MALLAREDDYCOLLEGE OFENGINEERING&TECHNOLOGY

(Autonomous Institution – UGC, Govt. of India)
Sponsored by CMR Educational Society

(Affiliated toJNTU, Hyderabad, Approved byAICTE - Accredited byNBA & NAAC – 'A' Grade - ISO 9001:2008 Certified)
Maisammaguda, Dhulapally(Post Via Hakimpet), Secunderabad – 500100, Telangana State, India.

Contact Number: 040-23792146/64634237, E-Mail ID: mrcet2004@gmail.com, website:www.mrcet.ac.in

MASTER OF TECHNOLOGY AEROSPACE ENGINEERING

DEPARTMENT OF AERONAUTICAL ENGINEERING

COURSE STRUCTURE AND SYLLABUS

(Batches admitted from the academic year 2018 - 2020)

Note: The regulations hereunder are subject to amendments as may be made by the Academic Council of the College from time to time. Any or all such amendments will be effective from such date and to such batches of candidates (including those already pursuing the program) as may be decided by the Academic Council.

PRELIMINARY DEFINITIONS AND NOMENCLATURES

"Autonomous Institution /College" means an institution/college designated as autonomous institute / college by University Grants Commission (UGC), as per the UGC Autonomous College Statutes.

- "Academic Autonomy" means freedom to a College in all aspects of conducting its academic programs, granted by the University for promoting excellence.
- "Commission" means University Grants Commission.
- "AICTE" means All India Council for Technical Education.
- "University" the Jawaharlal Nehru Technological University, Hyderabad.
- "College" means Malla Reddy College of Engineering & Technology, Secunderabad unless indicated otherwise by the context.
- "Program" means: Master of Technology (M.Tech) degree program PG Degree Program: M.Tech
- "Branch" means specialization in a program like M.Tech degree program in Aeronautical Engineering, M.Tech degree program in Computer Science and Engineering etc.
- "Course" or "Subject" means a theory or practical subject, identified by its course – number and course-title, which is normally studied in a semester.
- T–Tutorial, P–Practical, D–Drawing, L-Theory, C-Credits

FOREWORD

The autonomy is conferred on Malla Reddy College of Engineering & Technology (MRCET) by UGC based on its performance as well as future commitment and competency to impart quality education. It is a mark of its ability to function independently in accordance with the set norms of the monitoring bodies like UGC and AICTE. It reflects the confidence of the UGC in the autonomous institution to uphold and maintain standards it expects to deliver on its own behalf and thus awards degrees on behalf of the college. Thus, an autonomous institution is given the freedom to have its own curriculum, examination system and monitoring mechanism, independent of the affiliating University but under its observance.

Malla Reddy College of Engineering & Technology (MRCET) is proud to win the credence of all the above bodies monitoring the quality in education and has gladly accepted the responsibility of sustaining, and also improving upon the values and beliefs for which it has been striving for more than a decade in reaching its present standing in the arena of contemporary technical education. As a follow up, statutory bodies like Academic Council and Boards of Studies are constituted with the guidance of the Governing Body of the College and recommendations of the JNTU Hyderabad to frame the regulations, course structure and syllabi under autonomous status.

The autonomous regulations, course structure and syllabi have been prepared after prolonged and detailed interaction with several experts drawn from academics, industry and research, in accordance with the vision and mission of the college which reflects the mindset of the institution in order to produce quality engineering graduates to the society.

All the faculty, parents and students are requested to go through all the rules and regulations carefully. Any clarifications, if needed, are to be sought at appropriate time and with principal of the college, without presumptions, to avoid unwanted subsequent inconveniences and embarrassments. The Cooperation of all the stake holders is sought for the successful implementation of the autonomous system in the larger interests of the institution and brighter prospects of engineering graduates.

"A thought beyond the horizons of success committed for educational excellence"

PRINCIPAL

MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

(Autonomous Institution – UGC, Govt. of India)
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(Affiliated to JNTU, Hyderabad, Approved by AICTE - Accredited by NBA & NAAC – 'A' Grade - ISO 9001:2008 Certified)

Maisammaguda, Dhulapally (Post Via Hakimpet), Secunderabad – 500100, Telangana State, India.
Contact Number: 040-23792146/64634237, E-Mail ID: mrcet2004@gmail.com, websitewww.mrcet.ac.in

VISION

- To establish a pedestal for the integral innovation, team spirit, originality and competence in the students, expose them to face the global challenges and become technology leaders of Indian vision of modernsociety.

MISSION

- To become a model institution in the fields of Engineering, Technology and Management.
- To impart holistic education to the students to render them as industry ready engineers.
- To ensure synchronization of MRCET ideologies with challenging demands of International Pioneering Organizations.

QUALITY POLICY

- To implement best practices in Teaching and Learning process for both UG and PG courses meticulously.
- To provide state of art infrastructure and expertise to impart the quality education.
- To groom the students to become intellectually creative and professionally competitive.
- To channelize the activities and tune them in heights of commitment and sincerity, the requisites to claim the never ending ladder of SUCCESS year after year.

For more information: www.mrcet.ac.in

M.TECH – AEROSPACE ENGINEERING

COURSE STRUCTURE & SYLLABUS

I Year I Semester

S.NO.	JBJECT CODE	SUBJECT	L	T/P/D	C	MAX MARKS	
						INT	EXT
1	R18D7601	Aerodynamics of Flight Vehicles	3	-	3	30	70
2	R18D7602	Engineering Analysis of Flight Vehicles	3	-	3	30	70
3	R18D7603	Rocket and Missile Technology	3	-	3	30	70
4	R18D7607 R18D7608 R18D7609	Elective-1 1) Fundamentals of Aerospace Engineering* 2) Air-breathing Propulsion And Design 3)Flight Navigation and surveillance systems	3	-	3	30	70
5	R18D7610 R18D7611 R18D7612	Elective-2 1)Modeling and Simulation of Fluid Flows 2) Continuum Mechanics 3)Rotorcraft Aerodynamics	3	-	3	30	70
6	OE-I	Open Elective-I	3	-	3	30	70
7	R18D7681	Digital Simulation Lab-I		3	2	30	70
8	R18DHS54	Audit Course I - Value Education	2	-	-	50	-
Total			20	3	20	260	490

***Audit course: Non-credit course, 50% of scoring is required for the award of the degree**

*NOTE: *Fundamentals of Aerospace Engineering*

(Required to be taken by all students other than B.Tech Aeronautical/ Aerospace Engineering degree holders)

OPEN ELECTIVE I	
Subject Code	**Subject Name**
R18DME51	Non-Conventional Energy Sources
R18DME52	Industrial Safety
R18DME53	Operations Research
R18DHS51	Business Analytics
R18DCS51	Scripting Languages
R18DAE51	Mathematical Modeling Techniques
R18DEC51	Embedded Systems Programming

I Year II Semester

S.NO.	SUBJECT CODE	SUBJECT	L	T/P/D	C	MAX MARKS	
						INT	EXT
1	R18D7604	Aircraft Control and Simulation	3	-	3	30	70
2	R18D7605	Aerospace Sensors and Measurement Systems	3	-	3	30	70
3	R18D7606	Computational Approaches to Aerospace Vehicle Design	3	-	3	30	70
4	R18D7613 R18D7614 R18D7615	Elective-III 1) High Angle of Attack Aerodynamics 2) Advanced Topics in Air Traffic Management Systems 3) Flight Dynamics and Control	3	-	3	30	70
5	R18D7616 R18D7617 R18D7618	Elective-IV 1) Tactical Missile Design Space Transportation Systems Aero elasticity	3	-	3	30	70
6	OE-II	OPEN ELECTIVE- II	3	-	3	30	70
7	R18D7682	Digital Simulation Lab-II	-	3	2	30	70
8	R18DHS55	Audit Course II - English for Research Paper Writing	2	-	-	50	
Total			20	3	20	260	490

*Audit course: Non-credit course, 50% of scoring is required for the award of the degree

OPEN ELECTIVE II	
Subject Code	Subject Name
R18DME54	Composite Materials
R18DME55	Waste to Energy
R18DME56	Industrial Management
R18DHS52	Cost Management of Engineering Projects
R18DCS52	Information Security
R18DAE52	Unmanned Aerial Vehicles
R18DEC52	Research Methodology

II Year I Semester

S.NO.	SUBJECT CODE	SUBJECT	L	T/P/D	C	MAX MARKS	
						INT	EXT
1	R18D7683	Seminar-I	-	-	2	50	-
2	R18D7691	Mini Project	-	-	4	100	-
3	R18D7692	Project Review-I	-	-	8	100	-
Total			-	-	14	250	-

II Year II Semester

S.NO.	SUBJECT CODE	SUBJECT	L	T/P/D	C	MAX MARKS	
						INT	EXT
1	R18D7684	Seminar-II	-	-	2	50	-
2	R18D7693	Project Review-II	-	-	8	100	-
3	R18D7694	Project Viva-voce	-	-	8	-	100
Total			-	-	18	150	100

MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

	L	T/P/D	C
I Year M. Tech, ASP-I SEM	**3**	**-**	**3**

(R18D7601) AERODYNAMICS OF FLIGHT VEHICLES

UNIT-I: REVISION OF BASICS LEARNT AT UNDER GRADUATE LEVEL IN BRIEF

AERODYNAMIC CHARACTERISTICS OF AIRFOILS: Vortex sheet, Vortex sheet in thin-airfoil theory, Planar wing, Properties of symmetrical airfoil, Properties of cambered airfoil, Flapped airfoil, Numerical Solution of thin airfoil problem, Airfoil of arbitrary thickness and camber

UNIT II: THE FINITE WING

Flow fields around finite wings, Downwash and induced drag, Fundamental equations of finite-wing theory, Elliptical lift distribution, Arbitrary circulation distribution, Twisted wing: Basic and Additional lift, Approximate calculation of additional lift, Winglets, Stability and trim of wings, Higher approximations, The complete airplane, Interference effects,

AIRFOILS IN COMPRESSIBLE FLOWS

Boundary conditions, subsonic airfoils Prandtl-Glauert transformation, Critical Mach number, Drag divergence Mach number, Airfoils in transonic flow, Airfoils in supersonic flow

UNIT-III: WINGS AND WING-BODY COMBINATIONS IN COMPRESSIBLE FLOW

Wings and bodies in compressible flows: Prandtl-Glauert-Goethert transformation, Influence of sweepback, Design rules for wing-fuselage combinations

LAMINAR BOUNDARY LAYER IN COMPRESSIBLE FLOW

Conservation of energy in the boundary layer, Rotation and entropy gradient in the boundary layer, Similarity considerations for compressible boundary layers, Solution of energy equation for Prandtl number unity, Temperature recovery factor, Heat transfer versus skin friction, Velocity and temperature profiles and skin friction, Effects of pressure gradient

UNIT-IV: FLOW INSTABILITIES AND TRANSITION FROM LAMINAR TO TURBULENT FLOW

Gross effects, Reynolds experiment, Tollmien-Schlichting instability and transition, Natural laminar flow and laminar flow control, Stability of vortex sheets, Transition phenomenon, Methods for experimentally detecting transition, Flow around spheres and circular cylinders

TURBULENT FLOWS

Description of turbulent field, Statistical properties, Conservation equations, Laminar sub-layer, Fully developed flows in tubes and channels, Constant-pressure turbulent boundary layer, Turbulent drag reduction, Effects of pressure gradient, Stratford criterion for turbulent separation, Effects of compressibility on skin friction, Reynolds analogy: Heat transfer and temperature recovery factor, Free turbulent shear flows

AIRFOIL DESIGN, MULTIPLE SURFACES, VORTEX LIFT, SECONDARY FLOWS, VISCOUS EFFECTS

Airfoil design for high $C_{l_{max}}$, multiple lifting surfaces, Circulation control, Stream wise vorticity, Secondary flows, Vortex lift strakes, Flow about three-dimensional bodies, unsteady lift

UNIT-V: UNSTEADY AERODYNAMICS

Unsteady lifting force coefficient, Unsteady aerodynamics of slender wings, Compressible Unsteady aerodynamics, Equations of motion, Boundary condition, Moving coordinate system, Navier Stoke equations, Aerodynamic forces and moments, Turbulence modelling, Numerical Problems

INCOMPRESSIBLE FLOW OVER AN AIRFOIL

Steady flow, Unsteady flow, Simple Harmonic Motion, Lowey's problem: returning Wake problem, Arbitrary motion and Wagner Function, Gust problem and Kussner function. Numerical Problems

INCOMPRESSIBLE FLOW OVER WINGS

Steady flow: Lifting line theory (results), Weissinger's L – method, Low aspect ratio wings, unsteady flow: Reissner's Approach, Numerical solutions, Numerical Problems

TEXT BOOKS

1. *Foundations of Aerodynamics*: Bases of Aerodynamic Design, Arnold M. Kuethe and Chuen-Yen Chow, John Wiley & Sons, Inc., Fifth Edition, 1997, ISBN: 978-0-471-12919-6
2. *Fundamentals of Modern Unsteady Aerodynamics*, Gulcat, Ulgen, Springer, Publications, ISBN 978-3-642-14761-6

MALLAREDDYCOLLEGE OFENGINEERING&TECHNOLOGY

	L	T/P/D	C
I Year M. Tech, ASP-I SEM	**3**	**-**	**3**

(R18D7602) ENGINEERING ANALYSIS OF FLIGHT VEHICLES

UNIT-I: THE MORPHOLOGY OF FLIGHT VEHICLES

Introduction, Key factors affecting vehicles configuration, some representative flight vehicles.

UNIT-II: EQUATIONS OF MOTION FOR RIGID FLIGHT VEHICLES

Definitions, Vector and Scalar realizations of Newton's second law, The tensor of inertia, Choice of vehicle axes, Principal axes, Stability axes, Aerodynamic axes, Orientation of the vehicle relative to the ground; flight path determination, Gravitational terms in the equations of motion, The state vector, Equations of motion; Aerodynamic Approximations; stability derivatives; Estimation of stability derivatives: Longitudinal.

INTRODUCTION TO VEHICLE AERODYNAMICS

Aerodynamics contributions to X, Y and M, dimensionless coefficients defined, equations of perturbed longitudinal motion.

