Syllabus of

UNDERGRADUATE DEGREE COURSE

Aeronautical Engineering

Rajasthan Technical University, Kota

Effective from session: 2021-22

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

2nd Year - IV Semester: B.Tech. (Aeronautical Engineering)

4AN2-01: Digital Science

Credit: 2 **Max. Marks: 100 (IA: 30, ETE: 70)**

3L+0T+0P **End Term Exam: 2 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Number Systems, Basic Logic Gates & Boolean Algebra:**Binary Arithmetic & Radix representation of different numbers. Sign & magnitude representation complement notation, various codes & arithmetic in different codes & their inter conversion. Postulates of Boolean algebra. Theorems of Boolean algebra. Boolean function. Derived logic gates: Exclusive-OR, NAND, NOR gates, their block diagrams and truth tables. Logic diagrams from Boolean expressions and vica-versa. Converting logic diagrams to universal logic. Positive, negative and mixed logic gate conversion. A/D Converter and D/A Converter and their types.	6
3	**Minimization Techniques:** Minterm, Maxterm, Karnaugh Map, K-map upto 4 variables, Simplification of logic functions with K-map, conversion of truth tables in POS and SOP form. Incomplete specified functions. **Data Buses:** Operation of Data Buses in Aircraft Systems, Knowledge of ARINC	4
4	**Combinational Systems & Sequential Circuits:** Combinational logic circuit design, half and full adder, subtractor. Decoder:Binary to Gray decoder, BCD to decimal. Multiplexer, Demultiplexer, Encoder. Octal to binary, BCD to excess-3 encoder. Design of logic circuits by multiplexers, encoders, decoders and demultiplexers.	4
5	**Sequential Systems:** Latches, Flip flops: R-S, D, JK, Master Slave flip flops. Conversions of flip-flops, Counters: Synchronous & Asynchronous ripple and decade counters, Modulus counter, Skipping state counter Registers: Buffer register, Shift register, Software Management Control.	4
6	**Electronic & Electrical Measuring Instruments:** Units of Measurements, Calibration, Accuracy & precision, Repeatability, Limits of errors, Systematic & random errors, standard deviation, Gaussian error analysis, Combination of errors. Theoryand working principle of galvanometer, Analog Voltmeter, ammeter and Multimeters, Digital Voltmeter, Electrostatic Sensitive Devices.	5
7	**Electromagnetic Environment:** Electromagnetic Compatibility (EMC), Electromagnetic interferences (EMI), High Intensity Radiated Field (HIRF), Lightning/ Lightning Protection.	4
	TOTAL	28

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4AN1-03/3AN1-03: Managerial Economics and Financial Accounting

Credit: 2 **Max. Marks: 100 (IA: 30, ETE: 70)**
3L+0T+0P **End Term Exam: 2 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Basic Economic Concepts:** Meaning, nature and scope of economics, deductive vs inductive methods, static and dynamics, Economic problems: scarcity and choice, circular flow of economic activity, national income concepts and measurement.	3
3	**Demand and Supply analysis:** Demand-types of demand, determinants of demand, demand function, elasticity of demand, demand forecasting –purpose, determinants and methods, Supply-determinants of supply, supply function, elasticity of supply.	5
4	**Production and Cost analysis:** Theory of production production function, law of variable proportions, laws of returns to scale, production optimization, least cost combination of inputs, isoquants. Cost concepts-explicit and implicit cost, fixed and variable cost, opportunity cost, sunk costs, cost function, cost curves, cost and output decisions, cost estimation.	5
5	**Market structure and pricing theory:** Perfect competition, Monopoly, Monopolistic competition, Oligopoly.	4
6	**Financial statement analysis:** Balance sheet and related concepts, profit and loss statement and related concepts, financial ratio analysis, cash-flow analysis, funds-flow analysis, comparative financial statement, analysis and interpretation of financial statements, capital budgeting techniques.	8
	TOTAL	26

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4AN1-02/3AN1-02: Technical Communication

