Scheme & Syllabus of

UNDERGRADUATE DEGREE COURSE

B.Tech. VII & VIII Semester

Aeronautical Engineering

Rajasthan Technical University, Kota

Effective from session: 2020 – 2021

Teaching & Examination Scheme
B.Tech. : Aeronautical Engineering
4th Year – VII Semester

SN	Category	Course Code	Course Title	Hours Per Week			Marks				Cr
				L	T	P	Exm Hrs	IA	ETE	Total	
1	PEC	7AN5-11	Cryogenics	3	0	0	3	30	70	**100**	**3**
2		7AN5-12	Maintenance of Airframe and System								
3		7AN5-13	Helicopter Theory								
4	OE		Open Elective-I	3	0	0	3	30	70	**100**	**3**
	SUB TOTAL			**6**	**0**	**0**		**60**	**140**	**200**	**6**
PRACTICAL & SESSIONAL											
5	PCC	7AN4-21	Aircraft Drafting Lab	0	0	3	2	60	40	**100**	**1.5**
6		7AN4-22	Aircraft Electrical and Instruments Lab	0	0	3	2	60	40	**100**	**1.5**
7		7AN4-23	Airframe Lab	0	0	2	2	60	40	**100**	**1**
8	PSIT	7AN7-30	Industrial Training	1	0	0		60	40	**100**	**2.5**
9		7AN7-40	Seminar	2	0	0		60	40	**100**	**2**
10	SODECA	7AN8-00	Social Outreach, Discipline & Extra Curricular Activities	0	0	0			100	**100**	**0.5**
		SUB TOTAL		**0**	**0**	**8**		**300**	**300**	**600**	**9.0**
		TOTAL OF VII SEMESTER		**9**	**0**	**8**		**360**	**440**	**800**	**15**

L: *Lecture,* ***T:*** *Tutorial,* ***P:*** *Practical,* ***Cr:*** *Credits*

ETE: *End Term Exam,* ***IA:*** *Internal Assessment*

Teaching & Examination Scheme
B.Tech. : Aeronautical Engineering
4th Year – VIII Semester

SN	Category	Course Code	Course Title	Hours Per Week			Marks				Cr
				L	T	P	Exm Hrs	IA	ETE	Total	
1	PEC	8AN5-11	Hypersonic Aerodynamics	3	0	0	3	30	70	**100**	**3**
2		8AN5-12	Maintenance of Power Plant and System								
3		8AN5-13	Unmanned Aerial Vehicles & Systems (UAV)								
4	OE		Open Elective-II	3	0	0	3	30	70	**100**	**3**
	SUB TOTAL			**6**	**0**	**0**		**60**	**140**	**200**	**6**
PRACTICAL & SESSIONAL											
5	PCC	8AN4-21	Computational Fluid Dynamics (CFD) Lab	0	0	4	3	60	40	**100**	**2**
6	PSIT	8AN7-50	Project	3	0	0		60	40	**100**	**7**
7	SODECA	8AN8-00	Social Outreach, Discipline & Extra Curricular Activities	0	0	0		0	100	**100**	**0.5**
		SUB TOTAL		**3**	**0**	**4**		**120**	**180**	**475**	**9.5**
		TOTAL OF VIII SEMESTER		**9**	**0**	**4**		**180**	**320**	**500**	**15.5**

