2009-10
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITYHYDERABAD

B.TECH. AERONAUTICAL ENGINEERING

III YEAR II SEMESTER **COURSE STRUCTURE**

Code	Subject	L	T/P/D	C
	Computational aerodynamics	3	1	3
	Computational Design of Flight Vehicles	4	1	4
	Aerospace Propulsion- II	4	1	4
	Aircraft Systems	3	1	3
	Finite Element Methods	4	1	4
	Open Elective Nanotechnology Probability & Statistics Engineering Optimization	3	1	3
	Advanced English Communication Skills Lab	0	3	2
	Flight Vehicle Design Lab	0	3	2
	Total	**21**	**12**	**25**

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III Year B.Tech. AE II –Sem	**L**	**T/P/D**	**C**
	3	**1/-/-**	**3**

COMPUTATIONAL AERODYNAMICS

UNIT- I BASIC ASPECTS OF COMPUTATIONAL AERODYNAMICS

Why Computational Fluid Dynamics? What is CFD? CFD as a research tool- as a design tool. Applications in various branches of engineering. - Models of fluid flow- Finite Control Volume, Infinitesimal Fluid Element. Substantial derivative- physical meaning of Divergence of velocity.

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

Introduction to finite differences- finite difference approximation for first order, second order and mixed derivatives. Pros and cons of higher order difference schemes. Difference equations- explicit and implicit approaches- truncation and round-off errors, consistency, stability, accuracy, convergence, efficiency of numerical solutions-Von Neumann stability analysis. Physical significance of CFL stability condition.

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

Need for grid generation. Structured grids- Cartesian grids, stretched (compressed) grids, body fitted structured grids, H-mesh, C-mesh, O-mesh, I-mesh, Multi-block grids, C-H mesh, H-O-H mesh, overset grids, adaptive grids. Unstructured grids- triangular/ tetrahedral cells, hybrid grids, quadrilateral/ hexahedra cells.

UNIT- VII CFD TECHNIQUES- I

Lax-Wendroff technique, MacCormack's technique-Crank Nicholson technique-Relaxation technique-aspects of numerical dissipation and dispersion. Alternating-Direction-Implicit (ADI) Technique.

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

1. Anderson, J.D., Jr., *Computational Fluid Dynamics- The Basics with Applications*, McGraw-Hill Inc., 1995.
2. Anderson, D.A., Tannehill, J.C., Pletcher, R.H., *Computational Fluid Mechanics and Heat Transfer*, Second Edition, Taylor and Francis, 1997.

REFERENCES

1. Hirsch, C., *Numerical Computation of Internal and External Flows-Fundamentals of Computational Fluid Dynamics*, Second Edition, Elsevier, 2007.
2. Versteeg, H.K. and Malalasekera, W., *An Introduction to Computational Fluid Dynamics-The Finite Volume Method,* Second Edition, Pearson Education Ltd, 2010
3. Tu, J., Yeoh, G.H., Liu, C., *Computational Fluid Dynamics-A Practical Approach,* Butterworth-Heinemann, 2008.

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III Year B.Tech. AE II –Sem	**L**	**T/P/D**	**C**
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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.

The initial conceptual sketches, L / D estimation. Initial takeoff weight build-up, empty weight estimation – historical trends, fuel fraction estimation, mission profiles, mission segment weight fractions.

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

Sizing with fixed engine and with rubber engine. Geometry sizing of fuselage, wing, tail, control surfaces.

Development of configuration lay out from conceptual sketch. The inboard profile drawing, wetted area, volume distribution and fuel volume plots. Lofting- definition, significance and methods, flat wrap lofting.

Special consideration in configuration lay out. Isobar tailoring, Sears-Haack volume distribution, structural load paths. Radar, IR, visual detectability, aural signature. Considerations of vulnerability, crashworthiness, producibility, maintainability.

Fuselage design- crew station, passenger compartment, cargo provisions, weapons carriage, gun installation.

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

Propulsion selection, jet engine integration, engine dimensions, inlet geometry, inlet location, capture area calculation, boundary layer diverters, nozzle integration, engine cooling provisions, engine size estimation. Fuel system design and integration.

Landing gear arrangements, guidelines for lay out. Shock absorbers – types, sizing, stroke determination, gear load factors. Gear retraction geometry. Aircraft subsystems, significance to configuration lay out. The baseline design layout and report of initial specifications.

