### 2009-10

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**B.TECH. AERONAUTICAL ENGINEERING**

**III YEAR II SEMESTER**

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www.jntuworld.com
COMPUTATIONAL AERODYNAMICS

UNIT-I  BASIC ASPECTS OF COMPUTATIONAL AERODYNAMICS

UNIT-II  GOVERNING EQUATIONS AND PHYSICAL BOUNDARY CONDITIONS
Derivation of continuity, momentum and energy equations- physical boundary conditions- significance of conservation and non-conservation forms and their implication on CFD applications- strong and weak conservation forms- shock capturing and shock fitting approaches.

UNIT-III  MATHEMATICAL BEHAVIOR OF PARTIAL DIFFERENTIAL EQUATIONS AND THEIR IMPACT ON COMPUTATIONAL AERODYNAMICS
Classification of quasi-linear partial differential equations by Cramer’s rule and eigen value method. General behaviour of different classes of partial differential equations and their importance in understanding physical and CFD aspects of aerodynamic problems at different Mach numbers involving hyperbolic, parabolic and elliptic equations- domain of dependence and range of influence for hyperbolic equations. Well-posed problems.

UNIT-IV  BASIC ASPECTS OF DISCRETIZATION

UNIT-V  FINITE VOLUME METHODS
Basis of finite volume method- conditions on the finite volume selections- cell-centered and cell-vertex approaches. Definition of finite volume discretization-general formulation of a numerical scheme- two-dimensional finite volume method with example.

UNIT-VI  GRID TYPES AND CHARACTERISTICS

UNIT-VII  CFD TECHNIQUES-I

UNIT-VIII  CFD TECHNIQUES-II
Pressure correction technique- application to incompressible viscous flow- need for staggered grid. Philosophy of pressure correction method- pressure correction formula. Numerical procedures- SIMPLE, SIMPLER, SIMPLEC and PISO algorithms. Boundary conditions for the pressure correction method.

TEXT BOOKS

REFERENCES
Jawaharlal Nehru Technological University Hyderabad

III Year B.Tech. AE II –Sem

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CONCEPTUAL DESIGN OF FLIGHT VEHICLES

UNIT– I OVERVIEW OF THE DESIGN PROCESS, SIZING FROM A CONCEPTUAL SKETCH
Phases of aircraft design. Aircraft conceptual design process, project brief / request for proposal, problem definition, information retrieval, aircraft requirements, configuration options. Integrated product development and aircraft design.

UNIT– II AIRFOIL AND GEOMETRY SELECTION, THRUST TO WEIGHT RATIO, WING LOADING
Airfoil selection, airfoil design, design lift coefficient, stall, airfoil thickness ratio and other airfoil considerations. Wing geometry and wing vertical location, wing tip shapes. Tail geometry and arrangements. Thrust to weight ratio - statistical estimation, thrust matching. Wing loading – performance constraints. Selection of thrust-to-weight ratio and wing loading.

UNIT– III INITIAL SIZING & CONFIGURATION LAYOUT, CREW STATION, PASSENGERS & PAYLOAD

UNIT– IV PROPULSION & FUEL SYSTEM INTEGRATION, LANDING GEAR & SUBSYSTEMS

UNIT– V BASELINE DESIGN ANALYSIS- AERODYNAMICS & PROPULSION, STRUCTURES & WEIGHT AND BALANCE

UNIT– VI BASELINE DESIGN– STABILITY & CONTROL, PERFORMANCE AND CONSTRAINT ANALYSIS

UNIT– VII COST ESTIMATION, PARAMETRIC ANALYSIS, OPTIMISATION, REFINED SIZING & TRADE STUDIES
Elements of life cycle cost, cost estimating method, RDT&E and production costs, operation and maintenance costs, fuel and oil costs, crew salaries, maintenance expenses, depreciation. Cost measures of merit. Aircraft and airline economics, DOC and IOC, airline revenue, breakeven analysis, investment cost analysis.


Determination of final baseline design configuration, preparation of type specification report.

