
3.6.3 Yaw-Rudder-Aileron less rudder only
3.7 Main Control Surfaces:

3.7.1 Ailerons-Placing, purpose, action
3.7.2 Elevators-Placing, purpose, action
3.7.3 Rudder-Placing, purpose, action
3.8 Trim Tabs: Purpose, Placing, action
3.9 Spoilers-Purpose, use,
3.10 Flaps-Placing, purpose, action,
3.11 Slats-Placing, purpose, action
3.12 Air Brakes-Placing, purpose, action
3.13 General arrangement of Aircraft Flight Control Systems (AFCS):
3.13.1 Control yoke for roll that moves AILERONS,
3.13.2 Control column for PITCH that moves the elevators,
3.13.3 Rudder pedals for YAW that moves the rudder.
3.14 Classification of flight control systems (FCS)
3.14.1 Mechanical FCS
3.14.2 Hydro-Mechanical FCS/Powered flight control units (PFCU)
3.14.3 Fly-by-wire (FBW)
3.14.3.1 Analog Fly by wire FCS
3.14.3.2 Digital fly by wire FCS
3.14.3.3) Power-by-wire FCS
3.14.3.4 Intelligent FCS

UNIT IV. AIRCRAFT REMOTE CONTROL SYSTEMS MEDIA, UNDERCARRIAGE SYSTEM

4.1 Introduction-concept of remote control system, basic principles used.
4.2 Explanation of basic manual control system using mechanical media.
4.3 Advantages and disadvantages of mechanical media in Aircraft remote Control systems
4.4 Application areas for mechanical media systems.
4.4.1 Flying controls,
4.4.2 Engine controls,
4.4.3 Operation of control valves and Selector valves.
4.5 Examples of commonly used mechanical media systems, units brief explanations:-
4.5.1 Multi stranded cable system with pullies, drums etc
4.5.2 Chain & sprocket system – common examples
4.6 Explanation of a typical mechanical media push-pull control system- with diagram
4.7 Chain and cable controls-Introduction
4.8 Chain control-Brief explanation of how chain control is used for controlling aircraft, control surface movements.
4.9 Inspection and maintenance on chain control system: Routine and periodical.
4.10Aircraft cables-control cables, their specifications and strands.
4.11 Cable Maintenance.
4.12 Introduction to hydraulic system and brief discussion on properties of fluids useful for this system.
4.13 Hydraulic fluid medium:
4.13.1 General properties of hydraulic fluid.
4.13.2 Incompressibility of hydraulic fluid.
4.13.3 Liquid pressure and PASCAL'S law.
4.14 Aircraft hydraulic fluid-Important properties of aircraft hydraulic fluids:-
4.14.1 Viscosity
4.14.2 Low Freezing point
4.14.3 High Boiling point
4.14.4Flight flash and fire points

4.14.5 Chemical and physical stability
4.14.6Compatibility
4.14.7 Lubricity
4.15 Aircraft hydraulic fluid specifications & colours of Fluids
4.16 Explanation of a simple closed loop

HYDRAULIC SYSTEM- Vehicle Brake System.
4.17 Description of a simple pump-powered hydraulic system.
4.18 AIRCRAFT REMOTE CONTROL SYSTEM- PNEUMATIC MEDIA
4.18.1 Introduction-Pneumatic media systems
4.18.2 Special qualities of Air and typical applications in aircraft:
4.18.2.1 Pressure energy storage-under carriage blow-down systems,
4.18.2.2 Compression-shock absorbers
.
AIRCRAFT UNDERCARRIAGE SYSTEMS
4.19 Purpose and functions of Aircraft under carriage system.
4.20 Systems requirement for under carriages.
4.21 Classification of under carriages:
4.21.1 By general configuration of the 3 point support with reference to the Airframe.
4.21.2 Tail under carriage type with 2 main Undercarriages located in wings.
4.22 Nose undercarriage type with their main undercarriage located in the fuselage or under wings (Tricycle base)
4.22.1 By constructional features:
4.22.2 Single nose wheel and main wheel undercarriage
4.22.3 Double nose wheel and single main wheel undercarriage
4.22.4 Double nose wheel and double tandem undercarriage.
4.22.5 By operating features:-
4.22.5.1 Non retractable undercarriage mounted on fuselage or wings
4.22.5.2 Retractable undercarriage:

UNIT V. AIRCRAFT ENVIRONMENT SYSTEMS
5.1 Cabin pressurization and air conditioning systems: Introduction.
5.2 Altitude limits of tolerance for human being.
5.3 Effect of rate of change of altitude on human body.
5.4 Normal composition of cabin atmosphere in an aircraft.
5.5 Temperature, humidity and comfort zone inside aircraft cabin.
5.6 Cabin altitude, differential pressure ambient pressure
5.7 Pressurization systems-introduction
5.8 Supply of Air-engine bled supply and ram air supply.
5.8.1 Cabin pressure control-cabin pressure control value (CPCV). Important functions of CPCV.
5.8.2 Compression and explosive de-compression of aircraft cabin-cause and effects.
5.9 Aircraft air conditioning systems-introduction
5.10 Air conditioning units-boot Strap or Air cycle principle.

UNIT VI. AIRCRAFT EMERGENCY SYSTEMS
6.1Aircraft fire warning systems-Introduction
6.1.1 Common causes of fire in aircraft: Fuel, Hot gases, Electrical/Mechanical
6.1.2 Purpose and function of fire detection system.
6.1.3 Ancillary systems: Fire extinguisher systems
6.1.4 Cabin protection in civil transport aircraft-modern trend.

6.2. ICE AND RAIN PROTECTION SYSTEMS
6.2.1 Ice and Rain Protection Systems Introduction-Common flight hazards due to ice pitot tubes, control systems etc.
6.2.1.1 Areas sensitive for ice formation:
6.2.1.2 Aero foil surfaces
6.2.1.3 Engine intakes
6.2.1.4 Engine internal surfaces
6.2.1.5 Rotor blades & propellers
6.2.1.6 Wind screens
6.2.1.7 Instrument probes & vanes
6.2.1.8 Control hinges & linkages
6.2.2 Principles of operation :
6.2.2.1 Active system
6.2.2.2 Passive system
6.2.3 Ice protection systems:
6.2.3.1 Thermal (Hot Air)-Air frame.
6.2.3.2 Thermal (Hot Air)-Engine
6.2.3.3 Thermal (Electrical)
6.2.3.4 Ground De-icing-Aircraft on open parking.

Syllabus to be covered upto IA: Chapter 1,2,3

TEXT BOOKS AND REFERENCES:
1. Aircraft systems by Lalit gupta & Dr.O P sharma.
2. Aircraft powerplant by Michael kroes
3. FAA Aircraft mechnics handbook AC 65-15A
4. Aircraft systems by Lalit gupta & Dr.O P sharma.
5. Aircraft powerplant by Michael kroes
6. Aircraft Systems: Mechanical, electrical, and avionics subsystems integration, Third Edition Author(s): Ian Moir, Allan Seabridge Published Online: 10 APR 2008

TH.5. AIRCRAFT MAINTAINCE MANAGEMENT

Theory	4 Periods per week	Internal Assessment	20 Marks
Total Periods	60 Periods	End Sem Exam	80 Marks
Examination	3hours	Total Marks	100Marks

Topic-wise distribution of periods

S.L. No.	TOPICS	PERIODS
I	INTRODUCTION, MAINTAINABILITY, AVAILABILITYAND SAFETY	9
II	RELIABILITY AND FAILURE ANALYSIS	7
III	MAINTENANCE PHILOSOPHY AND ERGONOMICS	11
IV	MATERIALS MANAGEMENT AND COMPUTERIZATION OF AIRCRAFT MAINTENANCE	9
V	QUALITY, STANDARDS AND STATISTICS	8
VI	SOCIAL ISSUES AND ENVIRONMENT	8

Rationale:

1. To prepare Technicians of Aeronautical engineering disciplines to work at middle management level effectively and to deal with workforce and management problems.
2. To prepare technicians for optimum utilization of the resources with higher productivity, quality and least cost in the industry

Course Objectives:

- **To** Know the general management principles, maintainability, availability
- **To** Know about the importance of reliability and failure
- **To** Know about various types of management and application of Ergonomics
- **To** Know about material management and computerization of aircraft maintenance
- **To** Know the application of statistics, Quality, and QMS
- **To** Appreciate the social responsibilities of engineer and ways to protect our environment

UNIT I : INTRODUCTION, MAINTAINABILITY, AVAILABILITYAND SAFETY

1.1 Management – Definition

1.1.1. Functions of Management.

1.1.2. Types of management.

1.1.3. Introduction to Maintenance and its importance towards maintaining optimum serviceability of the aircraft.

1.1.4. Explanation of important terms like Life Cycle profitability, maintenance cost, Explanation of life Characteristic curve.