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

Estimation of lift curve slope, maximum lift coefficient, complete drag build up. Installed performance of an engine, installed thrust methodology, net propulsive force, part power operation. Aircraft loads, categories– manoeuvre, gust, inertial, power plant, landing gear loads. Limit loads, the V, n diagram. Air load distribution on lifting surfaces. Review of methods of structural analysis. Material selection. Weights and moments-statistical group estimation method, centre of gravity excursion control.

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

Estimation of static pitch stability, velocity stability and trim. Estimation of stability and control derivatives. Static lateral-directional stability & trim. Estimation of aircraft dynamical characteristics, handling qualities. Cooper – Harper scale, relation to aircraft dynamic characteristics.

Performance analysis and constraint analysis– steady level flight, minimum thrust required for level flight, range and loiter endurance. Steady climbing and descending flight, best angle and rate of climb, time to climb and fuel to climb. Level turning flight, instantaneous turn rate, sustained turn rate. Energy manoeuvrability methods of optimal climb trajectories and turns. The aircraft operating envelope. Take off analysis, Balanced field length. Landing analysis. Fighter performance measures of merit. Effects of wind on aircraft performance.

Initial technical report of baseline design analysis and evaluation. Refined baseline design and report of specifications.

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.
Parametric analysis and optimisation. Refined conceptual sizing methods. Sizing matrix plot and carpet plot. Trade studies - design trades, requirement trades, growth sensitivities. Multivariable design optimisation methods. Measures of merit.
Determination of final baseline design configuration, preparation of type specification report.

UNIT – VIII CASE STUDIES AND DESIGN OF UNIQUE AIRCRAFT CONCEPTS

Design of the DC – 1, DC – 2, DC- 3 aircraft, Boeing B-47 and 707, General Dynamics F-16, SR-71 Blackbird, Northrop-Grumman B-2 Stealth Bomber. A survey of the Indian aircraft design effort. Design of VTOL aircraft, helicopters, hypersonic vehicles, delta and double delta wings, forward swept wings, uninhabited air vehicles.

TEXT BOOKS

1. Raymer, D.P., *Aircraft Design: A Conceptual Approach*, 3rd edn., AIAA Education Series, AIAA, 1999, ISBN: 1-56347-281-0.
2. Howe, D., *Aircraft Conceptual Design Synthesis*, Professional Engineering Publishing, London, 2000, ISBN: 1-86058-301-6.
3. Fielding, J.P., Introduction to Aircraft Design, Cambridge University Press, 2005, ISBN: 0-521-657222-9.

REFERENCES

1. *AIAA Aerospace Design Engineer's Guide*, 5th edn., AIAA Education Series, 2003, ISBN 1-56347-590-1.
2. Jenkinson, L.R. and Marchman III, J. F., *Aircraft Design Projects for Engineering Students*, Butterworth Heinemann, 2003, ISBN: 0 7506 5772 3.
3. Brandt, S.A. et. al., *Introduction to Aeronautics: A Design Perspective*, 2nd edn., AIAA Education Series, AIAA, 2004, ISBN: 1-56347-701-7
4. Anderson, J.D. Jr., *Aircraft Performance and Design*, McGraw-Hill, 1999, ISBN: 0-07-001971-1.
5. Dole, C.E., *Flight Theory and Aerodynamics: A Practical Guide to Operational Safety*, Wiley, 1981, ISBN: 0-471-09152-9
6. Taylor, J., *Jane's All the World Aircraft*, latest edition, Jane's, London.
7. Stinton, The Design of the Airplane, second edition, AIAA, 2001, ISBN: 0-56347-524-6.
8. Kroo I., *Applied Aerodynamics: A Digital Textbook*, Desktop Aeronautics Inc., http://www.desktopaero.com/appliedaero/preface/welcome.html
9. Keane, A.J. And Nair, P.B., *Computational Approaches for Aerospace Design*, Wiley, 2005, ISBN:0-470-85540-1.

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III Year B.Tech. AE II –Sem	**L**	**T/P/D**	**C**
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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, burnig 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 velocity, mass ratio. Effect of atmosphere. Engine parameters, propellants.

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 seleted space vehicles and military missiles.

UNIT- VI ELECTRIC THRUSTERS- MISSION APPLICATIONS TO SPACE FLIGHT

Limitations of chemical rocket engines. Electric propulsion systems- structure, types, generation of thrust. System parameters- interrelations.

Electrothermal thrustors- resistojet, arcjet, solar/ laser/ microwave thermal propulsion- operating principles, components, system parameters, performance, applications.

Electrostatic thrusters- ionisation potenial, 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 I_{SP} 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 shut-down, nozzle, thrust generation.