UNIT-III: AIRCRAFT DYNAMICS

Equations of Motion of Aircraft including forces and moments of control surfaces, Dynamics of control surfaces

STATIC STABILITY, TRIM STATIC PERFORMANCE AND RELATED SUBJECTS

Impact of stability requirements on design and longitudinal control, Static performance

UNIT-IV: DYNAMIC PERFORMANCE OF SPACECRAFT WITH RESPECT TO NON-ROTATING PLANETS

Introduction, Numerical integration of ordinary differential equations, Simplified treatment of boost froma non-rotatingplanet,Anelementarylookatstaging,Equationsofboostfromarotatingplanet.

UNIT-V: DYNAMIC PERFORMANCE OF SPACECRAFT

Equations of Motion of Launch Vehicles with respect to a rotating planet, Motion of Spacecraft with respect to a rotating planet.

DYNAMIC PERFORMANCE-ATMOSPHERIC ENTRY

Equation of motion, Approximate analysis of gliding entry into a planetary atmosphere.

TEXT BOOK

1. Engineering Analysis of Flight Vehicles, Holt Ashley, Dover Publications, 1992

MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

I Year M. Tech, ASP-I SEM

L	T/P/D	C
3	-	3

(R18D7603) ROCKET AND MISSILE TECHNOLOGY

UNIT-I: INTRODUCTION

Rockets and military missiles–function, types, role, mission, mission profile, thrust profile, propulsion system, payload, staging, control and guidance requirements Performance measures, design, construction ,operation-similarities and differences .Some famous space launch vehicles and strategic missiles.

UNIT-II: SOLID AND LIQIUD PROPULSION SYSTEMS

Solid propellant rocket motors, principal features .applications, solid propellants, types, composition, properties, performance. Propellantgrain, desirableproperties, grainconfiguration, preparation. loading. structural design of grain .Combustion instabilities. Liners, insulators and inhibitors-function, requirements, materials. Rocket motor casing –materials. Nozzles –types, design- construction, thermal protection. Igniters, types, construction. Description of modern solid boosters I) Space Shuttle SRB II) the Arienne SRB

Liquid propellants –types, composition, properties. Performance .Propellant tanks, feed systems – pressurisation, turbo-pumps-valves and feed lines, injectors, starting and ignition .Engine cooling support structure. Control of engine starting and thrust build up. System calibration, integration and optimization – safety and environmental concerns combustion instabilities. Description of the space shuttle main engine .Propellant slosh, propellant hammer, geysering effect in cryogenic rocket engines. Tsiolskovsky's rocket equation in the absence of gravity, vertical motion in the earth's gravitational field , inclined motion , flight path at constant pitch angle , motion in the atmosphere , the gravity turn-the culmination altitude, Multi staging. Earth launch trajectories – vertical segment , the gravity turn ,constant pitch trajectory , orbital injection. Actual launch vehicle trajectories –types. Examples, the Mu-3-S-II. Ariane, Pegasus launchers, Reusable launch vehicles – future launchers –launch assist technologies

UNIT-III: AERODYNAMICS OF ROCKETS AND MISSILES AND ATTITUDE CONTROL

Classification of missiles, Airframe components of rockets and missiles. Forces acting on a missile while passing through atmosphere, method of describing aerodynamic forces and moments .lateral aerodynamic moment

,lateral damping moment , longitudinal moment of a rocket, lift and drag forces, drag estimation ,body up wash and down wash in missiles. Rocket dispersion. re-entry body design considerations Rocket thrust vector control – methods of thrust vector control for solid and liquid propulsion systems, thrust magnitude control .thrust termination; stage separation dynamics , separation techniques

UNIT-IV: MATERIALS AND ROCKET TESTING

Criteria for selection of materials for rockets and missiles- requirements for choice of materials for propellant tanks, liners, insulators, inhibitors, at cryogenic temperatures, requirements of materials at extremely high temperatures, requirements of materials for thermal protection and for pressure vessels.Ground testing and flight testing-

types of tests, test facilities and safeguards monitoring and control of toxic materials, instrumentation and data management. Ground testing, flight testing, trajectory monitoring, post accident procedures. Description of a typical space launch vehicle launches procedure.

UNIT-V: ALTERNATIVE PROPULSION SYSTEMS AND FLIGHT VEHICLES

Hybrid propulsion system .Ramjet propulsion and its performance and limitations, the scramjet engine – construction , flow process , drag components , fuel injection systems , applications , components performance analysis – Hypersonic transport vehicles, missions , trajectories, sounding rockets , cruise missiles , unmanned Aerial Vehicles and drones , Micro Aerial Vehicles – applications of these vehicles

TEXT BOOKS

1. Sutton, GP. and Biblarz, ., Rocket Propulsion Elements, 7th edition, Wiley-Interscience, 2000.
2. Cornelisse, J.W., Schoyer H.F.R. and Wakker. K.F., Rocket propulsion and space flight dynamics , pitman 1979
3. Turner ,M.J.L., Rocket and Spacecraft Propulsion ,springer ,2001
4. Hill ,PG. and Peterson ,CR, Mechanics and Thermodynamics of propulsion , 2nd edition , Addison Wesley ,1992

REFERNCE BOOKS

1. Anderson JD., Introduction to flight 5th edition ,Tata McGraw Hill ISBN: 0-07-006082-4
2. James all the world flight vehicles Jones aviation publications London

MALLAREDDYCOLLEGE OFENGINEERING&TECHNOLOGY

I Year M. Tech, ASP-I SEM

L	T/P/D	C
3	-	3

(R18D7607) FUNDAMENTALS OF AEROSPACE ENGINEERING*
(ELECTIVE-I)

UNIT-I: INTRODUCTION TO AEROSPACE ENGINEERING

Brief history of Aeronautics, Anatomy of the Airplane, Anatomy of a Space Vehicle, The Nature of Aerodynamic forces and dimensional analysis; Theory and experiment: wind tunnels, Atmosphere: Properties of U.S. standard atmosphere, Definitions of altitude,

UNIT-II: INCOMPRESSIBLE ONE DIMENSIONAL FLOWS AND COMPRESSIBLE FLUIDS

Continuity equation, Bernoulli's equation, Application of Bernoulli's equation: Airspeed indicators and wind tunnels, One-dimensional compressible flow concepts, Speed of sound, Compressible flow equations in a variable-area stream tube, Application to airspeed measurement, Applications to channels and wind tunnels

TWO-DIMENSIONAL FLOW AND FINITE WING: Limitations of one-dimensional flow equations, Theory of lift: circulation, Airfoil pressure distribution, Helmholtz vortex theorems, Simulating the wing with a vortex line, Downwash, Elliptic lift distribution, Lift and drag: momentum and energy, Slope of finite wing lift curve, Verification of Prandtl wing theory, Additional effects of wing vortices, Search for reduced induced drag

UNIT-III: EFFECTS OF VISCOSITY, TOTAL DRAG

Boundary layer, Boundary layer on bluff bodies, Creation of circulation, Laminar and turbulent boundary layers: skin friction, Nature of Reynolds number, Effect of turbulent boundary layer on separation; Parasite drag, Drag due to lift, Importance of aspect ratio; Prediction of drag divergence Mach number, Sweptback wings, Total drag, Supersonic flow: shock waves and Mach waves, Supersonic wing lift and drag, Area rule, Supersonic aircraft,

AIRFOILS, WINGS AND HIGHLIFT SYSTEMS: Early airfoil development, Modern airfoils, Supersonic airfoils, Airfoil pitching moments, Effects of sweepback on lift, airfoil characteristics, Airfoil selection and wing design; Airfoil maximum lift coefficient, Leading and trailing edge devices, Effect of sweepback, Deep stall, Effect of Reynolds number, Propulsive lift

UNIT-IV: AERODYNAMIC PERFORMANCE, STABILITY AND CONTROL

Level flight performance, Climb performance, Range, Endurance, Energy-state approach to airplane performance, Takeoff performance, landing performance; Static longitudinal stability, Dynamic longitudinal stability, Dynamic lateral stability, Control and Maneuverability: turning performance, Control systems, Active controls

UNIT-V: AEROSPACE PROPULSION AND AIRCRAFT STRUCTURES

Aerospace Propulsion: Piston engines, Gas turbines, Speed limitations of gas turbines: ramjets, Propellers, Overall propulsion efficiency, Rocket engines, Rocket motor performance, Propulsion- airframe integration; Aircraft structures: Importance of structural weight and integrity, Development of aircraft structures, Importance of fatigue, Materials, Loads, Weight estimation

ROCKET TRAJECTORIES, ORBITS AND REENTRY

Rocket trajectories, Multistage rockets, Escape velocity, Circular orbital or satellite velocity, Elliptical orbits, Orbital maneuvers.

TEXT BOOK

1. Fundamentals of Flight, Richard S. Shevell, Pearson Education Publication, ISBN 81-297-0514-1, 1989

REFERENCE BOOK

1. Introduction to Flight, John D. Anderson, Jr., Tata McGraw-Hill Publishing Company, Fifth Edition, Fifth Edition, 2007, ISBN 13: 978-0-07-066082-3

MALLAREDDYCOLLEGE OFENGINEERING&TECHNOLOGY

	L	T/P/D	C
I Year M. Tech, ASP-I SEM	**3**	**-**	**3**

(R18D7608) AIR-BREATHING PROPULSION AND DESIGN

(ELECTIVE-I)

UNIT-I: FUNDAMENTALS OF JET PROPULSION

Aircraft Propulsion, Thermodynamic relations and cycles involved, Classification of Air breathing Engines, Ideal and Real Cycle Analysis - Turbojet and Turbofan, Effects of Altitude, Mach number, Aircraft Performance and Engine Performance analysis, Aircraft Engine Design, Methods employed for Thrust Augmentation and Jet Engine Noise suppression.

UNIT-II: INLETS AND NOZZLES

Types of Inlets, Combined Area Changes and Friction, Supersonic Inlet Design Considerations, Engine Starting, Effect of Additive Drag, Types of nozzles, Performance Map, Non-ideal equations for Various Nozzles, Effects of Pressure Ratios on Engine Performance, Performance Maps, Methods and advantages in reversing the Thrust, Types of Thrust Vectoring.

COMBUSTION CHAMBER

Classification of combustion chamber, Process of Combustion, factors affecting combustion, Chemical Kinetics, Properties of various fuels used in aviation, Flame Stabilization, Ignition and Engine Starting, Adiabatic Flame Temperature, Pressure Losses, Design and Optimization, Performance Maps.

UNIT-III: COMPRESSORS AND TURBINES

Classification of Compressors, Euler's Turbo-Machinery Equations, components of axial flow compressor, stage, Velocity Triangles, Single-Stage Energy Analysis, Variable Stators, Radial Equilibrium and Streamline Analysis Method; Centrifugal Compressors- Geometry, Velocity triangles, Impeller Design, Performance Maps;
Axial Flow Turbines- Geometry, Single-Stage Energy analysis, Velocity Triangles, Performance Maps, Thermal Limits of Blades and Vanes, Numerical problems and Performance Analysis.

RAMJETS

Working principle of Ramjet engine, Combustors for liquid fuel ramjet engines, Combustion Instability and its Suppression, Solid fuel Ramjet Engines, Test bed of Ramjet engine, Advancements in ramjets- Ram-rockets- Performance analysis, Ducted and Shrouded types, Air-augmented rockets, Integrated ramjet-rocket systems, Nozzle-less solid propellant rockets and Integrated Ramjet-rocket boosters, Dump combustors. Problems related to combustion, CFD techniques and guide lines required in designing and development of combustor employed in ramjets.

UNIT-IV: HYPERSONIC AIR-BREATHING PROPULSION

Hypersonic Air-breathing Propulsion, SCRAM jet engines-Methods of Analysis, Hypersonic Intakes, Supersonic Combustors, Engine Cooling and Materials Problem, CFD Applications, Liquid Air-cycle Engines, Space Plane Applications, Experimental and Testing Facilities, The Shock tube and shock Tunnel, Hypersonic wind tunnel.

UNIT-V: DESIGN OF GAS TURBINE ENGINE

Aircraft Mission Analysis, Engine Selection- Performance and Parametric Analysis, Sizing the Engine, Major Considerations in Engine Component Design - Rotating Turbo-machinery, Combustion Systems, Inlets and Exhaust Nozzles

SYSTEM MATCHING AND ANALYSIS

Matching of Gas Turbine Components, Cycle Analysis of one and two spool engines, Gas Generator, Component Modeling, Solution of Matching Problem, Dynamic or Transient behavior, Matching of Engine and Aircraft, Use of Matching and Cycle analysis in Second stage design

TEXT BOOKS

1. Gas Turbine theory, Cohen H., Rogers G.F.C, Saravanamutto H., Longman Publication, 4th Edition, 2003
2. Elements of Propulsion: Gas turbines and Rockets, Jack D. Mattingly, AIAA Education series, 2nd Edition, 2006
3. Aircraft Engine Design, Jack D. Mattingly, AIAA Education Series, 2nd Edition, 2008.
4. Hypersonic Air breathing Propulsion, William H. Heiser, David T. Pratt, AIAA Education Series, 1st Edition, 1994

REFERENCE BOOK

1. Gas Tables, Third edition E. Radha Krishnan, University press.
2. Fundamentals of Jet Propulsion with applications, Ronald D. Flack, Cambridge University Press, 1st Edition, 2005.

