JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

INSTITUTE OF SCIENCE AND TECHNOLOGY

COURSE STRUCTURE & SYLLABUS
M.Tech AVIONICS Programme

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

Semester I

S.No	Course No	Course Name	P.Os	Category	L	T	P	Credits
1		**Program Core I** Flight Mechanics			3	0	0	3
2		**Program Core II** Avionics Systems			3	0	0	3
3		**Program Elective I** 1. Flight Instrumentation 2. Advanced Image Processing 3. Missile And Space Vehicle Dynamics			3	0	0	3
4		**Program Elective II** 1. Aircraft Communication Systems 2. Cyber Security 3. Network Centric Warfare			3	0	0	3
5		**Research Methodology and IPR**			2	0	0	2
6		**Audit Course I**			2	0	0	0
7		**Laboratory 1** (Based on Core) Avionics Engineering Lab			0	0	4	2
8		**Laboratory 2** (Based on Electives) Flight Instrumentation and Communication Lab			0	0	4	2
				Total	**16**	**0**	**8**	**18**

Semester II

S.No	Course No	Subject	P.Os	Category	L	T	P	Credits
1		**Program Core III** Flight Control Systems			3	0	0	3
2		**Program Core IV** Aircraft Navigation Systems			3	0	0	3
3		**Program Elective III** 1. Avionics Embedded Systems 2. Avionics Network Technology 3. Multi Sensor Data Fusion			3	0	0	3
4		**Program Elective IV** 1. Aircraft Utility Systems 2. Embedded Robotics 3. Missile And Space Vehicle Guidance And Control			3	0	0	3
5		**Audit Course II**			2	0	0	0
6		**Laboratory 3** (Based on Core) Control ,Guidance and Navigation Lab			0	0	4	2
7		**Laboratory 4** (Based on Electives) Avionics Embedded Systems Lab			0	0	4	2
8		**Mini Project with Seminar**			0	0	4	2
				Total	**14**	**0**	**12**	**18**

*Students be encouraged to go to Industrial Training/Internship for at least 2-3 Weeks during semester break.

Audit course 1 & 2

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India

6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

Semester III

S.No	Course No	Subject	P.Os	Category	L	T	P	Credits
1		**Program Elective V** 1. ADA 95 2. Aerospace Electromagnetic Compatibility 3. Unmanned Aircraft Systems			3	0	0	3
2		**Open Elective *** 1. Business Analytics 2. Industrial Safety 3. Operations Research 4. Cost Management of Engineering Projects 5. Composite Materials 6. Waste to Energy			3	0	0	3
3		**Dissertation-I /Industrial Project**			0	0	20	10[#]
				Total				16

[#] Evaluated and Displayed in IV Sem Marks list.

*Students going for Industrial Project/Thesis will complete these courses through MOOCs

Semester IV

S.No	Course No	Course Name	P.Os	Category	L	T	P	Credits
1		Project/ Dissertation Phase-II **(continued from III semester)**			0	0	32	16
				Total	0	0	32	16

I Year I Semester	L	P	C
	3	0	3

FLIGHT MECHANICS
(Program Core-I)

OBJECTIVES:

- To provide the knowledge of history of aviation and the mechanics involved in the flying of aircraft.
- To provide the understanding of mathematical relations and aerodynamics associated with the controllability of the flight, aircraft engines and propulsion.

UNIT I History of Aviation and Introduction to Atmospheric Flight

History of Aviation Introduction, Flying, Static and dynamic aviation, Forces on the aeroplane Lift, drag and thrust Properties of air, The earth's atmosphere, The standard atmosphere, Atmospheric flight.

UNIT II Low-Speed Aerodynamics

Speed domains and compressibility, Basic concepts, Equations for steady flow, viscous flows, The boundary layer, Flow separation and drag Shape and scale effects on drag.

UNIT III Lift and Drag at Low Speeds

Function and shape of aeroplane wings, Aerofoil sections, Circulation and lift, Aero foil section properties, Wing geometry, High-aspect ratio straight wings, Low-aspect ratio wings, The whole aircraft.

UNIT IV Aircraft Engines and Propulsion

History of engine development, Fundamentals of reaction propulsion, Engine efficiency and fuel consumption, Piston engines in aviation, Gas turbine engine components, Non-reheated turbojet and turbofan engines, Turboprop and turbo shaft engines, Gas turbine engine operation, Propeller performance.