Credit: 2 **Max. Marks: 100 (IA: 30, ETE: 70)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Introduction to Technical Communication-** Definition of technical communication, Aspects of technical communication, forms of technical communication, importance of technical communication, technical communication skills (Listening, speaking, writing, reading writing), linguistic ability, style in technical communication.	3
3	**Comprehension of Technical Materials/Texts and Information Design & development-** Reading of technical texts, Readingand comprehending instructions and technical manuals, Interpreting and summarizing technical texts, Note-making. Introduction of different kinds of technical documents, Information collection, factors affecting information and document design, Strategies for organization, Information design and writing for print and online media.	6
4	**Technical Writing, Grammar and Editing**- Technical writing process, forms of technical discourse, Writing, drafts and revising, Basics of grammar, common error in writing and speaking, Study of advanced grammar, Editing strategies to achieve appropriate technical style, Introduction to advanced technical communication. Planning, drafting and writing Official Notes, Letters, E-mail, Resume, Job Application, Minutes of Meetings.	8
5	**Advanced Technical Writing**- Technical Reports, types of technical reports, Characteristics and formats and structure of technical reports. Technical Project Proposals, types of technical proposals, Characteristics and formats and structure of technical proposals. Technical Articles, types of technical articles, Writing strategies, structure and formats of technical articles.	8
	Total	26

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4AN3-03: Heat Transfer

Credit: 2 **Max.Marks: 100 (IA: 30, ETE: 70)**
3L+0T+0P **End Term Exam: 2 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Introduction to Heat Transfer Processes:**Conduction and radiation, Fourier's law of heat conduction, thermal conductivity, thermal conductivity of solids, liquids and gases, effect of temperature on thermal conductivity, Newton's law of cooling, definition of overall heat transfer coefficient, general parameters influence on the value of heat transfer coefficient.	3
3	**Conduction:**General 3-Dimensoinal conduction equation in Cartesian, cylindrical and spherical coordinates, different kinds of boundary conditions, nature of differential equations, one dimensional heat conduction with and without heat generation, electrical analogy, heat conduction through composite walls, critical thickness of insulation.	3
4	**Heat Transfer from Finned Surfaces:**Fin efficiency and effectiveness, two dimensional steady state heat conduction using analytical and numerical methods, periodic heat conduction.	3
5	**Convection:** Review of Navier-Stokes and energy equation, hydrodynamic and thermal boundary layers, laminar boundary layer equations, forced convection appropriate non dimensional members, effect of Prandtl number, empirical relations for flow over a flat plate and flow through pipes.	4
6	**Natural Convection:**Dimensional analysis, Grashoff number, boundary layers in external flows (flow over a flat plate only), boundary layer equations and their solutions, heat transfer correlations.	3
7	**Heat Transfer with Change of Phase:**Nature of vaporization phenomena, different regimes of boiling heat transfer, correlations for saturated liquid vaporization, condensation on flat plates, correlation of experimental results, drop wise condensation.	3
8	**Heat Exchanger:**Different types of heat exchangers, arithmetic and logarithmic mean temperature differences, heat transfer coefficient for parallel, counter and cross flow type heat exchanger. Effectiveness of heat exchanger, N.T.U. method, fouling factor, constructional and manufacturing aspects of Heat Exchangers.	4
9	**Thermal Radiation:**Plank distribution law, Kirchhoff's law, radiation properties, diffuse radiations, Lambert's law, radiation intensity, heat exchange between two black bodies, Heat exchanger between gray bodies, shape factor, electrical analogy, reradiating surfaces heat transfer in presence of reradiating surfaces.	4
	TOTAL	28