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	L	T/P/D	C
I Year M. Tech, ASP-I SEM	**3**	**-**	**3**

(R18D7609) FLIGHT NAVIGATION AND SURVEILLANCE SYSTEMS

(ELECTIVE-I)

UNIT-I: ROLE OF NAVIGATION IN FLIGHT VEHICLE MISSION - NAVIGATION EQUATIONS:

Introduction: Definitions of navigation and surveillance, Guidance versus navigation, Categories of navigation, Civil and military aircraft, Phases of flight, Design trade-offs, Evolution of avionics, Human navigator; Navigation Equations: Geometry of the Earth, Coordinate frames, Dead-reckoning computations, Positioning,Terrain-matching navigation, Course computation, Navigation errors, Digital charts, Software development

UNIT-II: TERRESTRIAL-RADIO-NAVIGATION SYSTEMS:

General principles, System design considerations, Point source systems, Hyperbolic systems

SATELLITE RADIO NAVIGATION: System configuration, Basics of satellite radio navigation, Orbital mechanics and clock characteristics, Atmospheric effects on satellite signals, NAVSTAR Global Positioning System, Global Orbiting Navigation Satellite System(GLONASS), GNSS integrity and availability

UNIT-III: INERTIAL NAVIGATION

Inertial navigation system, Instruments, Platforms, Mechanization equations, Error analysis, Alignment, Fundamental limits

AIR-DATA SYSTEMS, ATTITUDE AND HEADING REFERENCES: Air-Data Systems: Air-data measurements, Air-data equations, Air-data systems, Specialty designs, Calibration and system test; Attitude and Heading References: Basic instruments, Vertical references, Heading references, Initial alignment of heading references

UNIT-IV:

DOPPLER AND ALTIMETER RADARS, LANDING SYSTEMS

Doppler Radars: Functions and applications, Doppler radar principles and design approaches, Signal characteristics, Doppler radar errors, Equipment configurations, Radar Altimeters: Functions and applications, General principles, Pulsed radar altimeters, FM-CW radar altimeter, Phase-coded pulsed radar altimeters; Landing Systems: Low-visibility operations, Mechanics of landing, Automatic landing systems, Instrument landing systems, Microwave-landing system, Satellite landing systems, Carrier landing systems,

UNIT-V: MULTISENSOR INTEGRATED NAVIGATION SYSTEMS

Inertial system characteristics, Integrated stellar-inertial systems, Integrated Doppler- inertial systems, Airspeed-damped inertial system, Integrated stellar-inertial-doppler system, Position update of an inertial system, Noninertial GPS multisensory navigation systems, Filtering of measurements, Kalman filter basics, Open-loop and closed loop Kalman filter mechanizations, GPS-INS mechanization, Practical considerations, Federated system architecture

AIR TRAFFIC MANAGEMENT Services provided to aircraft carriers, Government responsibilities, Flight rules and airspace organization, Airways and procedures, Phases of flight, Subsystems, Facilities and operations, System capacity, Airborne Collision Avoidance Systems

TEXT BOOKS

1. *Avionics Navigation Systems,* Second Edition, Myron Kayton and Walter R.Freid, John Wiley & Sons, Inc, 1997, ISBN 0-471-54795-6

2. *Civil Avionics Systems,* Moir, I and Seabridge, A, AIAA Education Series, AIAA, 2002, ISBN 1-56347589-8

MALLAREDDYCOLLEGE OFENGINEERING&TECHNOLOGY

I Year M. Tech, ASP-I SEM

L	T/P/D	C
3	-	3

(R18D7610) MODELING AND SIMULATION OF FLUID FLOWS

(ELECTIVE-II)

UNIT-I: BASIC EQUATIONS OF FLUID DYNAMICS AND DYNAMICAL LEVELS OF APPROXIMATION

General form of a conservation law, Mass conservation equation, Momentum conservation law or equation of motion, Energy conservation equation; Navier–Stokes equations, Approximations of turbulent flows, Thin shear layer approximation, Parabolized Navier–Stokes equations, Boundary layer approximation, Distributedlossmodel,Inviscidflowmodel:Eulerequations,Potentialflowmodel.

UNIT II: MATHEMATICAL NATURE OF THE FLOW EQUATIONS AND THEIR BOUNDARY CONDITIONS

Simplified models of a convection–diffusion equation, Definition of the mathematical properties of a system of PDEs, Hyperbolic and parabolic equations: characteristic surfaces and domain of dependence, Time-dependent and conservation form of the PDEs, Initial and boundary conditions

UNIT III: DISCRETIZATION TECHNIQUES

Finite Difference Method for Structured Grids: Basics of finite difference methods, Multidimensional finite difference formulas, Finite difference formulas on non-uniform grids, General method for finite difference formulae, Implicit finite difference formulae; Finite Volume Method: Conservative discretization, Basis of finite volume method, Practical implementation of finite volume method; Introduction to Finite Element Method: Finite element definition of interpolation functions, Finite element definition of the equation discretization: integral formulation, Method of weighted residuals or weak formulation, Galerkin method, Finite element Galerkin method for a conservation law; Structured and Unstructured Grid Properties: Structured grids, Unstructured grids, Surface and volume estimations, Grid quality and best practice guidelines

UNIT IV: ANALYSIS OF NUMERICAL SCHEMES

Consistency, stability and error analysis of numerical schemes: Basic concepts and definitions, Von Neumann method for stability analysis, New Leapfrog, Lax-Fredrichs and Lax-Wendroff schemes for the linear convection equation, Spectral analysis of numerical errors; General Properties and High Resolution Numerical Schemes: General formulation of numerical schemes, Generation of new schemes with prescribed order of accuracy, Monotonicity of numerical schemes, Finite volume formulation of schemes and limiters

TIME INTEGRATION METHODS FOR SPACE DISCRETIZED EQUATIONS

Analysis of space-discretized systems, Analysis of time integration schemes, Selection of time integration methods, Implicit schemes for multidimensional problems: Approximate factorization method

UNIT V: ITERATIVE METHODS FOR RESOLUTION OF ALGEBRAIC SYSTEMS

Basic iterative methods, Overrelaxation methods, Preconditioning techniques, Nonlinear problems, Multigrid method.

NUMERICAL SIMULATION OF INVISCID FLOWS

Euler equations, Potential flow model, Numerical solutions for the potential equation, Finite volume discretization of the Euler equations, Numerical solutions for the Euler equation

NUMERICAL SOLUTIONS OF VISCOUS LAMINAR FLOWS Navier-Stokes Equations for laminar flows, Density based methods for viscous flows, Numerical solutions with the density-based method, Pressure correction method, Numerical solutions with pressure correction method.

TEXT BOOK

1. Numerical Computation of Internal and External Flows, Second Edition, Charles Hirsch, Elsevier Publication, 2007

REFERENCE BOOKS

1. Computational Fluid Dynamics: The Basics with Applications, John David Anderson, McGraw Hill, 1995
2. Computational Fluid Mechanics and Heat Transfer, 2nd Edition, John C. Tannehill, Dale A. Anderson, Richard H. Pletcher, Taylor & Francis, 1997.

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(R18D7611)CONTINUUM MECHANICS

(ELECTIVE-II)

UNIT I:

INTRODUCTION, VECTORS AND TENSORS

Background and Overview, Vector Algebra - Definition of a Vector, Scalar and Vector Products, Plane Area as a Vector, Components of a Vector, Summation Convention, Transformation Law for Different Bases; Theory of Matrices - Definition, Matrix Addition and Multiplication of a Matrix by a Scalar, Matrix Transpose and Symmetric Matrix, Matrix Multiplication, Inverse and Determinant of a Matrix; Vector Calculus - Derivative of a Scalar Function of a Vector, The del Operator, Divergence and Curl of a Vector, Cylindrical and Spherical Coordinate Systems, Gradient, Divergence and Curl Theorems; Tensors- Dyads and Polyads, Nonion Form of a Dyadic, Transformation of Components of a Dyadic, Tensor Calculus, Eigenvalues and Eigenvectors of Tensors

UNIT II:

KINEMATICS OF CONTINUA

Introduction, Description of Motion- Configurations of a Continuous Medium, Material Description, Spatial Description, Displacement Field; Analysis of Deformation- Deformation gradient tensors, Isochoric, Homogeneous and Inhomogeneous Deformations, Change of volume and surface; Strain Measures- Cauchy-Green deformation tensors, Green Strain tensor, Physical Interpretation of the Strain Components, Cauchy and Euler Strain Tensors, Principal Strains; Infinitesimal Strain Tensor and Rotation Tensor- Infinitesimal Strain Tensor, Physical Interpretation of Infinitesimal Strain Tensor Components, Infinitesimal Rotation Tensor, Infinitesimal Strains in Cylindrical and Spherical Coordinate Systems; Rate of Deformation and Vorticity Tensors- Definitions, Relationship between D and E, .Polar Decomposition Theorem, Compatibility Equations, Change of Observer- Material Frame Indifference.

UNIT III:

STRESS MEASURES

Introduction, Cauchy Stress Tensor and Cauchy's Formula, Transformation of Stress Components and Principal Stresses- Transformation of Stress Components, Principal Stresses and Principal Planes, Maximum Shear Stress. Other Stress Measures - Preliminary Comments, First Piola- Kirchhoff Stress Tensor, Second Piola- Kirchhoff Stress Tensor, Equations of Equilibrium.

CONSERVATION OF MASS, MOMENTA AND ENERGY

Introduction, Conservation of Mass - Preliminary Discussion, Material Time Derivative, Continuity Equation in Spatial Description, Continuity Equation in Material Description ,Reynolds Transport Theorem. Conservation of Momenta - Principle of Conservation of Linear Momentum, Equation of Motion in Cylindrical and Spherical Coordinates, Principle of Conservation of Angular Momentum, Thermodynamic Principles - Introduction, The First Law of Thermodynamics: Energy Equation, Special Cases of Energy Equation, Energy Equation for One-Dimensional Flows , The Second Law of Thermodynamics.

Unit – IV

CONSTITUTIVE EQUATIONS

Introduction, Elastic Solids - Generalized Hooke's Law, Material Symmetry, Monoclinic Materials, Orthotropic Materials, Isotropic Materials, Transformation of Stress and Strain Components, Nonlinear

Elastic Constitutive Relations, Constitutive Equations for Fluids - Ideal Fluids, Viscous Incompressible Fluids, Non-Newtonian Fluids, Heat Transfer - General Introduction, Fourier's Heat Conduction Law, Newton's Law of Cooling, Stefan-Boltzmann Law, Electromagnetics - Maxwell's Equation, Constitutive Relations.

LINEARIZED ELASTICITY

Governing Equations, The Navier Equations, The Beltrami-Michell Equations, Types of Boundary Value Problems and Superposition Principle. Clapeyron's theorem and Reciprocity Relations - Clapeyron's theorem, Betti's Reciprocity Relations, Maxwell's Reciprocity Relation, Solution Methods, Types of Solution Methods, Example: Rotating Thick Walled Cylinder; Two-Dimensional Problems, Airy Stress Function, End Effects: Saint-Venant's Principle, Torsion of Noncircular Cylinders. Principle of Minimum Total Potential Energy - Total Potential Energy Principle, Derivation of Navier's Equations, Castiglian's Theorem I . Hamilton's Principle-Hamilton's Principle for a Rigid Body, Hamilton's Principle for a
Continuum

UNIT V:

FLUID MECHANICS AND HEAT TRANSFER

Governing Equations- Preliminary Comments, Summary of Equations, Viscous Incompressible Fluids, Heat Transfer; Fluid Mechanics Problems - Inviscid Fluid Statics, Parallel Flow (Navier-Stokes Equations), Problems with Negligible Convective Terms; Heat Transfer Problems- Heat Conduction in a Cooling Fin, Axisymmetric Heat Conduction in a Circular Cylinder, Two-Dimensional Heat Transfer, Coupled Fluid Flow and Heat Transfer

LINEAR VISCOELASTICITY

Preliminary Comments- Initial Value Problem, the Unit Impulse, and the Unit Step Function, The Laplace Transform Method, Spring and Dashpot Models - Creep Compliance and Relaxation Modulus, Maxwell Element , Kelvin-Voigt Element, Three-Element Models , Four-Element Models , Integral Constitutive Equations, Hereditary Integrals, Hereditary Integrals for Deviatoric Components, The Correspondence Principle, Elastic and Viscoelastic Analogies

TEXT BOOK

1. *An Introduction to Continuum Mechanics*, J.N. Reddy, Cambridge University Press, 2007

REFERENCE BOOKS

2. *Continuum Mechanics*, George. E. Mase, Schaum's Outline Series, McGraw-Hill Book Company, 1969
3. *Continuum Mechanics*, Ellis H. Dill, CRC Press, 2006
4. Continuum Mechanics for Engineers, Second Edition, George E. Mase, G.Thomas Mase CRC Press,1999
3. *Computational Continuum Mechanics*, Ahmed A. Shabana, Cambridge University Press, 2008
4. *Introduction to Computational Mechanics*, Fourth Edition, W. Michael Lai, David Rabin and Erhard krempl, .Elsevier Inc, 2010
5. *Introduction to the Mechanics of a Continuous Medium*, Lawrence E. Malvern, Prentice- Hall, 1969
6. *A First Course in Continuum Mechanics,* Y. C. Fung, Prentice Hall, 1994

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(R18D7612) ROTORCRAFT AERODYNAMICS

(ELECTIVE-II)

UNIT-I:

FUNDAMENTALS OF ROTOR AERODYNAMICS, BLADE ELEMENT ANALYSIS: Momentum theory analysis in hovering flight, Disk loading and power loading, Induced inflow ratio, Thrust and power coefficients, Comparison of theory with measured rotor performance, Non-ideal effects on rotor performance, Figure of merit, Induced tip loss, Rotor solidity and blade loading coefficients, Momentum analysis in axial climb and descent, Momentum analysis in forward flight, Blade Element Analysis in hover and axial flight, forward flight

UNIT-II:

ROTATING BLADE MOTION: Types of rotors, Equilibrium about the flapping hinge and lead-lag hinge, Equations of motion for a flapping blade, Blade feathering and the swashplate, Dynamics of a lagging blade with a hinge offset, Coupled flap-lag motion, Coupled pitch-flap motion, Other types of rotors, Introduction to rotor trim

HELICOPTER PERFORMANCE: Hovering and axial climb performance, Forward flight performance, Performance analysis, Autorotational performance, Vortex ring state(VRS), Ground effect, Performance in maneuvering flight, Factors influencing performance degradation

UNIT-III:

AERODYNAMIC DESIGN OF HELICOPTERS: Overall design requirements, Conceptual and preliminary design processes, Design of the main rotor, Fuselage aerodynamic design issues, Empennage design, Role of wind tunnels in aerodynamic design, Design of tail rotors, Other anti-torque devices, High speed rotorcraft, Smart rotor systems, Human-powered helicopter, Hovering micro air vehicles

AERODYNAMICS OF ROTOR AIRFOILS: Helicopter rotor airfoil requirements, Reynolds number and Mach number effects, Airfoil shape definition, Airfoil pressure distribution, Aerodynamics of a representative airfoil section, Pitching moment and related issues, Drag, Maximum lift and stall characteristics, Advanced rotor airfoil design, Representing static airfoil characteristics, Circulation controlled airfoils, Very low Reynolds number airfoil characteristics, Effects of damage on airfoilperformance

UNIT-IV:

UNSTEADY AIRFOIL BEHAVIOR: Sources of unsteady aerodynamic loading, Concepts of blade wake, Reduced frequency and reduced time, Unsteady attached flow, Principles of quasi-steady thin airfoil theory, Theodorsen's theory, Returning wake-Loewy's problem, Sinusoidal gust-Sear's problem, Indicial response-Wagner's problem, Sharp edged gust-Kussner's problem, Traveling sharp edged gust- Milne's problem, Time varying incident velocity, Indicial method for subsonic compressible flow, Non-uniform vertical velocity fields, Time-varying incident Mach number, Unsteady aerodynamics of flaps, Principles of noise produced by unsteady forces,

UNIT-V:

DYNAMIC STALL: Flow morphology of dynamic stall, Dynamic stall in the rotor environment, Effects of forcing conditions on dynamic stall, Modeling of dynamic stall, Torsional damping, Effects of sweep angle, airfoil shape on dynamic stall, Three dimensional effects on dynamic stall, Time-varying velocity effects on dynamic stall, Prediction of in-flight airfoils, Stall control

ROTOR WAKES AND BLADE TIP VORTICES, ROTOR-AIRFRAME INTERACTIONAL

AERODYNAMICS:

Characteristics of rotor wake in hover and forward flight, Vortex models of rotor wake, Aperiodic wake developments, General dynamic inflow models, Descending flight and vortex ring state, Wake developments in manoeuvring flight; Rotor-fuselage interactions, Rotor-empennage interactions, Rotortail rotor interactions

TEXT BOOK

1. Principles of Helicopter Aerodynamics, Second Edition, J. Gordon Leishman, Cambridge University Press, 2006, ISBN 0-521-85860-7

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(R18DME51) NON CONVENTIONAL ENERGY SOURCES
(OPEN ELECTIVE-I)

UNIT-I

Introduction: Energy Scenario, Survey of energy resources. Classification and need for conventional energy resources.