Potential applications of nuclear engines- operational issues, interplanetary transfer manoeuvres, faster interplanetary journey. Development status of nuclear engines, alternative reactor types, safety issues, nuclear propelled missions.

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.

Micropropulsion- 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

1. Sutton, G.P. and Biblarz, O., *Rocket Propulsion Elements*, 7th edn., Wiley, 2001, ISBN: 0-471-32642-9.
2. Hill, P.G. and Peterson, C.R., *Mechanics and Thermodynamics of Propulsion*, 2nd edn. , Addison Wesley, 1992.
3. Kerrebrock, J.L., *Aircraft Engines and Gas Turbines*, 2nd edn. , MIT Press, 1992, ISBN: 0-262-11162-4.
4. Turner, M.J.L., *Rocket and Spacecraft Propulsion, 2nd edn.,* Springer, 2005, ISBN: 3 540 22190.
5. Tajmar, M., *Advanced Space Propulsion Systems,* Springer, 2003, ISBN: 3-211-83862-7.

REFERENCES

1. Jensen, G.E. and Netzer, D.W., ed. *Tactical Missile Propulsion*, AIAA, 1996, ISBN 1-56347-118-3.
2. NASA JPL Advanced Propulsion Concepts Notebook Online, http://sec353.jpl.nasa.gov/apc/
3. *Encyclpedia Astronautica,* http://www.astronautix.com/

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III Year B. Tech. AE – II Semester	**L**	**T/P/D**	**C**
	3	**1/-/-**	**3**

AIRCRAFT SYSTEMS

UNIT- I AIRCRAFT SYSTEMS

System concepts, everyday examples of systems, sub-systems. Generic system definition, inputs, outputs, feedback, external influence. Aircraft systems- airframe systems, vehicle systems, avionics systems, mission systems and their sub-systems. Specification of requirements- mission requirements, performance requirements. Operating environment conditions.

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

Aircraft hydraulic systems- function, merits, application, system loads, design requirements. Principal components. Flight control actuation- importance, need for redundancy- types- description, applications. Advanced actuation implementations. The 'fly-by-wire' actuation, fly-by-wire control laws. Hydraulic fluid- required properties, operating fluid pressures, temperatures, and flow rates. Hydraulic piping, pumps, reservoir, accumulator. Landing gear and brake management systems.

UNIT- IV PNEUMATIC AND ENVIRONMENTAL CONTROL SYSTEMS

Engine as source of high pressure air- engine bleed air- user systems- environment control, windscreen, wing and engine anti-ice, engine start, hydraulic, pitot-static systems. Bleed air control- structure, components, operation. Need for controlled cabin environment. Principal heat sources in aircraft. Methods of cooling- ram air, engine bleed air, fuel cooling. Cooling systems- air cycle refrigeration- types- turbo fan, bootstrap, reverse bootstrap systems. Vapour cycle refrigeration. Humidity control. Air distribution systems, cabin pressurization, molecular-sieve oxygen concentrators, g tolerance and protection.

UNIT- V ENGINE CONTROL AND FUEL SYSTEMS

Principle of operation of aircraft gas turbine engines. Engine- airframe interfaces. Control of fuel flow, air flow, exhaust gas flow- need, means, system parameters, basic inputs and outputs. Limited authority control systems, full authority control systems- examples. Engine monitoring- sensors, indicators. Power offtakes- need, types, effect on engine performance. Fuel systems- characteristics, components, operating modes. Fuel tank safety- fuel inerting system.

UNIT- VI FLIGHT CONTROL SYSTEMS

Flight management, guidance, control- objectives, interrelationship. Flight control systems- primary and secondary flight control- control linkages, actuation- types, description, redundancy. Provision of trim and artificial feel. All electric aircraft. Fly-by-wire control- control laws, implementation. Advanced systems- integrated flight and propulsion control- implementation.

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

4. Moir, I. and Seabridge, A., *Design and Development of Aircraft Systems- an Introduction*, AIAA Education Series, AIAA, 2004.
5. Moir, I. and Seabridge, A., *Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration*, 3rd edn, John Wiley, 2008, ISBN 978-0-470-05996-8.

REFERENCES

3. Pallett, E.H.J., *Aircraft Instruments and Integrated Systems*, 10th edn., Longman Scientific &Technical, 1992.
4. Harris, D., *Flight Instruments and Automatic Flight Control Systems*, 6th edition, Ground Studies for Pilots, Blackwell Science, 2004, ISBN 0-632-05951-6.
5. Bolton, W., *Pneumatic and Hydraulic Systems*, Butterworth-Heinemann.
6. *Jet Engine*, Rolls Royce.