4AN4-04: Aerodynamics-I

Credit: 4 **Max. Marks: 100 (IA: 30, ETE: 70)**
3L+1T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Review of Incompressible Fluid Mechanics:** Conservation laws: Mass, momentum (Integral and differential form), Introduction to turbulence, transition, structure of a turbulent boundary layer, momentum equation for turbulent boundary layer.	4
3	**Potential Flow Theory:**Stream function, Potential function, Equipotential lines, Source flow, Sink flow, Combination of source and sink flow, Doublet Flow, Uniform Flow, Vortex flow and their combinations, Half oval Rankine body and their superposition.	6
4	**Two Dimensional In-viscid Incompressible Flow:**Ideal Flow over a rotating & non rotating circular cylinder, D'Alembert's paradox, Magnus effect, KuttaJoukowski's theorem, starting vortex, Kutta condition, real flow over smooth and rough cylinder.	6
5	**Airfoil Theory:** Cauchy-Riemann relations, Complex Potential, Methodology of conformal transformation, Kutta-Joukowski transformation and its applications	6
6	**Thin Airfoil Theory:** Thin airfoil theory and its applications; Symmetrical airfoil and Cambered airfoil, Lift coefficient, and Moment coefficient, Aerodynamic centre and Centre of pressure related problems.	6
7	**Finite Wing theory:** Induced drag, Prandtl lifting line theory; Critical Mach number and drag divergence Mach number, Vortex line, Horse shoe vortex, Biot and Savart law, Lifting line theory and its limitations, Low aspect ratio wings. Induced drag coefficient. Relation between infinite and finite wing lift slope.	7
8	**Wind Tunnel Theory:** Introduction to wind tunnel, Types of wind tunnel and its application,Low speed wind tunnel calibration and calculation.	4
	TOTAL	40

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4AN4-05: Aircraft Structure-I

Credit: 4 **Max. Marks: 100 (IA: 30, ETE: 70)**
3L+1T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**INTRODUCTION:** Objective, scope and outcome of the course.	1
2	**Introduction:** Features of aircraft structures, monocoque and semi-monocoque structures, idealization, nomenclature & layout, functions; Static equilibrium, statically determinate and indeterminate structures; Concept of static stability	2
3	**Statically Determinate Structures:** Analysis of framed structures; Planar truss analysis: method of joints, method of sections, method of moments; Space truss analysis: 3d truss tension coefficients.	6
4	**Statically Indeterminate Structures:** Degree of indeterminacy; Fixed beams– bending & tension, composite beam, stress resultants, modulus weighted section properties;Clapeyron's three moment equation method.	5
5	**Deformations due to loading:** Differential equation of the elastic curve due to composite loading, double integration and moment area methods, Conjugate beam method, Macaulay's method, Principle of superposition.	5
6	**Energy Methods:** Strain Energy due to axial, bending and torsional loads, Castigliano's theorem, Principal of virtual work, Principal of virtual displacement, Maxwell's Reciprocal theorem, Unit load method, application to beams, trusses, frames, rings, etc	6
7	**Columns:** Euler's column curve, inelastic buckling, effect of initial curvature, Southwell plot, columns with eccentricity, use of energy methods, theory of beam columns, beam columns with different end conditions, stresses in beam columns.	6
8	**Failure Theories:** Ductile and brittle materials, maximum principal stress theory, maximum principal strain theory, maximum shear stress theory, distortion energy theory, octahedral shear stress theory.	5
9	**Induced Stresses** Thermal stresses, impact loading, Fatigue, Creep, Stress Relaxation.	4
	TOTAL	40

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4AN4-06: Aircraft Materials and Processes