1.1.5. Definition of Maintainability.

1.1.6. Factors effecting Maintainability. Maintainability and cost.

1.1.7. Availability definition and explanation.

UNIT II : RELIABILITY AND FAILURE ANALYSIS

2.1 Reliability Concept and definition Failure Rate:

2.1.1 Explanation of term. Mean Time Between Failure (MTBF).

2.1.2 Explanation of the term Hazard Rate.

2.1.3 Explanation of term areas of Reliability.

2.1.4 Explanation of the term Reliability Specification. Reliability studies: brief explanation.

2.2 Life testing and Reliability.

2.2.1 Classification of Life Testing.

2.2.2 Quality control Life Test.

2.2.3 Pilot-run life test.

2.2.4 Establishment life test.

2.2.5 Application life test.

2.2.6 Individual life test.

2.3 Concept of Failure:

2.3.1 EARLY failure,

2.3.2 CHANCE Failure,

2.3.3 Wear-Out Failure.

2.4 Explanation of Modes of failure:

2.4.1 Catastrophic failure,

2.4.2 Degradation Failure,

2.4.3 Independent Failure,

2.4.4 Secondary Failure.

UNIT III : MAINTENANCE PHILOSOPHY AND ERGONOMICS

3.1 Definition of Maintenance.

3.1.1 Objectives of maintenance.

3.1.2 Forms of maintenance.

3.1.3 Emergency maintenance.

3.1.4 Break down Maintenance.

3.1.5 Preventive Maintenance.

3.1.6 Corrective maintenance.

3.1.7 Automatic Maintenance.

3.1.8 Maintainability Vs Maintenance.

3.2 maintenance cost Analysis. Out sourcing or Contracted Maintenance.

3.3 Built in test Equipment (BITE).

3.31 Importance of BITE in Maintenance.

3.4 Total Productive Maintenance (TPM). Prophylactic Maintenance. Condition monitoring. Predictive Maintenance.

3.5 Wear Detection and Monitoring (WDM). Magnetic Chip Detector. Electric Chip Detector. Spectrometric Oil Analysis Program (SOAP),

Vibration Monitoring and Control. Vibration Check. Vibration Analysis.

3.6 ERGONOMICS: Basic meaning and explanation of term ergonomics.

3.6.1 Human – Machine matching. Ergonomically reasons for lay out and display.

UNIT IV: MATERIALS MANAGEMENT AND COMPUTERIZATION OF AIRCRAFT

MAINTENANCE

4.1 Material management - definition, functions-

4.1.1 Storekeeping- classification of stores - Functions of store keeper.

4.1.2 Store management- Bin Card - Material Issue Requisition- Material Returned Note- Store ledgers –Codification of stores-

4.1.3 Inventory Management- Definition - functions of Inventory Control- Advantages of Inventory Control.

4.1.4 Enterprise resource planning - concept, features and applications.-

4.1.5 Material Requirement Planning (MRP)- concept, applications

4.1.6 Just in Time (JIT)-concept and benefits-

4.1.7 Supply chain management-concept and benefits

4.2 Computerization of Aircraft Maintenance.

4.2.1 Basic data maintained with computerization:Main Schedule. Component Service life as applicable to that maintenance.

Parts Catalogue with illustration.

4.2.2 Work Card Reference. List of authorized modification and their implications.

Existing Technical orders and Service Instructions.

Details of Flying hours for that Aircraft. Condition of information like - Mechanics, Work areas, Flight destination detail etc.

UNIT V: QUALITY, STANDARDS AND STATISTICS

5.1 Quality–Concept-Quality control- Definition

5.1.1 Factors affecting quality- Advantages of quality control

5.1.2 Inspection-Different types of inspection.

5.2 Total Quality Management-Meaning-

5.2.1 Principles of total quality management- TQM,

5.2.2 Problem solving tools- Flow charts, Control charts, Histograms, Pareto charts, Cause and effect diagram, 5-S, Kaizen, and Six-sigma.