Solar Energy: The Sun-sun-Earth relationship, Basic matter to waste heat energy circuit, Solar Radiation, Attention, Radiation measuring instruments.

Solar Energy Applications: Solar water heating. Space heating, Active and passive heating, Energy storage, Selective surface, Solar stills and ponds, solar refrigeration, Photovoltaic generation.

UNIT -II

Geothermal Energy: Structure of earth, Geothermal Regions, Hot springs. Hot Rocks, Hot Aquifers. Analytical methods to estimate thermal potential. Harnessing techniques, Electricity generating systems.

UNIT-III

Direct Energy Conversion: Nuclear Fusion, Fusion reaction, P-P cycle, Carbon cycle, Deuterium cycle, Condition for controlled fusion, Fuel cells and photovoltaic, Thermionic and Thermoelectric generation and MHD generator.

Hydrogen Gas as Fuel: Production methods, Properties, I.C. Engines applications, Utilization strategy, Performances.

UNIT-IV

Bioenergy: Biomass energy sources. Plant productivity, Biomass wastes, aerobic and anaerobic bioconversion processes, Raw material and properties of bio-gas, Bio-gas plant technology and status, the energetic and economics of biomass systems, Biomass gasification

UNIT-V

Wind Energy: Wind, Beaufort number, Characteristics, Wind energy conversion systems, Types, Betz model. Interference factor. Power coefficient, Torque coefficient and Thrust coefficient, Lift machines and Drag machines. Matching Electricity generation.

Energy from Oceans: Tidal energy, Tides, Diurnal and semi-diurnal nature, Power from tides, Wave Energy, Waves, Theoretical energy available. Calculation of period and phase velocity of waves, Wave power systems, submerged devices. Ocean thermal Energy, Principles, Heat exchangers, Pumping requirements, Practical considerations.

TEXTBOOKS:

1. Non-conventional Energy Sources / GD Rai/Khanna publications.
2. Non-Conventional Energy Sources and Utilisation (Energy Engineering)/ R KRajput/S.Chand.
3. Renewable Energy Sources /Twidell & Weir/Taylor and Francis/ 2nd special Indian edition.

REFERENCE BOOKS:

1. Renewable Energy Resources- Basic Principles and Applications/ G.N.Tiwari and M.K.Ghosal Narosa Publications.
2. Renewable Energy Resources/ John Twidell & Tony Weir/Taylor & Francis/2^{n}edition.
3. Non Conventional Energy / K.Mittal/ Wheeler.

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(R18DME52) INDUSTRIAL SAFETY
(OPEN ELECTIVE –I)

Objectives:

- To explain the concept of various industrial safety methods.
- To outline division aspects measurements of safety performance .

UNIT-I :

Importance of Safety, health and environment. Health safety and environmental policy, fundamentals of safety, classification of accidents, Managements responsibility, objectives of safety management, National safety council, Employees state insurance act 1948, approaches to prevent accidents, principles of safety management, safety organization, safety auditing, maintenance of safety, measurements of safety performance, industrial noise and noise control, Industrial Psychology, Industrial accidents and prevention. Introduction to OSHAS 18001 AND OSHA.

UNIT II:

Process safety management (P.S.M) as per OSHA, legal aspects of safety, safety with respect to plant and machinery, the explosive act 1884, Petroleum act 1934, personal protective equipment, classification of hazards, protection of respiratory system, work permit system, hazards in refineries and process plants, safety in process plants, pollution in some typical process industry.

UNIT III:

Safe working practices, housekeeping, safe working environment, safety device and tools, precaution in use of ladders, safety instruction during crane operation, safety instruction for welding, burning and cutting and gas welding equipment, electrical safety, case studies, safety in use of electricity, electric shock phenomena, Occurrence of electric shock, medical analysis of electric shock and its effect, safety procedures in electric plants, installation of Earthing system,

UNIT IV:

Safety in hazardous area, hazard in industrial zones, classification of industrial Enclosures for gases and vapors. Mechanical, Chemical, Environmental and Radiation hazards, Machine guards and safety devices, slings, load limits, lifting tackles and lifting equipment, hydrostatic test, Chemical hazards, industrial toxicology, toxic chemicals and its harmful effects on humans, factors influencing the effect of toxic materials, Units of concentration, control measure, environmental hazards, devices for measuring radiation, safety analysis and risk analysis, risk management, First aid, Safety measures to avoid occupational diseases.

UNIT V

Factories act – 1948 Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures- Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules, mines act 1952, workman compensation act, rules – electricity act and rules

Text books:

1. Industrial safety management By: L.M. Deshmukh Publishers: Tata Megraw Hill ,New Delhi Year: 2006 Edition: First
2. The Factories Act 1948, Madras Book Agency, Chennai, 2000

References:

1. Industrial safety health and environment Management system By: R.K. Jain & Sunil S. Rao Publishers: Khanna Publishers Year: 2008 Edition: Second
2. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt.Ltd., Allahabad.
3. Accident prevention manual for industrial operations", N.S.C.,Chicago, 1982.
4. Industrial Safety and Environment by Amit Gupta
5. "Safety in Industry" N.V. Krishnan JaicoPublishery House, 1996.

Outcome of course:

- Educate students about how to reduce work place hazards and to encourage the standard of Safety, Health & Environment programme , so as to aim 0% accidents and 100% safety in different industries in which Industrial Safety plays an important role.
- This has the blending mixture of both Learning and Skills.

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(R18DME53) OPERATIONS RESEARCH
(OPEN ELECTIVE –I)

Objectives:

- To familiarize the students with the use of practice oriented mathematical applications for optimization functions in an organization.
- To familiarize the students with various tools of optimization, probability, statistics and simulation,
- To applicable in particular scenarios in industry for better management of various resources.

UNIT–I

Introduction: Development – Definition– Characteristics and Phases – Types of models – operation Research models– applications.

Allocation: Linear Programming Problem Formulation – Graphical solution – Simplex method –Artificial variables techniques -Two–phase method, Big-M method.

UNIT–II

Transportation Problem – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy.Assignment problem – Formulation – Optimal solution - Variants of Assignment Problem-Traveling Salesman problem.

Sequencing – Introduction – Flow **–**Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines.

UNIT–III

Replacement: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely, group replacement.

Theory of Games: Introduction – Minimax (maximin) – Criterion and optimal strategy – Solution of games with saddle points – Rectangular games without saddle points – 2 X 2 games – dominance principle – m X 2 & 2 X n games -graphical method.

UNIT–IV

Waiting Lines: Introduction – Single Channel – Poisson arrivals – exponential service times – with infinite population and finite population models– Multichannel – Poisson arrivals – exponential service times with infinite population single channel Poisson arrivals.

Inventory: Introduction – Single item – Deterministic models – Purchase inventory models with one price break and multiple price breaks – shortages are not allowed – Stochastic models – demand may be discrete variable or continuous variable – Instantaneous production. Instantaneous demand and continuous demand and no set up cost.

UNIT–V

Dynamic Programming: Introduction – Bellman's Principle of optimality – Applications of dynamic programming- capital budgeting problem – shortest path problem – linear programming problem.

Simulation: Definition – Types of simulation models – phases of simulation– applications of simulation – Inventory and Queuing problems – Advantages and Disadvantages – Simulation Languages.

TEXT BOOKS :

1. Operations Research / S.D.Sharma-Kedarnath
2. Introduction to O.R/Hiller &Libermann (TMH).
3. Introduction to O.R /Taha/PHI

REFERENCE BOOKS:

1. Operations Research /A.M.Natarajan, P.Balasubramani,A. Tamilarasi/Pearson . Education.
2. Operations Research / R.Pannerselvam, PHI Publications.
3. Operation Research /J. K.Sharma/MacMilan.

OUTCOMES:

- Student will be able to illustrate the need to optimally utilize the resources in various types of industries.
- Apply and analyze mathematical optimization functions to various applications.
- Demonstrate cost effective strategies in various applications in industry.

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(R18DHS51) BUSINESS ANALYTICS
(OPEN ELECTIVE –I)

Learning Objective: To understand the importance of ever-increasing volume, variety and velocity of data in organization and application of data analytical tools for decision making.
Learning Outcome: Students will be able to understand a) Importance of Analytics b) Understanding the analytical tools c) Application of Analytical tools to solve business problems.

Unit-I: Introduction to Business Analytics: Importance, Scope, Evolution, Classification, and Application; Data Structure-Visualization of Data, Data Architecture, Measurement Scale; Decision Models-Classification, Structure of Decision Models; Data Structure and Data View-Understanding of data, exploring data using pivot tables.

Unit-II: Descriptive Analytics: Descriptive Statistical Measures–Population and samples, Measures of location, Measures of Dispersion, Measures of variability, measures of Association. Probability distribution and Data Modeling – Discrete Probability distribution, Continuous Probability distribution, Random sampling from Probability Distribution, Data Modeling and Distribution fitting.

Unit-III: Predictive Analytics: Karl Pearson Correlation Techniques -Multiple Correlation-Spearman's Rank correlation-Simple and Multiple regression-Regression by the method of least squares –Building good regression models –Regression with categorical independent variables --Linear Discriminant Analysis-One way and Two Way ANOVA

Unit-IV: Data Mining: Scope of Data Mining, Data Exploration and Reduction, Unsupervised learning – cluster analysis, Association rules, Supervised learning-Partition Data, Classification Accuracy, prediction Accuracy, k-nearest neighbours, Classification and regression trees, Logistics Regression.

Unit-V: Simulation: Random Number Generation, Monte Carlo Simulation, What if Analysis, Verification and Validation, Advantages and Disadvantages of Simulation, Risk Analysis, Decision Tree Analysis.

References:

1. James Evans, Business Analytics, 2e, Pearson.
2. Camm, Cochran, Fry, Ohlmann, Anderson, Sweeney, Williams Essential of Business Analytics, Cengage Learning.
3. Thomas Eri, Wajid Khattack & Paul Buhler: Big Data Fundamentals, Concepts, drivers and Techniques by Prentice Hall of India, New Delhi.
4. Akil Maheswari: Big Data, Upskill ahead by Tata McGraw Hill, New Delhi.
5. Seema Acharya & Subhashini Chellappan: Big Data and Analytics, Wiley Publications, New Delhi.
6. S. Christian Albright, Wayne L. Winston: Business Analytics: Data Analysis & Decision Making, Cengage Learning

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(R18DCS51) SCRIPTING LANGUAGES (OPEN ELECTIVE – I)

Objectives: The course demonstrates an in depth understanding of the tools and the scripting languages necessary for design and development of applications dealing with Bio-information/ Bio-data. The instructor is advised to discuss examples in the context of Bio-data/ Bio-information application development.

UNIT I

Introduction to PERL and Scripting Scripts and Programs, Origin of Scripting , Scripting Today, Characteristics of Scripting Languages, Web Scripting, and the universe of Scripting Languages. PERL-Names and Values, Variables, Scalar Expressions, Control Structures, arrays, list, hashes, strings, pattern and regular expressions, subroutines, advance perl - finer points of looping, pack and unpack, filesystem, eval, data structures, packages, modules, objects, interfacing to the operating system, Creating Internet ware applications, Dirty Hands Internet Programming, security Issues.

UNIT II

PHP Basics- Features, Embedding PHP Code in your Web pages, Outputting the data to the browser, Datatypes, Variables, Constants, expressions, string interpolation, control structures, Function, Creating a Function, Function Libraries, Arrays, strings and Regular Expressions.

UNIT III

Advanced PHP Programming Php and Web Forms, Files, PHP Authentication and Methodologies -Hard Coded, File Based, Database Based, IP Based, Login Administration, Uploading Files with PHP, Sending Email using PHP, PHP Encryption Functions, the Mcrypt package, Building Web sites for the World – Translating Websites- Updating Web sites Scripts, Creating the Localization Repository, Translating Files, text, Generate Binary Files, Set the desired language within your scripts, Localizing Dates, Numbers and Times.

UNIT IV

TCL Structure, syntax, Variables and Data in TCL, Control Flow, Data Structures, input/output, procedures, strings, patterns, files, Advance TCL- eval, source, exec and up level commands, Name spaces, trapping errors, event driven programs, making applications internet aware, Nuts and Bolts Internet Programming, Security Issues, C Interface. Tk- Visual Tool Kits, Fundamental Concepts of Tk, Tk by example, Events and Binding , Perl-Tk.

UNIT V

Python Introduction to Python language, python-syntax, statements, functions, Built-in-functions and Methods, Modules in python, Exception Handling, Integrated Web Applications in Python – Building Small, Efficient Python Web Systems, Web Application Framework.