L: *Lecture,* ***T:*** *Tutorial,* ***P:*** *Practical,* ***Cr:*** *Credits*

ETE: *End Term Exam,* ***IA:*** *Internal Assessment*

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

List of Open Electives for Aeronautical Engineering				
Subject Code	**Title**		**Subject Code**	**Title**
Open Elective - I			**Open Elective - II**	
7AG6-60.1	Human Engineering and Safety		8AG6-60.1	Energy Management
7AG6-60.2	Environmental Engineering and Disaster Management		8AG6-60.2	Waste and By-product Utilization
7CH6-60.1	Optimization Techniques		8CH6-60.1	Refinery Engineering Design
7CH6-60.2	Sustainable Engineering		8CH6-60.2	Fertilizer Technology
7CR6-60.1	Introduction to Ceramic Science & Technology		8CR6-60.1	Electrical and Electronic Ceramics
7CR6-60.2	Plant, Equipment and Furnace Design		8CR6-60.2	Biomaterials
7CE6-60.1	Environmental Impact Analysis		8CE6-60.1	Composite Materials
7CE6-60.2	Disaster Management		8CE6-60.2	Fire and Safety Engineering
7CS6-60.1	Quality Management/ISO 9000		8CS6-60.1	Big Data Analytics
7CS6-60.2	Cyber Security		8CS6-60.2	IPR, Copyright and Cyber Law of India
7EE6-60.1	Electrical Machines and Drives		8EE6-60.1	Energy Audit and Demand side Management
7EE6-60.2	Power Generation Sources.		8EE6-60.2	Soft Computing
7EC6-60.1	Principle of Electronic communication		8EC6-60.1	Industrial and Biomedical applications of RF Energy
7EC6-60.2	Micro and Smart System Technology		8EC6-60.2	Robotics and control
7ME6-60.1	Finite Element Analysis		8ME6-60.1	Operations Research
7ME6-60.2	Quality Management		8ME6-60.2	Simulation Modeling and Analysis
7MI6-60.1	Rock Engineering		8MI6-60.1	Experimental Stress Analysis
7MI6-60.2	Mineral Processing		8MI6-60.2	Maintenance Management
7PE6-60.1	Pipeline Engineering		8PE6-60.1	Unconventional Hydrocarbon Resources
7PE6-60.2	Water Pollution control Engineering		8PE6-60.2	Energy Management & Policy
7TT6-60.1	Technical Textiles		8TT6-60.1	Material and Human Resource Management
7TT6-60.2	Garment Manufacturing Technology		8TT6-60.2	Disaster Management

7AN5-11: Cryogenics

Credit: 3 **Max. Marks: 100 (IA: 30, ETE: 70)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Basic Principles:** Introduction to Cryogenics and superconductivity, Applications of Cryogenics, Common Cryogens and their properties, Cryogenic rockets, Thermodynamic analysis of low-temperature systems, Basic principles of low temperature heat transfer, Cryogenic liquefaction process.	5
3	**Basic modes of heat transfer:** Conduction, Convection and Radiation incryogenic systems in steady and unsteady conditions, Temperaturedependent thermal conductivity, Boiling and two phase flow, Pool and film boiling of cryogenic fluids, Thermal contact resistance, Unique problems ofheat transfer in cryogenic applications.	6
4	**Thermo-physical properties of cryogenic systems:** PVT behaviour of a pure substance, Mechanical properties of materials used in cryogenic systems, Transport properties of solids, Thermal properties, Emissivity, Absorptivity and Reflectivity. Electrical properties and superconductivity. Prediction of thermodynamic properties, ultra-low temperature refrigerators and cryocoolers.	6
5	**Cryo Insulation And Devices:** Storage vessel, thermal shields and insulation, effect of size and shape ofstorage vessel on heat in-leak, vapour shielding, vacuum insulation, evacuated porous insulation, solid foams, multilayer insulation, compositeinsulation, critical radius of insulation, Micro-sphere insulation, typicalinsulation systems for space propulsion, aerogel beds, light density Mylar, comparison of insulations.	6
6	**Cryogenic Instrumentation & Equipment's:** Strain, displacement and position, pressure, flow, liquid level, density and temperature for cryogenic applications. Introduction of Compressors, pumps, expansionengines, valves, and heat exchangers for cryogenic applications.	5
7	**Performance Analysis of Cryogenic Rockets:** Design concepts of cryogenic rockets, selection of propellants and itschallenges, boil-off rate, thrust and velocity gain, specific impulse, propellant feed system, tank pressurization and vent system, two-phase flowand heat transfer in reduced gravity, process design parameters, launch window.	6
8	**Safety With Cryogenic Systems:** Introduction, Physiological hazards, explosions and flammability, excessive pressure gas, suitability of materials and construction techniques, safety considerations for liquid hydrogen and liquid oxygen. General safetyprinciples.	5
	TOTAL	40