UNIT – VIII CASE STUDIES AND DESIGN OF UNIQUE AIRCRAFT CONCEPTS

TEXT BOOKS

REFERENCES
AEROSPACE VEHICLE PROPULSION- II

UNIT- I TRANS-ATMOSPHERIC AND SPACE FLIGHT MISSION PROPULSION REQUIREMENTS-
PROPULSION SYSTEMS- CLASSIFICATION, PERFORMANCE CHARACTERISTICS

Hypersonic transport vehicles, military missiles, space launch vehicles, spacecraft- role, types, missions-
profile, trajectories, operating conditions- gravity, atmosphere. Incremental flight velocity budget for climb
out and acceleration, orbital injection- Breguet equation for cruise- mission propulsion requirements- thrust
levels, burnign time, economy.

High speed propulsion systems- types, construction, operating principles- sources of energy, generation of
power, momentum, propellants.- applications, performance parameters- specific thrust, specific impulse,
internal efficiency, propulsive efficiency- typical values. Reaction control systems- applications.

UNIT- II  AIR BREATHING ENINES FOR HYPERSONIC TRANSPORT PLANES AND
MILITARYMISSILES- SUPERSONIC COMBUSTION- THE SCRAM-JET ENGINE

Performance of turbojets, ramjets at high speeds- limitations. Need for supersonic combustion- implications-
criticality of efficient diffusion and acceleration, problems of combustion in high speed flow.
The scramjet engine- construction, flow process- description, control volume analysis- spill-over drag, plume
drag. Component performance analysis- isolator, combustor- flow detachment and reattachment, thermal
throat, scheduled, distributed fuel injection. Nozzle flow, losses- failure to recombination, viscous losses,
plume losses. Scramjet performance, applications.

Combined cycle engines- turbo-ramjet, air turbo-rocket (ATR), ejector ramjet- Liquid-air collection engine
(LACE)- need, principle, construction, operation, performance, applications to hypersonic transport plane
and missile propulsion.

UNIT- III  CHEMICAL ROCKET ENGINES

Rocket propulsion- history, principles, types, applications. The rocket equation. Vehicle velocity, jet exit
Chemical rockets- the thrust chamber- processes- combustion, expansion- propellants. Thermo-chemical
analysis of combustion, equilibrium energy balance, mass balance, combustion efficiency. Equilibrium
composition, recombination.
Nozzle expansion, performance, design parameters, analysis- non-equilibrium expansion- frozen
equilibrium, shifting equilibrium. One dimensional, two dimensional flows, presence of liquid drops and solid
particles- two phase flow, losses, efficiency.
Performance measures of chemical rocket engines- thrust coefficient, specific impulse; engine parameters-
thrust chamber pressure, temperature, characteristic velocity, exhaust velocity, effective velocity.
Computing rocket engine performance- theoretical, delivered performance, performance at standard
operating conditions, guaranteed minimum performance.

UNIT- IV  LIQUID PROPELLANT ROCKET ENGINES

Liquid propellant rocket engines- structure- principal components, basic parameters- propellant combination,
chamber pressure, nozzle area ratio, feed system, thrust level. Propellants – properties- considerations for
selection- storage, feed, control, injection, ignition.
Combustion chamber and nozzle, shape, size, materials, cooling- thrust vector control, combustion
instabilities. Engine control, optimisation, system integration. Liquid propellant rocket performance data.

UNIT- V  SOLID PROPELLANT ROCKET MOTORS

Basic configuration, essential differences from liquid propellant rocket engines, propellant composition,
combustion chambers, ignition, surface recession rate, gas generation rate, effect of propellant temperature,
combustion pressure, charge design- thrust profile, burning stability, erosive burning. Combustion chamber
integrity- thermal protection. Combustion instabilities- types, corrective measures.
Solid propellant motor components and motor design. Applications, performance analysis. Examples of solid
propellant boosters. Hybrid propellant rockets, selection of rocket propulsion systems.
Advanced thermal rockets- fundamental physical limitations to thermal rockets, improving efficiency of
thermal rockets in the atmosphere, pulse detonation engine, rotary rocket engine, variable exhaust velocity,
optimising the ascent, descent. SSTO (single stage to orbit)- concept, practical approaches.
Particulars of propulsion systems of selected space vehicles and military missiles.
UNIT- VI ELECTRIC THRUSTERS - MISSION APPLICATIONS TO SPACE FLIGHT