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	**Elements Of Aircraft Materials:** Structure of solid materials, Atomic structure of materials, Crystal structure, Miller indices, Packing factor, Space lattice, Imperfection in crystals, Polymorphism and allotropy, General requirements of materials for aircraft application	6
3	**Broad Classification Of Aircraft Materials:**Ferrous materials, nonferrous materials and alloys, Ceramic materials and fibre reinforced composite materials, polymers, metal matrix particulate. Conventional Manufacturing processes of Aircraft Materials.	8
4	**Mechanical Behaviour Of Materials (Both Ferrous & Non Ferrous):** Principal mechanical properties of materials, Tensile and compression test, Hardness testing, Impact testing, Fatigue and creep testing, Linear and Non-linear elastic properties, Strain hardening, Fracture, Bauchinger's effect-notch effect testing and flaw detection of materials & components, Comparative study of metals.	6
5	**Corrosion And Heat Treatment Of Metals & Alloys:** Types of corrosion, Effect of corrosion on mechanical properties, Stress corrosion cracking, Corrosion resistant material used for aircraft vehicle, Heat treatment of carbon steels; aluminum alloy, magnesium alloy and titanium alloy and identification of ferrous and non ferrous metals, Effect of alloying treatment.	6
6	**Ceramics And Composites:** Introduction of ceramics and composites, Powder metallurgy, Modern ceramic materials, cements, cutting tools, glass ceramics, production of semi fabricated forms, plastic and rubber, glass & carbon composites, Fabrication process involved in metal matrix composites, Shape memory alloys, application of aircraft vehicle design, Open and closed mould process.	7
7	**High Temperature Materials Characterization:**Classification of high temperature material used in aircraft industry, production and characteristics, Methods & testings, Determination of mechanical and thermal properties of materials at elevated temperature, Application of these materials in thermal protection systems of aircrafts, Super alloys, and High temperature material characterization.	6
	TOTAL	40

4AN4-21: Thermal Engineering Lab

Credit: 1 **Max. Marks: 100 (IA:60, ETE:40)**

0l+0T+2P

SN	Contents
1	To determine thermal conductivity of a good conductor of heat (metal rod).
2	To determine the heat transfer rate and temperature distribution for a pin fin.
3	To measure the emissivity of the test plate surface.
4	To determine Stefan-Boltzmann constant of radiation heat transfer.
5	To determine the surface heat transfer coefficient for heated vertical cylinder in natural convection.
6	Determination of heat transfer coefficient in drop wise and film wise condensation.
7	To determine critical heat flux in saturated pool boiling.
8	To study performance of simple heat pipes.
9	To study and compare LMTD and effectiveness in parallel and counter flow heat exchangers.
10	To find out the thermal conductivity of given slab material.
11	Testing and performance of different heat insulators.

4AN4-22: Aerodynamics Lab

Credit: 1.5 **Max. Marks: 100 (IA:60, ETE:40)**

0L+0T+3P

SN	Contents
1	Calibration of subsonic wind tunnel.
2	Pressure distribution over smooth and rough cylinder.
3	Pressure distribution over symmetric airfoil.
4	Pressure distribution over cambered airfoil & thin airfoils
5	Force measurement using wind tunnel balance.
6	Flow over a flat plate at different angles of incidence
7	Flow visualization studies in low speed flow over cylinders
8	Flow visualization studies in low speed flow over airfoil with different angle of incidence

4AN4-23: Programming with MATLAB

Credit: 2 **Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+4P

SN	Contents
1	Basics of MATLAB computer programming
2	Use of formulae and inbuilt functions
3	MATLAB scripts and functions (m-files)
4	Loops and nested loops
5	Array, vector and matrices
6	Plotting functions and vector plots
7	Solving differential equations using MATLAB
8	Reading and writing data, file handling
9	Using MATLAB toolboxes
10	MATLAB graphic functions

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4AN4-24: Material Science Lab

Credit: 1.5 **Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+3P

SN	Contents
1	Study of Engineering Materials and crystals structures. Study of models BCC, FCC, HCP and stacking sequence, tetrahedral and octahedral voids.
2	To calculate the effective number of atoms, co-ordination number, packing factors,c/a ratio for HCP structure.
3	Study of brittle and ductile fracture.
4	To prepare metallic samples for metallographic examination and to study the principle and construction of the Metallurgical Microscope.
5	Study of the following Micro structures: Hypo, Hyper and Eutectoid Steel, Grey, White, Nodular and Malleable Cast Iron.
6	Annealing of Steel; Effect of annealing temperatures and time on hardness.
7	Study of Microstructure and hardness of steel at different rates of cooling.
8	Microstructure examination of white cast iron.
9	Hardening of steel, effect of quenching medium on hardness.
10	Effect of Carbon percentage on the hardness of Steel.
11	Study of various crystal structures and dislocations through models.
12	Study of Iron-Carbon Equilibrium Diagram and sketch the various structures present at room temperature.