7AN5-12: **Maintenance of Airframe and System**

Credit: 3 **Max. Marks: 100 (IA: 30, ETE: 70)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Airframe Structure & Controls:** Various types of structures in airframe construction, tubular, braced monocoque, semimoncoque, etc. Longerons, stringers, formers, bulkhead, spars and ribs, honeycomb construction. Airplane controls, ailerons, elevators, rudder, trimming and control tabs, leadingand trailing edge flaps, tail plane and fins.	6
3	**Aircraft Structure associated Materials:** Basics of structure and structural components fabricated from metal, glass fiber, vinyl, Perspex, composites. Finishing materials, paints, surface finishes and associated materials.	5
4	**Aircraft Control Systems & Auxiliary Systems:** Flying controls including power operated controls, hydraulic, pneumatic, landinggear various types, shock struts, nose wheel steering. Oxygen, air-conditioning and pressurization systems, wheels, tyres brakes, antiskidsystem. Ice and rain protection, firedetection warning and extinguishing, Windows, doors and emergency exists. Reliability and redundancy of systems design.	8
5	**Basic Inspections:** Basic principles of inspection, gauges, and tools. Standard inspection techniques and procedures. Go/No go gauges, gauge calibration and maintenance, limits and tolerance. NDT techniques.	7
6	**Major Inspections:** Major and minor damage, damage tolerance. Corrosion and corrosion prevention. Major and minor defects. Defect reporting rectification and investigation. Riggingof aircraft, symmetry checks. Balancing of control surfaces,	6
7	**Periodical inspections:** Periodical inspections, heavy landing, overweight landing checks, abnormal flightloads. Aircraft weighing, weight schedule, calculation of centre of gravity. Electrostatic Sensitive Devices, Electromagnetic Environment	7
	TOTAL	40

7AN5-13: Helicopter Theory

Credit: 3 **Max. Marks: 100 (IA: 30, ETE: 70)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Theory of Flight:** Helicopter as an aircraft, Basic features, Layout, Generation of lift, Main rotor, Gearbox, tail rotor, power plant, considerations on blade, flapping and feathering, Rotor controls and various types of rotor, Blade loading, Effect of solidity, profile drag, compressibility etc., Blade area required, number of Blades, Blade form, Power losses, Rotor efficiency.	8
3	**Aerodynamics Of Rotor Blade:** Aerofoil characteristics in forward flight, Hovering and Vortex ring state, Blade stall, maximum lift of the helicopter calculation of Induced Power, High speed limitations; parasite drag, power loading, ground effect	6
4	**Power Plants And Flight Performance:** Piston engines, Gas turbines, Ramjet principle, Comparative performance, Horsepower required, Range and Endurance, Rate of Climb, Best Climbing speed, Ceiling in vertical climb, Autorotation.	5
5	**Stability And Control:** Physical description of effects of disturbances, Stick fixed Longitudinal and lateral dynamic stability, lateral stability characteristics, control response. Differences between stability and control of airplane and helicopter.	6
6	**Rotor Vibrations:** Dynamic model of the rotor, Motion of the rigid blades, flapping motion, lagging motion, feathering motion, Properties of vibrating system, phenomenon of vibration, fuselage response, vibration absorbers, Measurement of vibration in flight. Rotor Blade Design: General considerations, Airfoil selection, Blade construction, Materials, Factors affecting weight and cost, Design conditions, Stress analysis.	6
7	**Helicopter Structures:** Airworthiness requirements for structural strength, Structural classification, primary, secondary and tertiary, Fail safe, safe life, damage tolerance concepts,Zonal and station identification systems, Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue, Drains and ventilation provisions. System installation provisions, Lightning strike protection provision. Construction methods of structures.	8
	TOTAL	40