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III Year B. Tech. AE – II Semester	**L**	**T/P/D**	**C**
	4	**1/-/-**	**4**

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:
Stiffness equations for a truss bar element oriented in 2D plane - Finite Element Analysis of Trusses – Plane Truss and Space Truss elements – methods of assembly.

UNIT -IV:
Analysis of beams: Hermite shape functions – Element stiffness matrix – Load vector – Problems.

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

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

UNIT -VII:
Scalar field problems: 1-D Heat conduction – 1D fin elements – 2D heat conduction - analysis of thin plates – Composite slabs - problems.

UNIT -VIII:
Dynamic Analysis: Dynamic equations – Lumped and consistent mass matrices – Eigen Values and Eigen Vectors – mode shapes – modal analysis for bars and beams.

TEXT BOOKS:
1. The finite element methods in Engineering – S.S. Rao – Elsevier – 4th edition
2. Introduction to finite elements in engineering – Tirupathi K. Chandrupatla and Ashok D. Belagundu.

REFERENCES:
1. Finite Element Methods/ Alavala/TMH
2. The Finite element method in engineering science – O.C. Zienkowitz, Mc Grawhill.
3. Concepts and applications of finite element analysis – Robert Cook – Wiley
4. Introduction of Finite Element Analysis – S.Md.Jalaludeen – Anuradha publications

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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:
e-beam lithography and SEM based nanolithography and nanomanipulation, Ion beam lithography, oxidation and metallization. Mask and its application. Deep UV lithography, X-ray based lithography.

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:
1. David Ferry “Transport in Nano structures” Cambridge University press 2000
2. Nanobiotechnology; ed. C.M.Niemeyer, C.A. Mirkin.
3. Nanofabrication towards biomedical application: Techniques, tools, Application and impact – Ed. Challa S.,S. R. Kumar, J. H. Carola.
4. Encyclopedia of Nanotechnology- Hari Singh Nalwa
5. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
6. S. Dutta “Electron Transport in Mesoscopic systems” Cambridge University press
7. H. Grabert and M. Devoret “Single charge Tunneling” Plenum press 1992

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PROBABILITY AND STATISTICS
(OPEN ELECTIVE)

UNIT-I : Probability
Sample space and events – Probability – The axioms of probability – Some
Elementary theorems - Conditional probability – Baye's theorem, Random variables – Discrete and continuous.

UNIT-II: Distributions
Binomial , Poisson & normal distributions related properties . Sampling distributions –Sampling distribution of means (σ 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 χ^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
Introduction to Stochastic Processes – Markov process classification of states – Examples of Markov Chains, Stochastic Matrix, limiting probabilities.

TEXT BOOKS:
1. Probability & Statistics by D.K. Murugesan & P.Guru Swamy, Anuradha Publications.
2. Probability & Statistics for Engineers by G.S.S.Bhisma Rao, Scitech Publications.

REFERENCES:
1. Probability & Statistics by T.K.V.Iyengar & B.Krishna Gandhi & Others, S.Chand.
2. Probability & Statistics by William Mendenhall & Others, Cengage Publications.
3. Higher Engineering Mathematics by B.S. Grewal, Khanna Publications.
4. Higher Engineering Mathematics by Jain & S.K.R. Iyengar, Narasa Publications.
5. A first course in Probability & Statistics by B.L.S. Prakasa Rao, World Scientific.
6. Probability & Statistics for Engineers, Miller and John E. Freund, Prentice Hall of India.

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ENGINEERING OPTIMIZATION
(OPEN ELECTIVE)

UNIT – I
Introduction: Optimal Problem formulation: Design variables-Constraints- Objective function-Variable bounds. Engineering Optimization problems: Classification& Some examples (just theory & discussion) : Truss structure, Ammonia structure, Transit schedule and Car suspension

UNIT – II
Single variable non-linear optimization problems: Local minimum Global minimum & Inflection point. Necessary & Sufficient conditions theorems, some problems based on this. Numerical methods: Exhaustive Search methods- Fibonacci method, Golden section method & comparison. Interpolation methods: Quadratic.

UNIT – III
Multivariable unconstrained non-linear optimization problems: Numerical methods part a: Direct Search methods: Univariate method, Pattern Search methods: Powell, Hook-Jeeve's, Rosen Brock's search and Simplex methods.