TEXT BOOKS:

1. The World of Scripting Languages, David Barron, Wiley Publications.
2. Python Web Programming, Steve Holden and David Beazley, New Riders Publications.
3. Beginning PHP and MySQL, 3rd Edition, Jason Gilmore, Apress Publications (Dreamtech)

REFERENCE BOOKS:

1. Open Source Web Development with LAMP using Linux, Apache, MySQL, Perl and PHP, J.Lee and B.Ware (Addison Wesley) Pearson Education.
2. Programming Python, M.Lutz, SPD.
3. PHP 6 Fast and Easy Web Development, Julie Meloni and Matt Telles, Cengage Learning Publications.
4. PHP 5.1,I.Bayross and S.Shah, The X Team, SPD.
5. Core Python Programming, Chun, Pearson Education.
6. Guide to Programming with Python, M.Dawson, Cengage Learning.
7. Perl by Example, E.Quigley, Pearson Education.
8. Programming Perl, Larry Wall, T.Christiansen and J.Orwant, O'Reilly, SPD.
9. Tcl and the Tk Tool kit, Ousterhout, Pearson Education.
10. PHP and MySQL by Example, E.Quigley, Prentice Hall(Pearson).
11. Perl Power, J.P.Flynt, Cengage Learning.
12. PHP Programming solutions, V.Vaswani, TMH.

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(R18DAE51) MATHEMATICAL MODELING TECHNIQUES
(OPEN ELECTIVE-I)

UNIT-I: INTRODUCTION TO MODELING AND SINGULAR PERTURBATION METHODS

Definition of a model, Procedure of modeling: problem identification, model formulation, reduction, analysis, Computation, model validation, Choosing the model, Singular Perturbations: Elementary boundary layer theory, Matched asymptotic expansions, Inner layers, nonlinear oscillations

UNIT-II: VARIATIONAL PRINCIPLES AND RANDOM SYSTEMS

Variational calculus: Euler's equation, Integrals and missing variables, Constraints and Lagrange multipliers, Variational problems: Optics-Fermat's principle, Analytical mechanics: Hamilton's principle, Symmetry: Noether's theorem, Rigid body motion, Random systems: Random variables, Stochastic processes, Monte Carlo method

UNIT-III: FINITE DIFFERENCES: ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

ODE: Numerical approximations, Runge-Kutta methods, Beyond Runge-Kutta, PDE: Hyperbolic equations-waves, Parabolic equations-diffusion, Elliptic equations-boundary values

CELLULAR AUTOMATA AND LATTICE GASES

Lattice gases and fluids, Cellular automata and computing

UNIT- IV: FUNCTION FITTING AND TRANSFORMS

Function fitting: Model estimation, Least squares, Linear least squares: Singular value decomposition, Non-linear least squares: Levenberg-Marquardt method, Estimation, Fisher information, and Cramer- Rao inequality, Transforms: Orthogonal transforms, Fourier transforms, Wavelets, Principal components

FUNCTION FITTING ARCHITECTURES

Polynomials: Pade approximants, Splines, Orthogonal functions, Radial basis functions, Over-fitting, Neural networks: Back propagation, Regularization

UNIT-V: OPTIMIZATION AND SEARCH

Multidimensional search, Local minima, Simulated annealing, Genetic algorithms

FILTERING AND STATE ESTIMATION

Matched filters, Wiener filters, Kalman filters, Non-linearity and entrainment, Hidden Markov models

TEXT BOOK

1. The Nature of Mathematical Modeling, Neil Gershenfeld, Cambridge University Press, 2006, ISBN 0-521-57095-6

REFERENCE BOOKS

1. Mathematical Models in the Applied Sciences, A. C. Fowler, Cambridge University Press, 1997, ISBN 0-521-46140-5
2. A First Course in Mathematical Modeling, F. R. Giordano, M.D. Weir and W.P. Fox, 2003, Thomson, Brooks/Cole Publishers
3. Applied Numerical Modeling for Engineers, Donald De Cogan, Anne De Cogan, Oxford University Press, 1997

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(R18DEC51) EMBEDDED SYSTEMS PROGRAMMING (OPEN ELECTIVE –I)

UNIT I - EMBEDDED OS (LINUX) INTERNALS

Linux internals: Process Management, File Management, Memory Management, I/O Management. Overview of POSIX APIs, Threads – Creation, Cancellation, POSIX Threads Inter Process Communication - Semaphore, Pipes, FIFO, Shared Memory

Kernel: Structure, Kernel Module Programming Schedulers and types of scheduling.

Interfacing: Serial, Parallel Interrupt Handling Linux Device Drivers: Character, USB, Block & Network

UNIT II- OPEN SOURCE RTOS

Basics of RTOS: Real-time concepts, Hard Real time and Soft Real-time, Differences between General Purpose OS & RTOS, Basic architecture of an RTOS, Scheduling Systems, Inter-process communication, Performance Matric in scheduling models, Interrupt management in RTOS environment, Memory management, File systems, I/O Systems, Advantage and disadvantage of RTOS.

UNIT III – OPEN SOURCE RTOS ISSUES

POSIX standards, RTOS Issues - Selecting a Real Time Operating System, RTOS comparative study. Converting a normal Linux kernel to real time kernel, Xenomai basics.

Overview of Open source RTOS for Embedded systems (Free RTOS/ Chibios-RT) and application development.

UNIT IV – VXWORKS / FREE RTOS

VxWorks/ Free RTOS Scheduling and Task Management - Real-time scheduling, Task Creation, Intertask Communication, Pipes, Semaphore, Message Queue, Signals, Sockets, Interrupts I/O Systems - General Architecture, Device Driver Studies, Driver Module explanation, Implementation of Device Driver for a peripheral

UNIT V – CASE STUDY

Cross compilers, debugging Techniques, Creation of binaries & porting stages for Embedded Development board (Beagle Bone Black, Rpi or similar), Porting an Embedded OS/ RTOS to a target board ().Testing a real time application on the board

TEXT BOOKS:

1. Essential Linux Device Drivers, Venkateswaran Sreekrishnan
2. Writing Linux Device Drivers: A Guide with Exercises, J. Cooperstein
3. Real Time Concepts for Embedded Systems – Qing Li, Elsevier

REFERENCES:

1. Embedded Systems Architecture Programming and Design: Raj Kamal, Tata McGraw Hill
2. Embedded/Real Time Systems Concepts, Design and Programming Black Book, Prasad, KVK

3. Software Design for Real-Time Systems: Cooling, J E Proceedings of 17the IEEE Real-Time Systems Symposium December 4-6, 1996 Washington, DC: IEEE Computer Society
4. Real-time Systems – Jane Liu, PH 2000
5. Real-Time Systems Design and Analysis : An Engineer's Handbook: Laplante, Phillip A
6. Structured Development for Real - Time Systems V1 : Introduction and Tools: Ward, Paul T & Mellor, Stephen J
7. Structured Development for Real - Time Systems V2 : Essential Modeling Techniques: Ward, Paul T & Mellor, Stephen J
8. Structured Development for Real - Time Systems V3 : Implementation Modeling Techniques: Ward, Paul T & Mellor, Stephen J
9. Monitoring and Debugging of Distributed Real-Time Systems: TSAI, Jeffrey J P & Yang, J H
10. Embedded Software Primer: Simon, David E.
11. Embedded Systems Architecture Programming and Design: Raj Kamal, Tata McGraw Hill

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(R18D7681) DIGITAL SIMULATION LAB – I

I. MATLAB / SIMULINK FUNDAMENTALS FOR AEROSPACE APPLICATIONS

MATLAB introduction, Plotting and graphics: Plot, log and semi-log plots, polar plots,Subplots, axis, mesh, contour diagrams, flow diagrams, movies, MATLAB Toolboxes: Continuous transfer functions, root locus, Nichols chart, Nyquist chart, linear quadratic regulator, state-space design, digital design, Aerospace toolbox; M Cells, Structures and M-files, MEX-files,

Standard Simulink libraries, Simulink aerospace blockset, Building Simulink linear models: transfer function modeling in Simulink, zero pole model, state-space model; Simulink LTI viewer and usage of it, equivalent Simulink LTI models, Single-Input, Single-Output (SISO) design tool, Building Multi-Input, Multi –Output models, Building Simulink S-functions; Stateflow introduction: Opening, executing, and saving stateflow models, constructing a simple stateflow model, using a stateflow truth table

II. SOFTWARE DEVELOPMENT FOR SIMULATION OF FLUID FLOWS

- Generation of structured and unstructured grids in two and three dimensions
- Solution of Burgers equation using explicit MacCormack method
- Blasius solution for laminar boundary layer over a flat

III. FLOW SIMULATION

Simulation of Flow past airfoils and wings
Simulation of Compressible flow in convergent-divergent nozzle Simulation of compressible flow in a compressor

REFERENCES

1. Basic MATLAB, Simulink, and State Flow, Richard Colgren, AIAA Education Series, 2007
2. Introduction to Simulink with Engineering Applications, Steven T. Karris, Orchard Publications, 2006, ISBN –9744239-8-X
3. Computational Fluid Mechanics and Heat Transfer, Second Edition, John C. Tannehill, Dale A. Anderson, Richard H. Pletcher, Taylor & Francis Publication, 1997.
4. Computational Fluid Dynamics, T. J. Chung, Cambridge University Press, 2002

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(R18DHS54)VALUE EDUCATION
(Audit Course I)

UNIT I:

Values and self-development

Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation. Standards and principles, Value judgements

UNIT II:

Importance of cultivation of values

Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity. Power of faith, National Unity, Patriotism, Love for nature, Discipline

UNIT III:

Personality and Behavior Development

Soul and Scientific attitude, Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness ,Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship, Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature

UNIT IV:

Character and Competence

Holy books vs Blind faith, Self-management and Good health, Science of reincarnation, Equality, Nonviolence ,Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively

TEXT BOOKS:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

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(R18D7604) AIRCRAFT CONTROL AND SIMULATION

UNIT-I: THE KINEMATICS AND DYNAMICS OF AIRCRAFT MOTION

Vector Kinematics, Matrix Analysis of Kinematics, Geodesy, Earth's Gravitation, Terrestrial Navigation, Rigid-Body Dynamics.

UNIT-II: MODELING THE AIRCRAFT

Basic Aerodynamics, Aircraft Forces and Moments, Static Analysis, The Nonlinear Aircraft Model, Linear Models and the Stability Derivatives.

MODELING, DESIGN AND SIMULATION TOOLS

State Space Models, Transfer Function Models, Numerical Solution of the State Equations, Aircraft Models for Simulation, Steady State Flight, Numerical Linearization, Feedback control, Aircraft dynamic behavior.

UNIT-III: AIRCRAFT DYNAMICS AND CLASSICAL CONTROL DESIGN

Aircraft Rigid Body Modes, The Handling Qualities Requirements, Stability Augmentation Systems, control augmentation system, auto pilots and Nonlinear Simulation.

UNIT-IV: MODERN DESIGN TECHNIQUES

Assignment of Closed-Loop Dynamics, Linear Quadratic Regulator with Output Feedback, Tracking a Command, Modifying the Performance Index, Model Following Design, Linear Quadratic Design with Full State Feedback, Dynamic Inversion Design.

UNIT-V: ROBUSTNESS AND MULTIVARIABLE FREQUENCY DOMAIN TECHNIQUES

Multivariable Frequency Domain Analysis, Robust Output Feedback Design, Observers and the Kalman Filter.

DIGITAL CONTROL

Simulation of Digital Controllers, Discretization of Continuous Controllers, Modified Continuous Design, Implementation Considerations.

TEXT BOOK

1. Aircraft Control and Simulation, Brian L. Stevens and Frank L. Lewis, John Wiley & Sons, 2003

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(R18D7605) AEROSPACE SENSORS AND MEASUREMENT SYSTEMS

UNIT-I: **INTRODUCTION TO EXPERIMENTAL METHODS**

Characteristics of Measuring systems:: Readability, Sensitivity, Hysteresis, Accuracy, Precision: Calibration, Standards, Experiment planning, Causes and types of experimental errors, Statistical analysis of experimental data

UNIT II: **FLOW MEASUREMENTS**

Pressure Measurement: Manometer, Pressure transducers, Scanning valves; Temperature Measurement: Thermometers, Thermocouples, Thermopiles, Keil probes; Velocity Measurement: Pitot probes, Hot wires, 7 hole probes, Laser Doppler Velocimetry (LDV), Particle Image Velocimetry (PIV), Doppler Global Velocimetry(DGV) ; Turbulence Measurements: LDV, Hot wire anemometers, Root Mean Square(RMS), Spectrum;

FLOW VISUALIZATION

Path-, Streak-, Stream-, and Time lines, Direct visualization, Surface flow visualization, Flow field visualization, Data driven visualization

UNIT-III: **FORCES AND MOMENTS FROM WIND TUNNEL BALANCE MEASUREMENTS:** Types of wind tunnels, Aeronautical wind tunnels, Wind tunnel data systems, Balances, Balance requirements and specifications, External balances and internal balances

STRESS AND STRAIN MEASUREMENTS

Stress and strain, Strain measurements, Strain gauge types, Basic characteristics of a strain gauge, Electrical resistance strain gauges, Rosette analysis, Strain gauge sensitivity, Stress gauges

UNIT IV: **MOTION AND VIBRATION MEASUREMENT**

Two simple vibration instruments, Principles of seismic instrument, Practical considerations for seismic instruments, Sound measurements

MOTION AND INERTIAL MEASUREMENTS

Applications of accelerometer sensors, Acceleration sensing principles, Pendulous accelerometer (open and closed loop), Micro-machined accelerometer, Piezoelectric accelerometer, Rate gyroscope principles, Rate-integrating gyroscope principles, Micro-gyro sensors, Laser gyros

UNIT-V: **SPACECRAFT ATTITUDE DETERMINATION SENSORS**

Infrared earth sensors-Horizon Crossing Sensors, Sun sensors, Star sensors, Rate and rate integrating gyros, Magnetometers

TEXT BOOKS

1. *Experimental Methods for Engineers,* Seventh Edition, J. P. Holman, Tata McGraw Hill, 2004
2. *Measurement Systems-Application and Design,*5th Edition, Ernest O Doebelin, Dhanesh N Manik, Tata McGraw Hill, 2007
3. *Low-Speed Wind Tunnel Testing,* Jewel B Barlow, William H. Rae,Jr. , Alan Pope, John Wiley, Third Edition, 1999
4. *Spacecraft Dynamics and Control-A Practical Engineering Approach,* Marcel J. Sidi, Cambridge University Press, 1997