Electrothermal thrusters- resistojet, arcjet, solar/ laser/ microwave thermal propulsion- operating principles, components, system parameters, performance, applications.
Electrostatic thrusters- ionisation potential, ionisation schemes. Beam current, power, acceleration, voltage, power efficiency, thrust-to-power ratio, specific impulse. Screen, accelerator grids, potential, charge distribution, saturated current density, electric field intensity, exhaust neutralisation, propellant choice. Estimation of performance, electrical efficiency, power to thrust ratio, thrust per unit area, applications.
Electromagnetic thrusters- magneto plasma dynamic (MPD), pulsed plasma (PPT), Hall effect and variable Isp-thrusters- principle, construction, operation, performance, applications.
Electric space power supplies and power conditioning- batteries, fuel cells, solar cell arrays, solar generators, nuclear power generators.
Current technology of electric propulsion engines, applications- overview. The problem of gravity loss. Criteria for selection of engine. Particulars of select current electric propulsion systems.

UNIT- VII NUCLEAR PROPULSION

Power, thrust, energy. Nuclear fission- basics, sustainable chain reaction, calculating criticality, reactor dimensions, neutron leakage, control, reflection, prompt and delayed neutrons, thermal stability.
Nuclear propulsion- history, principles, fuel elements, exhaust velocity, operating temperature. The nuclear thermal rocket engine- radiation and management, propellant flow and cooling, control, start-up and shutdown, nozzle, thrust generation.

UNIT- VIII ADVANCED PROPULSION SYSTEMS- CONCEPTS- PRINCIPLES OF OPERATION- OVERVIEW

Advanced nuclear propulsion systems- Fission fragment propulsion, radioisotope nuclear rocket, fusion propulsion, inertial, electrostatic and magnetic confinement fusion, anti-matter propulsion system.
Micropulsion- application of MEMS- chemical, electric microthrusters- principle, description.
Propellantless propulsion- tethers- momentum exchange and electrodynamic. Photon rocket, beamed energy propulsion, solar, magnetic sails.
Breakthrough propulsion- current fundamental limits to propulsion, Casimir effect, coupling of gravity and electromagnetism, superconductor gravitational shielding, coupling of charge, mass and acceleration.

TEXT BOOKS


REFERENCES

UNIT-I  AIRCRAFT SYSTEMS


UNIT-II  ELECTRICAL SYSTEMS

Electrical loads in aircraft. Electrical power generation and control- DC, AC- types. Power distribution- primary, secondary. Power conversion and energy storage. Load protection. Advanced systems- electrical load management systems, variable speed constant frequency (VSCS) cycloconverter, 270 V DC systems, more electric aircraft and more electric engines- implementation.

UNIT-III  HYDRAULIC SYSTEMS


UNIT-IV  PNEUMATIC AND ENVIRONMENTAL CONTROL SYSTEMS


UNIT-V  ENGINE CONTROL AND FUEL SYSTEMS


UNIT-VI  FLIGHT CONTROL SYSTEMS


UNIT-VII  AIRCRAFT SYSTEMS DESIGN AND DEVELOPMENT

Safety and economic considerations- system function, performance, integrity, reliability, maintainability, product support- failure severity. Verification of meeting system requirements- means of gathering evidence in the life cycle- modeling, simulation, testing, prototype construction.

UNIT-VIII  SYSTEMS INTEGRATION

Interdependence of aircraft systems and need for integration- examples. Systems integration- the concept-examples. Levels of integration- component, system, process, function, information levels- examples. Enumeration of aircraft systems and some subsystems- purpose, brief description, aspects of safety/ integrity, integration, interfaces, design drivers.

TEXT BOOKS


REFERENCES

FINITE ELEMENT METHODS

UNIT -I:
Introduction to FEM: basic concepts, historical back ground, application of FEM, general description, comparison of FEM with other methods. Basic equations of elasticity, Stress – Strain and strain - displacement relations. Rayleigh- Ritz method, Weighted residual methods.

UNIT -II:
One Dimensional problems: Stiffness equations for a axial bar element in local co-ordinates using Potential Energy approach and Virtual energy principle - Finite element analysis of uniform, stepped and tapered bars subjected to mechanical and thermal loads - Assembly of Global stiffness matrix and load vector - Quadratic shape functions - properties of stiffness matrix.