5.3 Introduction and scope of Statistics.

5.3.1 Importance of statistical data.

5.3.2 Classification of Statistical methods: Descriptive(Sampling).Inductive(Inference).Sampling.

Merits and demerits of Sampling.

5.4 Introduction to statistical Quality Control(SQC).

5.4.1 Control Charts: Types of control charts. Use of control charts.

5.5 Quality Certification Systems

5.5.1 ISO 9000 series quality standards,

5.5.2 quality certification procedure, AS 9100, ISO 18000, QS14000

UNIT VI: SOCIAL ISSUES AND ENVIRONMENT

6.1 Environment – Definition. Global environmental issues.

6.2 Ozone layer depletion.

6.2.1 Observations on Ozone layer depletion.

6.2.2 Consequence of Ozone layer depletion: (a) Biological effects (b) Effects on Humans. (C) Effects on Crops.

6.3 Greenhouse effect.

6.4 Global warming & it Causes,

6.4.1 Effects of global warming on Society,

6.5 Acid rain. Causes and effects.

6.6 Different types of wastes. Causes, effects, prevention / disposal.

6.7 Nuclear hazards: List the sources of nuclear radiation. Disposal of Radio active waste.

Explain effects of Radiation. Explain prevention of the above.

6.8 Water conservation and rain water harvesting.

6.9 Regulation on pollution prevention and control.

6.9.1 Functions of Pollution Boards.

6.9.2 Environment (protection) Act, 1986.

6.9.3 Definition. General power of the Central Government. Rules to regulate Environmental Pollution.

Syllabus to be covered upto IA: Chapter 1,2,3

TEXT BOOKS AND REFERENCES

1. Industrial Organization and Engineering Economics, T.R.Banga & S C Sharma, Khanna.Publishers
2 Industrial management and engineering economics, O.P.Khanna, Khannapublishers
3. Production and operations management, -Dr .K.Aswathappa And. Dr.Sreedhar Bhatt, Himalaya Publishers
4 Safety Management in Industry Krishnan.N V, Jaico Publishing House, Bombay, 1997
5 Total Quality Management S Raja Ram, Shivashankar
6 Environmental Engineering BR Sharma

PR.1. AIRCRAFT PISTON ENGINE LAB

Practical : 6 periods per week **Sessional: 50 Marks**
Examination: 3 hours **End Exams:50 Marks**
Total Marks: 100

Rationale:
To enable students to locate, identify and demonstrate various piston engine aircraft components

Practical/Exercise:

1 Demonstration of principle of operation of piston engine engine Study of General requirement of Aircraft power plants-Power and weight consideration, Durability, reliability, fuel economy, operating flexibility and
Compactness-Importance of each of these factors,

2 Dismantling and study of Multi-cylinder Petrol Engine

3 Assembling of Multi-cylinder Petrol Engine

4 Discussion on Opposed type, V - type and Radial type engines and uses their Applicability, advantages/disadvantages

5 Identification of various types of connecting rods

6 Identification of various types of Valves, Valve operating mechanism

7 Identification of Propeller, various types of Propeller reduction gear and accessories

8 Demonstration of piston engine ground run on light Aircraft Purpose and occasions for giving ground run for an aircraft Checking of all points of 'CHECK LIST' for aircraft ground run and safety precautions to be followed before giving ground run and during ground run for an aircraft

9. Starting of single engine piston engine for ground run as per procedure Identification of engine performance monitoring instruments and monitoring the engine parameters during the ground run

10 Demonstration of piston engine ground run on light Aircraft Familiarization of fire protection system during ground run Following of correct procedure of switching off of aircraft engine after ground run

PR.2. AIRCRAFT STRUCTURE LAB

Practical : 6 periods per week **Sessional: 50 Marks**
Examination: 3 hours **End Exams:50 Marks**
Total Marks: 100

Rationale:
To enable students to locate, identify and demonstrate various aircraft structural components

Practical/Exercise:

1 Identification of structural components for typical single engine , propeller driven aircraft

2 Study of structural components for typical multiengine aircraft

3 Fuselage: Basics and study of types of fuselage and their construction details

4 Study of wing structure ,and its parts,

5 Welded single

6 Welding double V-joints

7 Fabric Patch repairs and Riveted Patch repairs

8 Tube bending and flaring

9 Sheet metal forming

10 Preparation of glass epoxy of composite laminates and specimens.

Pr 3. PROJECT WORK (Phase-I)

Course code:		Semester	5th
Total Period:	60	Examination :	-
Theory periods:	4P / week	Sessional Marks	50
		TOTAL Marks	50

RATIONALE

Students' Project Work aims at developing innovative skills in the students whereby they apply the knowledge and skills gained through the course covered in many subjects and Labs, by undertaking a project. The prime emphasis of the project work is to understand and apply the basic knowledge of the principles of Aeronautical engineering and practices in real life situations, so as to participate and manage a large Aeronautical engineering projects in future. *Entire Project shall spread over 5th and 6th Semester*. Part of the Project covered in 5th Semester shall be named as *Project Phase-I* and balance portion to be covered in 6th Semester shall be named as *Project Phase-II*.

OBJECTIVES

After undergoing the Project Work, the student will be able to:

- Implement the theoretical and practical knowledge and skills gained through various subjects/courses into an application suitable for a real practical working environment, preferably in an industrial environment.
- Identify and contrast gap between the technological knowledge acquired through curriculum and the actual industrial need and to compensate it by acquiring additional knowledge as required.
- Carry out cooperative learning through synchronous guided discussions within the class in key areas, asynchronous document sharing and discussions, as well as prepare collaborative edition of the final project report.
- To achieve real life experience in Aeronautical engineering.
- To develop the skill of writing Project Report

General Guidelines

The individual students have different aptitudes and strengths and also areas of interest. Project work, therefore, should match the strengths and interest of the students. For this purpose, students should be asked to identify the type of project work, they would like to execute. The activity of problem identification should begin well in advance (right from beginning of 5th semester). Students should be allotted a problem of interest to him/her as a project work. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments for their students. The project assignment can be individual assignment or a group assignment. Preferably

there should not be more than 5 students, if the project work is given to a group. The project work identified in collaboration with industry should be preferred.

Following are the broad suggestive areas of project work

- ✓ Aircraft Design.
- ✓ Aeronautical Engineering
- ✓ Improving existing systems / equipment.
- ✓ Any other related area found worth.

A suggestive criterion for assessing student performance by the external (preferably person from industry) and internal (teacher) examiner is given in table below:

Sl. No.	**Performance Criteria**
1.	Selection of project assignment
2.	Planning and execution of considerations
3.	Quality of performance
4.	Providing solution of the problems or production of final product
5.	Sense of responsibility
6.	Self expression/ communication/ Presentation skills
7.	Interpersonal skills/human relations
8.	Report writing skills
9	Viva voce

The teachers are free to evolve other criteria of assessment, depending upon the type of project work.
It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organisations to such an exhibition.

Project Phase-I and Phase-II
The Project work duration shall cover 2 semesters(5^{th} and 6^{th} sem). The Grouping of students, selection of Project, assignment of Project Guide to the Group shall be done in the beginning of 5^{th} sem under Project Phase-I. The students may be allowed to study literature, any existing system and then define the Problem/objective of the Project. Preliminary work and Design of the system have to be complete in Phase-I. Execution of work may also begin in this phase. Project Milestones are to be set so that progress can be tracked . In Phase-II Execution of work, Testing, Documentation have to be complete. Project Report have to be prepared and complete in Phase-II. All Project reports should be organized uniformly in proper order, irrespective of group. Teacher Guides can make suitable alteration in the components of Task and schedule.
At the end of Project Phase-I in 5^{th} semester there shall be one presentation by each group to mark to progress and also to judge whether the Project is moving in right direction as per the objective of the Project.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. AIRCRAFT PISTON ENGINE LAB

S. No.	EQUIPMENT	Qty.
1	Multi Cylinder Petrol Engine	2
2	Propeller	1

2. AIRCRAFT STRUCTURE LAB

S. No	**Equipments**	**Qty**
1	Serviceable aircraft	1
2	Shear cutter pedestal type	1
3	Drilling Machine	1
4	Radius Bend bars	1
5	Pipe Flaring Tools	1
6	Welding machine	1
7	Glass fibre, epoxy resin	