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(R18D7606) COMPUTATIONAL APPROACHES TO AEROSPACE VEHICLE DESIGN

UNIT-I: PRINCIPLES OF AEROSPACE DESIGN

Historical perspective on aerospace design,Traditional manual approaches to design and design iteration, Design teams, Advances in modeling techniques:, Tradeoffs in aerospace system design, Design automation, evolution and innovation, Design search and optimization,Take-up of computational methods, Design oriented Analysis: Geometry modeling and design parameterization, Computational mesh generalization, Analysis and design of coupled systems

UNIT-II: ELEMENTS OF NUMERICAL OPTIMIZATION-I

Single variable optimizers- line search, Multi variable optimizers: Population versus single point methods, Gradient based methods, Noisy/Approximate function values, Non-gradient based algorithms, Termination and convergence aspects, Constrained optimization, Problem transformations, Lagrange multipliers, Feasible directions method, Penalty function methods, Combined Lagrangian and penalty function methods, Sequential quadratic programming, Chromosome repair

UNIT-III: ELEMENTS OF NUMERICAL OPTIMIZATION-II

Meta models and Response surface methods: Global versus local meta models, Meta modeling tools, Simple RSM examples, Combined approaches-Hybrid searches and meta heuristics, Multi-objective optimization, Multi-objective weight assignment techniques, Methods for combining goal functions, fuzzy logic and physical programming, Pareto set algorithms

Sensitivity Analysis: Finite-difference methods, Complex variable approach, Direct methods, Adjoint mehods, Semi-analytical methods, Automatic differentiation

UNIT-IV: APPROXIMATION CONCEPTS

Local approximations, Multipoint approximations, Black-box modeling, Generalized linear models, Sparse approximations techniques, Gaussian process interpolation and regression, Data parallel modeling, Design of experiments, Surrogate modeling using variable fidelity models, Reduced basis methods

DESIGN SPACE EXPLORATION-SURROGATE MODELS

Managing surrogate models in optimization: Trust regions, Space mapping approach, Surrogate assisted optimization using global models, Managing surrogate models in evolutionary algorithms

UNIT-V: DESIGN IN THE PRESNCE OF UNCERTAINTY

Uncertainty modeling and representation, Uncertainty propagation, Taguchi methods, Welch-Sacks method, Design for six sigma, decision theoretic formulations, Reliability-based optimization, Robust design using information-gap theory, Evolutionary algorithms for robust design

MULTI-DISCIPLINARY OPTIMIZATION

Multi-disciplinary analysis, Fully integrated optimization, System decomposition and optimization, Simultaneous analysis and design, Distributed analysis optimization formulation, Collaborative optimization, Concurrent subspace optimization, Co-evolutionary architectures

TEXT BOOK

1. *Computational Approaches for Aerospace Design-The Pursuit of Excellence*, Andy J. Keane, Prasanth B. Nair, John Wiley & Sons, 2005, ISBN 10:0-470-85540-1

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(R18D7613) HIGH ANGLE OF ATTACK AERODYNAMICS

(ELECTIVE-III)

UNIT-I:

Description Of Flows At High Angles Of Attack: Introduction, Finite lifting wing of medium and high aspect ratio at low subsonic speeds, Low aspect ratio rectangular wing at low subsonic speeds, Slender delta type wings, Flow over elongated slender bodies, Aircraft type configurations, Vortex breakdown, Non-steady aerodynamics at high angles of attack on slender configurations, Effect of separation at **high angles of attack in hypersonic flows**

UNIT-II:

Topology Of Separating And Reattaching Vortical Flows: Equations for vortical flows, Topological concepts for the analysis of vortical flows,

Linear Aerodynamics Of Wings And Bodies: Equations for potential subsonic flows, Equations for the lifting wing at low speeds, Linear panel methods for the calculation of the subsonic aerodynamic coefficients for wings and bodies, Low and higher order linear panel methods for subsonic and supersonic flows, Comparison of various panel methods

UNIT-III:

Vortex Flows And The Rolled Up Vortex Wake: Vortex core of the rolled up wake, Rolled up tip vortices, Rolling up of vortex wake behind wings, Bursting of rolled up vortices

Nonlinear Aerodynamics Of Wings And Bodies At High Angles Of Attack: Analytical and semi empirical methods for calculations of the non-linear aerodynamic characteristics

UNIT-IV:

Nonlinear Panel Methods For Aircraft And Missile Configurations at High Angles Of Attack: Nonlinear Vortex Lattice Method (NVLM) for subsonic flows, Free vortex sheet method for subsonic flows, NVLM for supersonic flows

Solutions Of Euler Equations For Flows Over Configurations At High Angles Of Attack: Euler equations, Numerical methods of solution of the Euler equations: Grid generation methods, Finite volume methods, Finite difference methods, finite element methods, multigrid calculations with Cartesian gridsand local refinements, Euler computations on three-dimensional configurations at high angles of attack

UNIT-V:

Solutions Of Navier-Stokes Equations For Flows Over Configurations At High Angkes Of Attack: Formulation of the Navier-Stokes equations, Numerical methods for solutions of Navier-Stokes equations, Method of solution of the thin layer equations, Grid topology, boundary and initial conditions, Solutions of Navier-Stokes equations for flows in three-dimensional configurations at high angles of attack

TEXT BOOK

1. *High Angle of Attack Aerodynamics-Subsonic, Transonic, and Super sonic Flows*, Josef Rom, Springer-Verlag, 1992

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(R18D7614) ADVANCED TOPICS IN AIR TRAFFIC MANAGEMENT SYSTEMS

(ELECTIVE-III)

UNIT- I: AIR TRAFFIC MANAGEMENT

Introduction: Air traffic services provided to aircraft operators, Government responsibilities, Flight rules and airspace organization, Airways and procedures, Phases of flight, Subsystems of ATM system, Facilities and operation, System capacity, Airborne collision avoidance systems, Future trends, Capacity driven operational concept of ATM.

UNIT-II: ECONOMICS OF CONGESTION

Impact of ATM on airspace user economic performance, Effects of schedule disruptions on the economics of airline operations, modeling of an airline operations control center.

COLLABORATIVE DECISION MAKING

Effect of shared information on pilot controller and controller- controller interactions, Modeling of distributed human decision making in traffic flow management operations.

UNIT-III: AIRPORT OPERATIONS AND CONSTRAINTS

Analysis, modeling and control of ground operations at airports, Collaborative optimization of arrival and departure traffic flow management strategies at airports.

AIRSPACE OPERATIONS AND CONSTRAINTS

Performance measures of air traffic services,Identification of airport and airspace capacity constraints.

UNIT-IV: SAFETY AND FREE FLIGHT

Accident risk assessment for advanced air traffic management, Airborne separation assurance systems. Human factors

COGNITIVE WORKLOAD ANALYSIS AND ROLE OF AIR TRAFFIC CONTROLLER: Task load measures of air traffic controllers, Technology enabled shift in controller roles and responsibilities.

UNIT-V: AIRCRAFT SELF SEPARATION

Cooperative optimal airborne separation assurance in free flight airspace, Automatic dependent surveillance broadcast system - operational evaluation.

TEXT BOOKS

1. Fundamentals of Air Traffic Control, Fourth edition, Nolan, M.S., Thomson Learning, 2004, ISBN- 13:978-0-534-39388-5.
2. Air Transportation Systems Engineering, Donohue, G. L. et al., (Editors), AIAA, 20003, ISBN 1-56347-474-3
3. Avionics Navigation Systems, Keyton, M. and Fried, W. R., John Wiley, 2001, ISBN0-471-54795-6

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(R18D7615) FLIGHT DYNAMICS AND CONTROL (ELECTIVE-III)

UNIT-I: INTRODUCTION

Basic principles of flight; Flying control surfaces: Elevator, ailerons and rudder; Pilot‟s controls: The throttle, the control column, modes of flight; Basic principles governing aerodynamic flows: Introduction, continuity principle, Bernoulli‟s principle, laminar flows and boundary layers, turbulent flows, aerodynamics of airfoils and wings, slender body aerodynamics, wing-body interference, empennage aerodynamics, aerodynamics of complete aircraft, aerodynamic forces and moments

UNIT-II: MECHANICS OF EQUILIBRIUM FLIGHT

Introduction, speeds of equilibrium flight, basic aircraft performance, conditions for minimum drag, range and endurance estimation, trim, stability of equilibrium flight, longitudinal static stability, maneuverability, lateral stability and stability criteria, experimental determination of aircraft stability margins; Aircraft non- linear dynamics; Equations of motion, introduction, aircraft dynamics, aircraft motion in a two dimensional plane, moments of inertia, Euler‟s equations and the dynamics of rigid bodies, aircraft equations of motion, motion-induced aerodynamic forces and moments, non-linear dynamics of aircraft motion, trimmed equations of motion

UNIT-III: SMALL PERTURBATIONS AND THE LINEARISED, DECOUPLED EQUATIONSOF MOTION

Small perturbations and linearization; Linearizing the aerodynamic forces and moments: Stability derivative concept, direct formulation in the stability axis, decoupled equations of motion, decoupled equations of motion in terms of the stability axis aerodynamic derivatives, decoupled equations of motion in terms of the stability axis aerodynamic derivatives.

Non-dimensional longitudinal and lateral dynamics; Simplified state-space equations of longitudinal and lateral dynamics, simplified concise equations of longitudinal and lateral dynamics.

UNIT-IV: LONGITUDINAL AND LATERAL LINEAR STABILITY AND CONTROL

Dynamic and static stability, modal description of aircraft dynamics and the stability, aircraft lift and drag estimation, estimating the longitudinal aerodynamic derivatives, estimating the lateral aerodynamic derivatives, aircraft dynamic response, numerical simulation and non-linear phenomenon longitudinal and lateral modal equations, methods of computing aircraft dynamic response, system block diagram representation, atmospheric disturbance, deterministic disturbances, principles of random atmospheric disturbance modeling, application to atmospheric turbulence modeling, aircraft non-linear dynamic response phenomenon.

UNIT-V: AIRCRAFT FLIGHT CONTROL

Automatic flight control systems: An introduction, functions of a flight control system, integrated flight control system, flight control system design.

TEXT BOOK

1. Vepa, R., “Flight Dynamics, Simulation and Control: For Rigid and Flexible Aircraft”, CRC Press, Taylor and Francis Group, 2015.

REFERENCES

1. Wayne Durham, “Aircraft Flight Dynamics and Control”, CRC Press, 2nd Edition 2013.
2. Robert F. Stengel “Flight Dynamics”. CRC Press, 2nd Edition 2013

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(R18D7616) TACTICAL MISSILE DESIGN
(ELECTIVE-IV)

UNIT-I:

Introduction / Key Drivers In Design Process: Tactical Missile characteristics, Conceptual design process, Examples of State-of-the-Art missiles, Aerodynamic configuration sizing parameters, Examples of alternatives in establishing mission requirements, Baseline missile

UNIT-II:

Aerodynamic Considerations In Tactical Missile Design: Missile diameter tradeoff, Nose fineness tradeoff, Boat-tail, Lifting body versus axi-symmetric body, Wings versus no wings, Normal force prediction for surfaces, Wing aerodynamic center prediction, Wing drag prediction, Surface planform geometry tradeoffs, Flight control alternatives, Maneuver alternatives, Roll orientation, Static stability, Tail area sizing, Stability and control conceptual design criteria, Body buildup

Propulsion Considerations In Tactical Nissile Design: Propulsion alternatives assessment, Ideal ramjet Mach number and temperature technology limit, Ramjet specific impulse prediction, Ramjet thrust prediction, Ramjet engine/booster integration, Ramjet inlet options, Ramjet inlet spillage, Inlet shock loss, Ramjet missile drag due to booster integration, Fuel alternatives, Rocket motor performance, Solid motor grain alternatives, Solid rocket thrust control, Solid propellant material alternatives, Motor case alternatives, Rocket nozzle material alternatives

UNIT-III:

Weight Considerations In Tactical Missile Design: Benefits of lighter weight missile, Subsystem weight sensitivity to flight performance, Missile weight prediction, Centre-of-gravity and moment-of-inertia prediction, Factor of safety, Micro Machined Electro-Mechanical Systems(MEMS), Manufacturing processes, Airframe material alternative, Aerodynamic heating prediction, Insulation trades, Insulation material alternatives, Structure design, Seeker dome materials, Thermal stress, Localized aerodynamic heating

Flight Performance Considerations In Tactical Missile Design: Flight performance envelope, Equations of motion modeling, Driving parameters for flight performance, Cruise flight performance, Steady state flight, Flight trajectory shaping, Turn radius, Coast flight performance, Boost flight performance, Intercept lead angle and velocity, Comparison with performance requirements

UNIT-IV:

Measures Of Merit And Launch Platform Integration: Robustness, Warhead lethality, Miss distance, Carriage and launch observables, Other survivability considerations, Reliability, Cost, Launch platform integration

Sizing Examples: Air-to-Air range requirements, Wing sizing for maneuverability, Weight and miss distance harmonization, Ramjet missile range robustness, Ramjet propulsion/fuel alternatives, Ramjet missile surface impact velocity, Computer-Aided sizing for conceptual design, Verification process

UNIT-V:

Development Process, Summary And Lessons Learned: Development Process:Technology Assessment/Roadmap, Phases of Development/Design maturity, Tactical-missile follow-on programs, Subsystem integration, Examples of technology development, Examples of State-of-the-Art advancement, New technologies for tactical missiles; Summary and Lessons Learned: Iterate-the-System-of-Systems Analysis, Exploit diverse skills, Apply creative skills, Identify high-payoff measures of merit, Start with a good baseline design, Conduct balanced tradeoffs, Evaluate a broad range of alternatives, Refine the design, Evaluate technology risk, Maintain real-time documentation, Develop good documentation, Utilize group skills, Balance the tradeoff of importance versus priority, Iterate the configuration design, Configuration sizing conceptual design criteria

TEXT BOOKS

1. Tactical Missile Design, Eugene L. Freeman, First Edition, AIAA Education Series, 2001

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(R18D7617) SPACE TRANSPORTATION SYSTEMS

(ELECTIVE-IV)

UNIT-I: **INDIAN SPACE TRANSPORTATION SYSTEM DEVELOPMENT**

Introduction, Systems engineering definition, System engineer, Systems engineering cycle, Systems engineering process, Doctrine of successive refinement, Tools and methodologies, Systems analysis, Modeling, and the trade study process, Basic launch vehicle system trade analysis methodology, System effective studies.