UNIT -III:

UNIT -IV:

UNIT -V:
2-D problems: CST - Stiffness matrix and load vector - Isoparametric element representation – Shape functions – convergence requirements – Problems.

UNIT -VI:
Two dimensional four nodded isoparametric elements - Numerical integration - Finite element modelling of Axisymmetric solids subjected to Axisymmetric loading with triangular elements - 3-D problems – Tetrahedran element.

UNIT -VII:

UNIT -VIII:

TEXT BOOKS:

REFERENCES:
1. Finite Element Methods/ Alavala/TMH
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

III Year B. Tech. AE – II Semester

NANO TECHNOLOGY
(OPEN ELECTIVE)

Unit-I:
Introduction to nanotechnology:
Importance of nanoscale, Nanostructure types, electronic, magnetic, optical Properties of Nanomaterials, top-down and bottom-up approach to nanostructures.

Unit-II:
Quantum Mechanical phenomenon in nanostructures:
Quantum confinement of electrons in semiconductor Nano structures, one dimensional confinement (Quantum wires), two dimensional confinements (Quantum Wells), three dimensional confinements (Quantum dots).

Unit-III
Carbon Nano Structures:
Carbon nanotubes (CNTs), Fullerenes, C60, C80 and C240 Nanostructures, Properties (mechanical, optical and electrical) and applications.

Unit-IV
Fabrication of Nanomaterials:
Physical Methods: Inert gas condensation, Arc discharge, RFplasma, Plasma arc technique, Ion sputtering, Laser ablation, Laser pyrolysis, Molecular beam epitaxy, Chemical vapour deposition method.

Unit-V
Nano scale characterization techniques:
Scanning probe techniques (AFM, MFM, STM, SEM, TEM), XRD

Unit-VI
Nanodevices and Nanomedicine:
Lab on chip for bioanalysis, Core/shell Nanoparticles in drug delivery systems (site specific and targeted drug delivery), cancer treatment, and bone tissue treatment.

Unit-VII
Nano and molecular electronics:
Resonant-Tunneling structures, single electron tunneling, Single Electron transistors, coulomb blockade, giant magneto resistance, tunneling magneto resistance.

Unit-VIII
nanolithography and nanomanipulation:

TEXT BOOKS:
1. Charles.p.pode, Introduction to nanotechnology, springer publications
2. Springer Handbook of Nanotechnology - Bharat Bhusan
3. Phani kumar, principles of nanotechnology, scitech publications

REFERENCES BOOKS:
4. Encyclopedia of Nanotechnology- Hari Singh Nalwa
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

III Year B. Tech. AE – II Semester

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PROBABILITY AND STATISTICS
(OPEN ELECTIVE)

UNIT-I: Probability

UNIT-II: Distributions
Binomial , Poisson & normal distributions related properties . Sampling distributions –Sampling distribution of means ( $\sigma$ known and Unknown)

UNIT-III: Testing of Hypothesis I
Tests of hypothesis point estimations – interval estimations Bayesian estimation. Large samples, Null hypothesis – Alternate hypothesis type I, & type II errors – critical region confidential interval for mean testing of single variance. Difference between the mean.

UNIT-IV : Testing of Hypothesis II
Confidential interval for the proportions. Tests of hypothesis for the proportions single and difference between the proportions.

UNIT-V: Small samples
Confidence interval for the t- distribution – Tests of hypothesis – t- distributions, F- distributions $\chi^2$ distribution. Test of Hypothesis –.

UNIT-VI
Correlation & Regression
Coefficient of correlation – Regression Coefficient – The lines of regression – The rank correlation

UNIT-VII
Queuing Theory
Arrival Theorem - Pure Birth process and Death Process M/M/1 Model .