7AN4-21: Aircraft Drafting Lab

Credit: 1 **Max. Marks: 100(IA:60, ETE: 40)**
0L+0T+2P

SN	Contents
1	Comparative studies of different types of airplanes and their specifications and performance details with reference to the design work under taken.
2	Preliminary weight estimation, Selection of design parameters, power plant selection, aerofoil selection, fixing the geometry of Wing, tail, control surfaces Landing gear selection.
3	Preparation of layout drawing, construction of balance and three view diagrams of the airplane under consideration.
4	Drag estimation, Performance calculations, Stability analysis and V-n diagram.
5	Preliminary design of an aircraft wing – Shrenck's curve, structural load distribution, shear force, bending moment and torque diagrams
6	Detailed design of an aircraft wing – Design of spars and stringers, bending stress and shear flow calculations – buckling analysis of wing panels.
7	Preliminary design of an aircraft fuselage – load distribution on an aircraft fuselage.
8	Detailed design of an aircraft fuselage – design of bulkheads and longerons – bending stress and shear flow calculations – buckling analysis of fuselage panels
9	Design of control surfaces - balancing and maneuvering loads on the tail plane and aileron, rudder loads.
10	Design of wing-root attachment.
11	Landing gear design.
12	Preparation of a detailed design report with CAD drawings.

7AN4-22: Aircraft Electrical and Instruments Lab

Credit: 1 **Max. Marks: 100(IA:60, ETE: 40)**
0L+0T+2P

SN	Contents
1	To study the constructional details of direct reading compass, carry outcompass swinging and prepare deviation correction card.
2	To study the construction details of pitot static instruments, carry out leaktest and calibration check on pitot-static instruments.
3	To study the constructional details of gyroscopic instruments and carry outcalibration check of gyroscopic instruments on gyro turn table.
4	The demonstration of operation and testing of transmission systemlike, Fuel content gauge, Flap position indicator, Rudder trim indicator etc.
5	Demonstration and Calibration of temperature sensing devices and relevant indicators.
6	Study and perform tests on aircraft power system (Batteries, Aircraft A.Cgenerator, Aircraft D.C generator, voltage regulator,aircraft static androtary invertors and TRU etc). & verify their characteristics.
7	Study and test a/c power distribution system.
8	To study and test a/c internal and external lighting system.

7AN4-23: Airframe Lab

Credit: 1 **Max. Marks: 100(IA:60, ETE: 40)**
0L+0T+2P

SN	Contents
1	Perform the inspection, maintenance and rectification of Pressurisation Sealing in Aircraft.
2	Perform the inspection, maintenance and rectification of manual system operation of Control surface.
3	Perform the servicing and maintenance of yaw damper and mach trim.
4	Perform the removal & installation of wiper motor convertor assembly.
5	Perform the inspection, maintenance and rectification of fixed volume pump.
6	Perform the inspection, maintenance and rectification of stall protection system.
7	Perform the inspection, maintenance and rectification of hydraulic actuator.
8	Hands on experience with aircraft structure fusleage station, wing station number.

8AN5-11: Hypersonic Aerodynamics

Credit: 3 **Max. Marks: 100 (IA: 30, ETE: 70)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Fundamentals Of Hypersonic Aerodynamics:** Introduction to hypersonic aerodynamics, differences between hypersonic aerodynamics and supersonic aerodynamics, concept of thin shock layers and entropy layers, hypersonic flight paths, hypersonic similarity parameters, shock wave and expansion wave relations of inviscid hypersonic flows.	8
3	**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 methods, hypersonic small disturbance theory, thin shock layer theory.	10
4	**Viscous Hypersonic Flow Theory:** Boundary layer equations for hypersonic flow, hypersonic boundary layers, self similar and non self similar boundary layers, solution methods for non self similar boundary layers, aerodynamic heating and its adverse effects on airframe.	8
5	**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.	8
6	**High Temperature Effects in Hypersonic Flows:** Nature of high temperature flows, chemical effects in air, real and perfect gases, Gibb's free energy and entropy, chemically reacting boundary layers, recombination and dissociation.	5
	TOTAL	40