Evolution of ISRO, organization and structure of ISRO, Goals, objectives, evolution of Indian carrier rockets-PSLV, GSLV, Chandrayan, Mangalyan

UNIT II: **TRANSPORTATION SYSTEM ARCHITECTURE, INFRASTRUCTURES AND U.S. SPACE SHUTTLE**

Introduction, Historical drivers for space infrastructure, Political considerations, National mission model, Private sector and commercialization, Development of commercial space transportation architecture and system concepts, Cost drivers for space transportation architecture options, Recommended improvements to space transportation architectures, Planning for future space infrastructure, Transportation Infrastructure for moon and mars missions U.S. Space Shuttle: Introduction, Historical background, Development of shuttle system, Orbiter development, Current shuttle vehicle and operations, Shuttle evolution and future growth,

UNIT-III: **EXPENDABLE SPACE TRANSPORTATION SYSTEMS AND REUSABLE SPACE LAUNCH VEHICLES**

Introduction, Expendable launch vehicle design, History behind existing Expendable Launch Vehicles, Evolving the expendable launch vehicle, Reusable space launch vehicles: Background—Previous efforts at hypersonic flight, Early aerospace plane conceptual studies, The X-series of research aircraft, Challenges facing manned aerospace planes, Manned reusable systems development programs-Past and Ongoing., NASA reusable launch vehicle studies in 1990s., Hypersonic waveriders, Importance of vehicle health management, Future reusable space launch vehicles

OPERATIONS AND SUPPORT SYSTEMS

Introduction, Launch operations definition, Shuttle mission operations, Facility requirements for launch operations, Obstacles to streamlining launch operations, Evolutionary launch operations strategies, Designing for future expendable launch vehicle launch operations, Improving Existing Launch Operations, Future launch operations

UNIT IV: SYSTEMS AND MULTIDISCIPLINARY DESIGN OPTIMIZATION

Introduction, Launch vehicle conceptual design problem, Modeling needs, Optimization strategies and applications, Collaborative work environment of the future

SYSTEMS TECHNOLOGY DEVELOPMENT

Introduction, Vehicle technologies, Propulsion technologies, Ground and mission operations technologies, Assessing technological options, Technology transfer and commercialization, Applying a commercial development process for access to space

UNIT V: PROGRAM PLANNING, MANAGEMENT, AND EVALUATION

Introduction, Management Trends, Good Project Management as Team Building and a Balancing Act, Types of Project Management, Configuration Management, Risk Management, Earned value management, Total Quality Management, Managing ultra-large projects

FUTURE SYSTEMS

Introduction, Next generation space transportation systems, Accelerator concepts, nuclear fission and fusion based concepts, Antimatter-based propulsion concepts, Solar propulsion concepts, Laser and beamed energy propulsion Concepts, Magnetic Monopoles Concept, Field and Quantum Effect Propulsion Concepts.

Text Book

1. ***S****pace Transportation: A Systems Approach to Analysis and Design****,*** Walter Hammond, AIAA Education Series, American Institute of Aeronautics and Astronautics, Inc, 1999.

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(R18D7618) AEROELASTICITY

(ELECTIVE-IV)

UNIT-I : AEROELASTIC PHENOMENA

Stability versus response problems; The aeroelastic triangle of forces; Aero elasticity in Aircraft Design; Prevention of aero elastic instabilities. Influence and stiffness coefficients. Coupled oscillations.

UNIT-II: DIVERGENCE OF A LIFTING SURFACE

Simple two dimensional idealizations; Strip theory, Integral equation of the second kind Exact solutions for simple rectangular wings, Semirigid‟ assumption and approximate solutions; Generalized coordinates, successive approximations, numerical approximations using matrix equations.

UNIT-III : STEADY STATE AEROLASTIC PROBLEMS

Loss and reversal of aileron control, critical aileron reversal speed, aileron efficiency, semi rigid theory and successive approximations, lift distribution, rigid and elastic wings.
Tail efficiency, effect of elastic deformation on static longitudinal stability.

UNIT-IV: FLUTTER PHENOMENON

Non-dimensional parameters, stiffness criteria, dynamic mass balancing, dimensional similarity; Flutter analysis, two dimensional thin airfoils in steady incompressible flow, quasi steady aerodynamic derivatives; Galerkin method for critical flutter speed, stability of disturbed motion, solution of the flutter determinant, methods of determining the critical flutter speeds, flutter prevention and control.

UNIT-V : EXAMPLES OF AEROELASTIC PROBLEMS

Galloping of transmission lines and Flow induced vibrations of transmission lines, tall slender structures and suspension bridges.

Text Books:

1. Y.C.Fung, “An Introduction to the Theory of Aero elasticity”, John Wiley & Sons Inc., New York, 2008.
2. E.G. Broadbent, “Elementary Theory of Aero elasticity”, Bun Hill Publications Ltd., 1986.

Reference Books:

1. R.L. Bisplinghoff, H.Ashley, and R.L. Halfmann, “Aero elasticity”, Edition Addison Wesley Publishing Co., Inc., 2nd Edition, 1996.
2. R.H. Scanlan and R. Rosenbaum, “Introduction to the study of Aircraft Vibration and Flutter”, Macmillan Co., New York,1981.
3. R. D. Blevins, “Flow Induced Vibrations”, Krieger Pub Co.,2001

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(R18DME54) COMPOSITE MATERIALS
(OPEN ELECTIVE –II)

Objectives:

- To be familiar with classification and characteristics of composite material and their applications.
- To gain the knowledge about manufacturing methods of composites .
- To know the testing methods related to composite materials.

UNIT-I

Introduction: Definitions, Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fibre composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites.

UNIT-II

Manufacturing methods: Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting and prepregs. Fibre/Matrix Interface, mechanical. Measurement of interface strength.

UNIT-III

Mechanical Properties -Stiffness and Strength: Geometrical aspects – volume and weight fraction. Unidirectional continuous fibre, discontinuous fibers, Short fiber systems, woven reinforcements – Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear.

UNIT-IV

Laminates: Plate Stiffness and Compliance, Assumptions, Strains, Stress Resultants, Plate Stiffness and Compliance, Computation of Stresses, Types of Laminates -, Symmetric Laminates, Anti-symmetric Laminate, Balanced Laminate, Quasi-isotropic Laminates, Cross-ply Laminate, Angle-ply Laminate. Orthotropic Laminate, Laminate Moduli, Hygrothermal Stresses.

UNIT-V

Joining Methods and Failure Theories: Joining –Advantages and disadvantages of adhesive and mechanically fastened joints. Typical bond strengths and test procedures.

TEXT BOOKS:

1. K.K. Chawla, (1998), Composite Materials, Springer-Verlag, New York
2. B.T. Astrom, (1997), Manufacturing of Polymer Composites, Chapman & Hall
3. Composite materials by J.N.Reddy

REFERENCE BOOKS:

1. Stuart M Lee, J. Ian Gray, Miltz, (1989), Reference Book for Composites Technology, CRC press
2. Frank L Matthews and R D Rawlings, (2006), Composite Materials: Engineering and Science, Taylor and Francis.
3. D. Hull and T.W. Clyne, (1996), Introduction to Composite Materials, Cambridge University Press
4. Analysis and Performance of Fiber Composites by Bhagwan D. Agarwal
5. Mechanics of Composite Materials by Autar K. Kaw

OUTCOMES:

- To provide knowledge on characteristics of composites
- To get knowledge on manufacturing and testing methods and mechanical behavior
- of composites.
- To get the exposure of different materials.

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I Year M. Tech, ASP-II SEM			
(R18DME55) WASTE TO ENERGY (OPEN ELECTIVE –II)	**3**	**-**	**3**

Prerequisite: Renewable Energy Sources, Physics, Environmental Studies

Course Objectives:

- To classify solid waste sources
- To identify methods of solid waste disposal
- To study various energy generation methods
- To analyse biogas production methods and recycling of e-waste

Course Outcomes: Upon the completion of the subject, the student will be able to

- Understand technologies for generation of energy from solid waste
- Compare methods of solid waste disposal
- Identify sources of energy from bio-chemical conversion
- Analyze methods for management of e-waste

UNIT- I :Solid Waste Sources Solid Waste Sources, types, composition, Properties, Global warming, Municipal Solid Waste: Physical, chemical and biological properties , Waste Collection and, Transfer stations, Waste minimization and recycling of municipal waste, Segregation of waste, Size Reduction , Managing Waste. Status of technologies for generation of Energy from Waste Treatment and Disposal Aerobic composting, incineration, Furnace type and design, Medical waste /Pharmaceutical waste treatment Technologies, incineration, Environmental impacts, Measures to mitigate environmental effects due to incineration .

UNIT – II: Land Fill method of Solid waste disposal Land fill classification, Types, methods and Sitting consideration, Layout and preliminary design of landfills: Composition, characteristics, generation, Movement and control of landfill leach ate and gases, Environmental monitoring system for land fill gases.

UNIT – III: Energy Generation from Waste Bio-chemical Conversion: Sources of energy generation, anaerobic digestion of sewage and municipal wastes, direct combustion of MSW-refuse derived solid fuel, Industrial waste, agro residues, Anaerobic Digestion.

UNIT – IV: Biogas production, Land fill gas generation and utilization, Thermo-chemical conversion: Sources of energy generation, Gasification of waste using Gasifiers, Briquetting, Utilization and advantages of briquetting, Environmental benefits of Bio-chemical and Thermo- chemical conversion.

UNIT – V: E-waste: e-waste in the global context – Growth of Electrical and Electronics Industry in India – Environmental concerns and health hazards – Recycling e-waste: a thriving economy of the unorganized sector – Global trade in hazardous waste – impact of hazardous e-waste in India. Management of e-waste: e-waste legislation, Government regulations on e-waste management – International experience – need for stringent health safeguards and environmental protection laws of India.

TEXT BOOKS:

1. Nicholas P. Cheremisinoff. Handbook of Solid Waste Management and Waste Minimization Technologies. An Imprint of Elsevier, New Delhi (2003).
2. P. Aarne Vesilind, William A. Worrell and Debra R. Reinhart. Solid Waste Engineering. Thomson Asia Pte Ltd. Singapore (2002)
3. M. Dutta , B. P. Parida, B. K. Guha and T. R. Surkrishnan. Industrial Solid Waste Management and Landfilling practice. Narosa Publishing House, New Delhi (1999).
4. "E-waste in India: Research unit, Rajya Sabha Secretariat, New Delhi, June 2011"
5. Amalendu Bagchi. Design, construction and Monitoring of Landfills. John Wiley and Sons. New York. (1994)
6. M. L. Davis and D. A. Cornwell. Introduction to environmental engineering. Mc Graw Hill International Edition, Singapore (2008)
7. C. S. Rao. Environmental Pollution Control Engineering. Wiley Eastern Ltd. New Delhi (1995)
8. S. K. Agarwal. Industrial Environment Assessment and Strategy. APH Publishing Corporation. New Delhi (!996)
9. Sofer, Samir S. (ed.), Zaborsky, R. (ed.), "Biomass Conversion Processes for Energy and Fuels", New York, Plenum Press, 1981
10. Hagerty, D.Joseph; Pavoni, Joseph L; Heer, John E., "Solid Waste Management", New York, Van Nostrand, 1973
11. George Tchobanoglous, Hilary Theisen and Samuel Vigil Prsl: Tchobanoglous, George Theisen, Hillary Vigil, Samuel, "Integrated Solid Waste management: Engineering Principles and Management issues", New York, McGraw Hill, 1993.

REFERENCES:

- C Parker and T Roberts (Ed), Energy from Waste – An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985
- KL Shah, Basics of Solid and Hazardous Waste Management Technology, Prentice Hall, 2000 3. M Datta, Waste Disposal in Engineered Landfills, Narosa Publishing House, 1997
- G Rich et.al, Hazardous Waste Management Technology, Podvan Publishers, 1987
- AD Bhide, BB Sundaresan, Solid Waste Management in Developing Countries, INSDOC, New Delhi,1983 FUEL CELL AND

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(R18DME56) INDUSTRIAL MANAGEMENT
(OPEN ELECTIVE-II)

Objectives:

- This course is intended to familiarise the students with the framework for the managers and leaders
- The student able to understanding and making decisions realting to issues related organiational structure, production operations, marketing
- The student learn about Human resource Management, product management and strategy.

UNIT- I

Concepts of Management and Organisation - Functions of Management - Evolution of Management Thought : Taylor's Scientific Management, Fayol's Principles of Management, Douglas Mc-Gregor's Theory X and Theory Y, Mayo's Hawthorne Experiments, Hertzberg's Two Factor Theory of Motivation, Maslow's Hierarchy of Human Needs - Systems Approach to Management.

UNIT –II

Designing Organisational Structures : Basic concepts related to Organisation - Departmentation and Decentralisation, Types of mechanistic and organic structures of organisation (Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organisation, Cellular Organisation, team structure, boundaryless organization, inverted pyramid structure, lean and flat organization structure) and their merits, demerits and suitability.

UNIT –III

Plant location, definition, factors affecting the plant location, comparison of rural and urban sites-methods for selection of plant- Matrix approach. Plant Layout - definition, objectives, types of production, types of plant layout - various data analyzing forms-travel chart. Work study - Definition, objectives, method study - definition, objectives, steps involved- various types of associated charts-difference between micromotion and memomotion studies. Work measurement- definition,time study, steps involved-equipment, different methods of performance rating- allowances, standard time calculation. Work Sampling - definition, steps involved, standard time calculations, differences with time study.

UNIT –IV

Materials Management-Objectives, Inventory - functions, types, associated costs, inventory classification techniques-ABC and VED analysis. Inventory Control Systems-Continuous review system-periodical review system. Stores Management and Stores Records. Purchase management, duties of purchase of manager, associated forms. Introduction to PERT / CPM : Project management, network modeling-probabilistic model, various types of activity times estimation-programme evaluation review techniques-Critical Path-probability of completing the project, deterministic model, critical path method (CPM)-critical path calculation-crashing of simple of networks.

UNIT –V

Inspection and quality control, types of inspections - Statistical Quality Control-techniques-variables and attributes-assignable and non assignable causes- variable control charts, and R charts, attributes control charts, p charts and c charts. Acceptance sampling plan- single sampling and double sampling plans-OC curves. Introduction to TQM-Quality Circles, ISO 9000 series procedures. Introduction to Human Resource Management, Functions of HRM, Job Evaluation, different types of evaluation methods. Job description, Merit Rating.- difference with job evaluation, different methods of merit ratings, wage incentives, different types of wage incentive schemes. Marketing, marketing vs selling, marketing mix, product lifecycle.