UNIT-VIII
Stochastic processes

TEXT BOOKS:

REFERENCES:
UNIT – I

UNIT – II

UNIT – III

UNIT – IV

UNIT – V

UNIT – VI
a) Geometric Programming: Posynomials – arithmetic – geometric inequality – unconstrained G.P- constrained G.P(s type only)
b) Integer Programming- Introduction – formulation – Gomory cutting plane algorithm – branch and bound method

UNIT – VII

UNIT – VIII
a) Simulation-Definition-Steps involved- Types of simulation Models-Advantages and disadvantages- Simple problems on queuing & inventory.
b) Non-traditional optimization algorithms: Genetic algorithms: working principles differences and similarities between Gas and traditional methods. Simulated annealing.

TEXT BOOKS

REFERENCE TEXT BOOKS
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

III Year B. Tech. AE – II Semester

ADVANCED ENGLISH COMMUNICATION SKILLS LAB

1. Introduction
The introduction of the English Language Lab is considered essential at 3rd year level. At this stage the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalised context.

The proposed course should be an integrated theory and lab course to enable students to use ‘good’ English and perform the following:
- Gather ideas and information, to organise ideas relevantly and coherently.
- Engage in debates.
- Participate in group discussions.
- Face interviews.
- Write project/research reports/technical reports.
- Make oral presentations.
- Write formal letters.
- Transfer information from non-verbal to verbal texts and vice versa.
- To take part in social and professional communication.

2. Objectives:
This Lab focuses on using computer-aided multimedia instruction for language development to meet the following targets:
- To improve the students’ fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
- Further, they would be required to communicate their ideas relevantly and coherently in writing.

3. Syllabus:
The following course content is prescribed for the Advanced Communication Skills Lab:

- Functional English - starting a conversation – responding appropriately and relevantly – using the right body language – role play in different situations.
- Vocabulary Building – synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, analogy, idioms and phrases.
- Reading Comprehension – reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, Critical reading.
- Group Discussion – dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and coherence.
- Presentation Skills – Oral presentations (individual and group) through JAM sessions/seminars and written presentations through posters/projects/reports/PPTs/e-mails/assignments etc.
- Interview Skills – concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele and video-conferencing.

4. Minimum Requirement:
The English Language Lab shall have two parts:
- The Computer aided Language Lab for 60 students with 60 systems, one master console, LAN facility and English language software for self-study by learners.
- The Communication Skills Lab with movable chairs and audio-visual aids with a P.A System, a T. V., a digital stereo-audio & video system and camcorder etc.

System Requirement (Hardware component):
Computer network with Lan with minimum 60 multimedia systems with the following specifications:
- P – IV Processor
  a) Speed – 2.8 GHZ
  b) RAM – 512 MB Minimum
  c) Hard Disk – 80 GB
ii) Headphones of High quality

5. Suggested Software:
The software consisting of the prescribed topics elaborated above should be procured and used.

Suggested Software:

- Clarity Pronunciation Power – part II
- Oxford Advanced Learner’s Compass, 7th Edition
- DELTA’s key to the Next Generation TOEFL Test: Advanced Skill Practice.
- Lingua TOEFL CBT Insider, by Dreamtech
- TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
- The following software from ‘train2success.com’
  - Preparing for being Interviewed,
  - Positive Thinking,
  - Interviewing Skills,
  - Telephone Skills,
  - Time Management
  - Team Building,
  - Decision making
- English in Mind, Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge

6. Books Recommended:


DISTRIBUTION AND WEIGHTAGE OF MARKS:

Advanced Communication Skills Lab Practicals:
1. The practical examinations for the English Language Laboratory practice shall be conducted as per the University norms prescribed for the core engineering practical sessions.
2. For the English Language lab sessions, there shall be a continuous evaluation during the year for 25 sessional marks and 50 End Examination marks. Of the 25 marks, 15 marks shall be awarded for day-to-day work and 10 marks to be awarded by conducting Internal Lab Test(s). The End Examination shall be conducted by the teacher concerned with the help of another member of the staff of the same department of the same institution.
FLIGHT VEHICLE DESIGN LAB

1. Specification of design requirements- mission profile- conceptual sketches, initial sizing.
2. Airfoil and geometry selection, determination of thrust to weight ratio, wing loading.
3. First sizing & configuration layout, crew station, passengers & payload.
7. Cost estimation, parametric analysis, optimisation, refined sizing &trade studies.
8. Determination of final baseline design configuration, preparation of type specification report.

REFERENCES