8AN5-12: Maintenance of Power Plant and System

Credit: 3 **Max. Marks: 100 (IA: 30, ETE: 70)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Piston Engine & Jet Engine Fuel Systems:** Piston Engine Carburetor Types, construction and principle of operation; Icing and heating. Fuel injection systems: Types, construction and principle of operation. Operation of engine control and fuel metering systems including electronic engine control (FADEC); Systems layout and components.	6
3	**Piston Engine Systems:** Starting & Ignition System, Starting systems, preheat systems, Magneto types, construction and principles of operation. Ignition harnesses, spark plugs; Low and high tension systems. Induction, Exhaust and Cooling Systems. Construction and operation of: induction systems including alternate air systems; Exhaust systems, engine cooling systems air and liquid.	6
4	**Supercharging/Turbocharging:** Principles and purpose of supercharging and its effects on engine parameters. Construction and operation of supercharging/ turbocharging systems. System terminology; Control systems, System protection. Lubricants and Fuels, Properties and specifications; Fuel additives; Safety precautions. Lubrication Systems, System operation/layout and components.	8
5	**Jet Engine Systems:** Starting & Ignition System Operation of engine start systems and components, Ignitionsystems and components. Air Systems: Operation of engine air distribution and anti-icecontrol systems, including internal cooling, sealing and external air services.	6
6	**Power Augmentation Systems:** Operation and applications; Water injection, water methanol; Afterburner systems. Fire Protection Systems: Operation of detection and extinguishing systems. Lubricants and Fuels Properties and specifications. Fuel additives. Lubrication Systems System operation/layout and components.	6
7	**Power plant Installation:** Configuration of firewalls, cowlings, acoustic panels,engine mounts, anti-vibration mounts, hoses, pipes, feeders, connectors, wiringlooms, control cables and rods, lifting points and drains.Engine Monitoring and Ground Operation: Procedures for starting and ground run-up. Interpretation of engine power output and parameters Inspection of engine and components: criteria, tolerances, and data specified by engine manufacturer. Engine Storage and Preservation: Preservation and depreservation for the engine and accessories/systems.	7
	TOTAL	40

8AN5-13: Unmanned Aerial Vehicles & Systems (UAV)

Credit: 3 **Max. Marks: 100 (IA: 30, ETE: 70)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Basic Review & Characteristics of UAV Types:** History, Classification and applications of UAVs, Unmanned Aircraft System (UAS), UAS composition, societal impact, future prospects, Regulations and safety considerations. Long-range, long-endurance, MUAV types, MAV and NAV types, UCAV, Novelhybrid aircraft configurations.	6
3	**UAV Propulsion, Aerodynamics & Control and stability:** Internal combustion engines, turbine engines, electrical systems. Low Reynolds number effects, Lift-induced drag, parasite drag, rotary wing aerodynamics, response toair turbulence, dynamic stall. Flight control, HTOL aircraft, helicopters, convertible rotor aircraft, Autopilot Systems &Ground control Station, Sensors used in UAVs, on-board flight control.	10
4	**Introduction to design and selection of UAV &Aspects of airframe design:** Conceptual design, preliminary design, detailed design, selection of UAV for particular requirement. Airframe configuration, Scale effects, packaging density, Aerodynamic design, Strength, stiffness and reliability requirements, flight and gust envelopes including manoeuvre loads, selection of powerplants, Design for stealth	8
5	**Avionics Hardware & Communication Payloads and Controls:** Autopilot, AGL-pressure sensors, servos, accelerometer, gyros, actuators, power supply, processor, integration, installation, configuration, and testing. Payloads, Telemetry, tracking, Aerial photography, controls, PID feedback, radio control frequency range, modems, memory system, simulation, ground test, analysis, trouble shooting.	9
6	**The Development of UAV Systems:** Waypoints navigation, ground control software, System Ground Testing, System In-flight Testing, Future Prospects and Challenges, Case Studies, Mini and Micro UAVs.	6
	TOTAL	40

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8AN4-21: Computational Fluid Dynamics (CFD) LAB.

Credit: 2 **Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+3P

SN	Contents
1	Introduction to ANSYS Fluent, its features and different options
2	Generation of structured and unstructured mesh over simple objects
3	Boundary layer resolution and grid independence test
4	Flow over flat plate and use of transition models
5	Inviscid and viscous flow over circular cylinder at different Reynolds number
6	Laminar and turbulent flow in a pipe
7	Flow over airfoil at high Reynolds number and use of different turbulence models
8	Supersonic flow past wedge and cone
9	Transonic flow over subsonic and supercritical airfoils
10	Flow over finite wing and effect of aspect ratio and taper ratio
11	Flow in nozzles and diffusers
12	Writing codes in C/ C++/ MATLAB for simple flow fields