TEXT BOOKS:

1. Amrine, Manufacturing Organization and Management, Pearson, 2nd Edition, 2004.
2. Industrial Engineering and Management O.P. Khanna Dhanpat Rai.
3. A.R.Aryasri, Management Science , Tata McGraw-Hill, 2002.

REFERENCE BOOKS:

1. Panner Selvam, Production and Operations Management, PHI, 2004.
2. Dr. C. Nadha Muni Reddy and Dr. K. Vijaya Kumar Reddy, Reliability Engineering & Quality Engineering, Galgotia Publications, Pvt., Limited.
3. Phillip Kotler, Marketing Management, Pearson, 2004.

Outcomes:

- Plan an organizational structure for a given context in the organisation carry out production operations through Work study and carry out production operations through Work study.
- Understand the markets, customers and competition better and price the given products appropriately and ensure quality for a given product or service.
- Plan and control the HR function better and plan, schedule and control projects through PERT and CPM, evolve a strategy for a business or service organisation.

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(R18DHS52) COST MANAGEMENT OF ENGINEERING PROJECTS (OPEN ELECTIVE –II)

Course Objective:

- Project Cost management is concerned with the process of planning and controlling the budget of a project or business.
- The Cost Management course addresses activities such as planning, estimating, budgeting, financing, funding, managing, and controlling costs so that the project can be completed within the approved budget.

Course Outcome:

- The student is able to understand the detailed cost concepts, cost structure and elements of costs of manufacturing and service organizations.
- To learn the reporting system of the organisation for effective decision making, planning, evaluation and control.

Unit-I: Introduction to Project Cost Management: Concept of project cost management - objectives and scope- Elements of project costs: functional classification and ascertainment of cost (material, labour and overhead costs) –Preparation of a cost sheet for an engineering project

Unit-II: Method of Project Costing: Single Output/ Unit Costing: Activity Based Costing - Job Costing - Batch Costing - Contract Costing - Process/ Operation Costing

Unit-III: Marginal Cost: Marginal Costing – Nature and Scope- Applications - Break even charts and Point, Decision Making (all types with full problems) Differential Cost Analysis, Advantages and Disadvantages of Marginal Costing.

Unit-IV: Project Budgetary Control: Objectives of Project Budgetary control - Functional Project Budgets - Master Budgets - Key Factor Problems on Production Budgets and Flexible Budgets. Standard Costing- Comparison with Budgetary control, analysis of Variances, Simple Problems on Material and Labour variances only.

Unit-V: Project Cost Audit & Reporting to Management: Objectives and advantages of Project Cost Audit – Project Cost Audit report - Management Audit - Objectives and Scope. Reporting to Management – Purpose of reporting- Requisites of a good report, Classifications of Report, Segment reporting

Reference Books

- Project Estimating and Cost Management, Project Management Essential Library, Berrett-Koehler Publishers (October 1, 2001)
- Project Management Accounting,: Budgeting, Tracking, and Reporting Costs and Profitability, Wiley; 2 edition (June 28, 2011) by Kevin R. Callahan, Gary S. Stetz , Lynne M. Brooks
- Cost and Management Accounting 2014, by S.P. Jain & K.L. Narang
- Cost and Management Accounting, New Age International by M.E. Thukaram Rao
- Advanced Cost & Management Accounting – Problems & Solutions, Prentice Hall of India (P) Ltd. by V.K. Saxena & C.D. Vashist
- Studies in Cost Management, Sultan Chand & Sons by S.N. Maheshwari

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(R18DCS52) INFORMATION SECURITY	**3**	**-**	**3**
(OPEN ELECTIVE II)			

Objective:

To introduce the fundamental concepts and techniques in computer and network security, giving students an overview of information security and auditing, and to expose students to the latest trend of computer attack and defense. Other advanced topics on information security such as mobile computing security, security and privacy of cloud computing, as well as secure information system development will also be discussed.

UNIT I

A model for Internetwork security, Conventional Encryption Principles & Algorithms (DES, AES, RC4, Blowfish), Block Cipher Modes of Operation, Location of Encryption Devices, Key Distribution.
Public key cryptography principles, public key cryptography algorithms (RSA, Diffie-Hellman, ECC), public Key Distribution.

UNIT II

Approaches of Message Authentication, Secure Hash Functions (SHA-512, MD5) and HMAC, Digital Signatures, Kerberos, X.509 Directory Authentication Service, Email Security: Pretty Good Privacy (PGP)
IP Security: Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.

UNIT III

Web Security: Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET). Firewalls: Firewall Design principles, Trusted Systems, Intrusion Detection Systems

UNIT IV

Auditing For Security: Introduction, Basic Terms Related to Audits, Security audits, The Need for Security Audits in Organization, Organizational Roles and Responsibilities for Security Audit, Auditors Responsibility In Security Audits, Types Of Security Audits.

UNIT V

Auditing For Security: Approaches to Audits, Technology Based Audits Vulnerability Scanning And Penetration Testing, Resistance to Security Audits, Phase in security audit, Security audit Engagement Costs and other aspects, Budgeting for security audits, Selecting external Security Consultants, Key Success factors for security audits.

TEXT BOOKS:

1. Cryptography and Network Security by William Stallings, Fourth Edition, Pearson Education 2007.
2. Network Security Essentials (Applications and Standards) by William Stallings Pearson Education, 2008.
3. Cryptography & Network Security by Behrouz A. Forouzan, TMH 2007.
4. Information Systems Security by Nina Godbole, WILEY 2008.

REFERENCE BOOKS:

1. Information Security by Mark Stamp, Wiley – INDIA, 2006.
2. Fundamentals of Computer Security, Springer.
3. Network Security: The complete reference, Robert Bragg, Mark Rhodes, TMH
4. Computer Security Basics by Rick Lehtinen, Deborah Russell & G.T.Gangemi Sr., SPD O'REILLY 2006.
5. Modern Cryptography by Wenbo Mao, Pearson Education 2007.
6. Principles of Information Security, Whitman, Thomson.

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(R18DAE52) UNMANNED AERIAL VEHICLES

UNIT-I: INTRODUCTION TO UNMANNED AIRCRAFT SYSTEMS

Applications of UAS, categories of UAV systems, roles of unmanned aircraft, composition of UAV system.

UNIT-II: DESIGN OF UAV SYSTEMS-I

Introduction to design and selection of the systems-conceptual phase, preliminary design, detailed design; Aerodynamics and airframe configurations-Lift-induced Drag, Parasitic Drag, Rotary-wing Aerodynamics, Response to Air Turbulence, Airframe Configurations; Medium-range, Tactical Aircraft, Characteristics of Aircraft Types-Long-endurance, Long-range Role Aircraft, Medium-range, Tactical Aircraft, Close-range/Battlefield Aircraft, MUAV Types, MAV and NAV Types, UCAV, Novel Hybrid Aircraft Configurations, Aspects of Airframe Design: Scale Effects, Packaging Density, Aerodynamics, Structures and Mechanisms, Selection of power- plants, Modular Construction, Ancillary Equipment, Design for Stealth: Acoustic Signature, Visual Signature, Thermal Signature, Radio/Radar Signature, Payload Types: Non-dispensable and dispensablepayloads.

UNIT-III: DESIGN OF UAV SYSTEMS-II

Communications-Communication Media, Radio Communication, Mid-air Collision (MAC) Avoidance, Communications Data Rate and Bandwidth Usage, Antenna Type; Control and Stability: HTOL Aircraft, Convertible Rotor Aircraft, Payload Control, Sensors, Autonomy; Navigation: NAVSTAR Global Positioning System (GPS), TACAN, LORAN C, Inertial Navigation, Radio Tracking, Way-point Navigation; Launch and Recovery.

Design for Reliability: Determination of the Required Level of Reliability, Achieving Reliability, Reliability Data Presentation, Multiplexed Systems, Reliability by Design, Design for Ease of Maintenance; Design for Manufacture and Development

UNIT-IV: THE DEVELOPMENT OF UAV SYSTEMS

System Development and Certification-System Development, Certification, Establishing Reliability; System Ground Testing: UAV Component Testing, UAV Sub- assembly and Sub-system Testing, Testing Complete UAV, Control Station Testing , Catapult Launch System Tests, Documentation; System In- flight Testing: Test Sites, Preparation for In-flight Testing, In- flight Testing, System certification.

UNIT-V: DEPLOYMENT AND FUTURE OF UAV SYSTEMS

Operational trials and full certification; UAV System Deployment- Network-centric Operations (NCO), Teaming with Manned and Other Unmanned System; Naval, arm and air force roles, civilian, paramilitary and commercial roles.

Text Books:

1. Reg Austin, Wiley, “Unmanned Aircraft Systems, UAVS Design and Deployment”, 2nd Edition, 2010.

Reference Books:

1. Richard K. Barnhart, Stephen B. Hottman, Douglas M. Marshall, Eric Shappee, (eds.), “Introduction to Unmanned Aircraft Systems”, CRC Press, 2012.
2. Valavanis, Kimon P., Vachtsevanos, George J. “Handbook of Unmanned Aerial Vehicles” AIAA series, 3rd Edition, 2004.

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(R18DEC52) RESEARCH METHODOLOGY (OPEN ELECTIVE – II)

UNIT - I

Introduction:Researchobjectiveandmotivation,Typesofresearch,Researchapproaches,Significance, Research method vs. methodology, Research process.

UNIT - II

Formulating a research problem: Literature review, Formulation of objectives, Establishing Operational definitions, Identifying variables, constructing hypotheses.

UNIT - III

Research design and Data Collection: Need and Characteristics, Types of research design, Principles of Experimental research design, Method of data collection, Ethical issues in collecting data.

UNIT - IV

Sampling and Analysis of data: Need of Sampling, Sampling distributions, Central limit theorem, Estimation: mean and variance, Selection of sample size Statistics in research, Measures of Central tendency, Dispersion, asymmetry and relationships, Correlation and Regression analysis, Displaying data

UNIT-V

Hypothesis Testing: Procedure, Hypothesis testing for difference in mean, variance limitations, Chi- square test, Analysis of variance (ANOVA), Basic principles and techniques of writing a Research Proposal

Text Books:

1. R. C. Kothari, Research Methodology: Methods and Techniques, 2nd edition, New Age International Publisher, 2009
2. RanjitKumar,ResearchMethodology:AStep-by-StepGuideforBeginners,2ndEdition,SAGE,2005

References:

1. Trochim, William M. The Research Methods Knowledge Base, 2nd Edition. Internet WWW page, at URL: <http://www.socialresearchmethods.net/kb/>
2. (Electronic Version): StatSoft, Inc. (2012). Electronic Statistics Textbook. Tulsa, OK: StatSoft. WEB: http://www.statsoft.com/textbook/.(Printed Version): Hill, T. & Lewicki, P. (2007). STATISTICS: Methods and Applications. StatSoft, Tulsa, OK.

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(R18D7683) DIGITAL SIMULATION LAB-II

I SOFTWARE DEVELOPMENT FOR THE FOLLOWING USING FINITE ELEMENT METHODS

Thin walled beams Plate bending Beams analysis Trusses analysis Thin shells analysis

II AEROSPACE STRUCTURAL ANALYSIS USING ANSYS

Structural analysis of aircraft wing
Structural analysis of aircraft wing (Composite material) Analysis of fuselage Analysis of landing gear
Structural and thermal analysis of exposed surface of space shuttle using FGM material Fractural mechanics of crack propagation of thin panel

III. SIMULATION EXPERIMENTS IN DYNAMICS AND CONTROL USING MATLAB AND SIMULINK

Simulation of Aircraft motion-longitudinal dynamics, lateral dynamics Six-degrees-of-freedom simulation of aircraft motion with illustration of F-16 model

REFERENCES

1. Engineering Analysis with ANSYS Software, Y. Nakasone, S.Yoshimoto, T. A. Stolarski, Elsevier Publication, 2006
2. Atmospheric and Space Flight Dynamics, Ashish Tewari, Birkhauser Publication, 2007 Modern Control Design with MATLAB and Simulink, A. Tewari

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(R18DHS56) ENGLISH FOR RESEARCH PAPER WRITING
(AUDIT COURSE –II)

INTRODUCTION

Writing a research paper is a significant part of any academia. It is a substantial piece of academic writing in which the author does independent investigation into a topic and writes a description of the findings of that study. Research studies are important because these contribute to a scholar's knowledge and also provides solutions to the latest challenges. Writing forces one to think about what he believes and what he wants to communicate. Since good writing skills allow a learner to communicate his message with clarity, an extensive exposure on techniques of writing research paper proves to be an immense value to the students .

OBJECTIVES

1. To enable the students to use linguistic structures to form well-organized texts in research contexts
2. To improve the quality of a composition by using appropriate cohesive devices
3. To enhance the mechanics of writing skills using correct grammar and vocabulary
4. To equip learners with the strategies of error – free writing

SYLLABUS

Unit 1 - Sentence Formation
Word order, Structuring paragraphs, Breaking up long sentences

Unit 2 - Cohesive devices
Types of cohesive devices - Anaphoric reference, Cataphoric reference, Exophoric reference
Tense agreement

Unit 3 – Academic Vocabulary
Hedging, Transitions – Additive, Adversative, Causal, Sequential

Unit 4– Grammar for Research Papers
Active & Passive, Punctuation, Articles

Unit 5 – Academic writing
Removing redundancy, Avoiding ambiguity, Paraphrasing, Sample Abstracts for practice, Sample videos

* Exercises apart from the text book shall also be referred for classroom tasks.

REFERENCE BOOKS:

1. English for Writing Research Papers. Adrian Wallwork, edition II, Springer, 2016.
2. Handbook of Technical Writing. James H. Shelton, McGraw Hill, 1994
3. Writing the Research Paper, a handbook. 8th edition, Anthony C. Winkler, Jo Ray Metherell, Wadsworth, 2012

OUTCOMES:

Students will be able to:

1. Write in a clear, coherent, and direct style appropriate for academic research
2. Draft coherent and unified paragraphs with adequate supporting details.
3. Develop the strategy to use lexical terms effectively.
4. Adopt appropriate syntactic and semantic techniques
5. Demonstrate analytical and inferencing skills.
6. Comprehend and employ the various forms of scholarly composition.

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(R18D7683) SEMINAR-I

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(R18D7691) Mini Project

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(R18D7692) Project Review-I

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(R18D7684) Seminar-II

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(R18D7693) Project Review-II

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(R18D7694) Project Viva-voce