UNIT – IV
Multivariable unconstrained non-linear optimization problems: Numerical methods part b: Gradient methods: Gradient of a function-Importance- Gradient direction search based methods: Steepest descent/ascent method, Conjugate gradient method and variable meteric method.

UNIT – V
Multivariable constrained non-linear optimization problems Classical optimization techniques: Constraints – equations-Lagrangian method- inequalities-Kuhn-Tucker necessary and sufficient conditions-Quadratic problem-Statement- Wolfe's and Beale's methods.

UNIT – VI

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

UNIT – VII
Sensitivity Analysis: Linear programming – Formulation – Simplex method and Artificial variable techniques-Big-M & two-phase methods- Change in the cost coefficients, coefficients & constants of the constraints, addition of variables.

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
1. Engineering Optimization: Theory & Practice-S.S.Rao-New Age International Publications- Thir Edition-2003
2 Optimization for Engineering Design- Kalyanmoy Deb-Prentice-Hall of India Pvt.Ltd, NewDelhi-2005.
3. Operations Research- S.D.Sharma- Kedar Nath & Ran Nath Co., New Delhi

REFERENCE TEXT BOOKS
1 Optimization Theory & Practice: Beveridge & Schechter.McGraw-Hill International Student edition.
2 Optimization in Operations Research Ronald L.Rardin. Pearson Education, Low Price Edition.
3 Optimization Theory & Practice: Mohan C.Joshi & KM Moudgalya. Narosa Publishing House, Chennai
4 Operations Research: A.P.Verma. S.K.Kataria & Sons, New Delhi-110006

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

III Year B. Tech. AE – II Semester	**L**	**T/P/D**	**C**
	0	**-/3/-**	**2**

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.
- **Writing Skills** – structure and presentation of different types of writing – *Resume writing / e-correspondence/Technical report writing/Portfolio writing* – planning for writing – *research abilities/data collection/organizing data/tools/analysis* – improving one's writing.
- **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:

i) **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.

ii) **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:

i) 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:

1. **Technical Communication** by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
2. **Advanced Communication Skills Laboratory Manual** by Sudha Rani, D, Pearson Education 2011.
3. **English Language Communication : A Reader cum Lab Manual** Dr A Ramakrishna Rao, Dr G Natanam & Prof SA Sankaranarayanan, Anuradha Publications, Chennai 2008.
4. **English Vocabulary in Use** series, Cambridge University Press 2008.
5. **Management Shapers Series** by Universities Press(India)Pvt Ltd., Himayatnagar, Hyderabad 2008.
6. **Communication Skills** by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.
7. **Handbook for Technical Writing** by David A McMurrey & Joanne Buckely CENGAGE Learning 2008.
8. **Job Hunting** by Colm Downes, Cambridge University Press 2008.
9. **Master Public Speaking** by Anne Nicholls, JAICO Publishing House, 2006.
10. **English for Technical Communication for Engineering Students**, Aysha Vishwamohan, Tata Mc Graw-Hil 2009.
11. Books on **TOEFL/GRE/GMAT/CAT/ IELTS** by Barron's/DELTA/Cambridge University Press.
12. **International English for Call Centres** by Barry Tomalin and Suhashini Thomas, Macmillan Publishers, 2009.

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.

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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.

4. Propulsion & fuel system integration, landing gear & subsystems.

5. Baseline Design Analysis- Aerodynamics & Propulsion, Structures & Weight And Balance.

6. Baseline design– stability & control, performance and constraint analysis.

7. Cost estimation, parametric analysis, optimisation, refined sizing &trade studies.

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

REFERENCES

1. Jenkinson, L.R. and Marchman III, J. F., *Aircraft Design Projects for Engineering Students*, Butterworth Heinemann, 2003, ISBN: 0 7506 5772 3.
2. Raymer, D.P., *Aircraft Design: A Conceptual Approach*, 3rd edn., AIAA Education Series, AIAA, 1999, ISBN: 1-56347-281-0.
3. *Fielding, J.P., Introduction to Aircraft Design, Cambridge University Press, 2005, ISBN: 0-521-657222-9.AIAA Aerospace Design Engineer's Guide*, 5th edn., AIAA Education Series, 2003, ISBN 1-56347-590-1.
4. Keane, A.J. And Nair, P.B., *Computational Approaches for Aerospace Design,* Wiley, 2005, ISBN:0-470-85540-1.
5. Taylor, J., *Jane's All the World Aircraft*, latest edition, Jane's, London.
6. Stinton, The Design of the Airplane, second edition, AIAA, 2001, ISBN: 0-56347-524-6.