UNIT V Aeroplane Performance

Introduction, Airspeed and altitude, Equations of motion for symmetric flight, Steady straight and level flight, Climb and descent, Gliding flight, Cruising flight, Take-off and landing, Horizontal steady turn, Maneuver and gust loads.

OUTCOMES:

- The student will analyze the basics of flight mechanics, aerodynamic equations, aircraft engine and propulsion system, aeroplane performance.

TEXT BOOKS:

1. E. Torenbeek, H. Wittenberg, "Flight Physics", Springer Science+Business Media, B.V. 2009.
2. John D Anderson Jr., "Introduction to Flight", 7th Edition, TMH.

REFERENCES:

1. C. Kermode., "Mechanics of Flight", Pearson Education Limited; III edition, 2012.
2. RanjanVepa, "Flight Dynamics, Simulation, and Control for Rigid and Flexible Aircraft" CRC Press Taylor & Francis Group, 2015.

I Year I Semester	L	P	C
	3	0	3

Avionics Systems
(Program Core-II)

OBJECTIVES:

- To provide knowledge in core avionic systems, displays, Man Machine Interaction and Evolution of avionics architectures.
- To provide exposure in basics of radar systems, advanced radar systems, electro-optics

UNIT I Introduction to Avionics

Introduction**:** Core avionic systems, The Avionic Environment. Displays and Man Machine Interaction - Head up displays. Helmet mounted displays, Head Down Displays (HDD), Control and data entry, Direct Voice Input (DVI).

UNIT II Technology and architectures

Avionics architectures: Distributed analogue architecture, Distributed Digital Architecture, Federated Digital Architecture, Integrated Modular Architecture. Aerospace-specific data buses: ARINC 429 , MIL-STD-1553B ,STANAG 3910., JIAWG architecture, COTS data buses, Real-time operating systems, RF integration, Pave Pace/F-35 shared aperture architecture.

UNIT III Advanced radar systems

Review of radar principles, Airborne radar modes: Air-to-air search, Air-to-air tracking, Air-to-air track-while-scan, Ground mapping. Doppler radar, other uses of radar, Target tracking.
Pulsed Doppler radar operation and implementation, Pulse compression, advanced antennas: Phased arrays, Active electronically steered array (AESA), Synthetic Aperture Radar, SAR Modes: Spotlight mode, Doppler Beam Sharpening, Inverse SAR. Millimeter Wave Radar: Principles and applications. Weather radar: System overview, airborne equipment, Precipitation and Turbulence, System enhancements, Lightning detection.

UNIT IV Aircraft Support Systems

Terrain awareness warning systems (TAWS): System overview, System warnings and protection, External references, Ground proximity modes, forward looking terrain awareness (FLTA).
Airborne Electro optics**:** Introduction, Television, Night-vision goggles, IR imaging, IR tracking: IR seeker heads, Image tracking, IR search and track systems. Lasers: Principles of operation, Laser sensor applications. Integrated systems: Electro optic sensor fusion, Pod installations.

UNIT V Electromagnetic Environment in Aircraft

Introduction, EME Energy Susceptibility: Soft Faults, MTBUR/MTBF. Civil Airworthiness Authority Concerns: EME Compliance Demonstration for Electrical and Electronic Systems, EME Energy Propagation. Architecture Options for Fault Mitigation: Electrical/Electronic System, Digital Computing Platform.

OUTCOMES:

- The students will analyze the basic concepts of core avionic systems, advanced radar systems – synthetic aperture radar.
- Students will get an exposure to electro-optics in the avionics engineering.

TEXT BOOKS:

1. Ian Moir, Allen Seabridge., “Military Avionics Systems”., AIAA , 2006
2. Collinson R.P.G., “Introduction to Avionics Systems”, Springer; 3rd ed. 2014

REFERENCES:

1. Cary R. Spitzer., “The Avionics Handbook”., CRC; 1st edition , 2006
2. Mike Tooley and David Wyatt ,“Aircraft Communications and Navigation Systems” Elsevier 2018
3. Mike Tooley and David Wyatt ,“Aircraft Electrical and Electronic Systems” Elsevier 2018

I Year I Semester	L	P	C
	3	0	3

FLIGHT INSTRUMENTATION
(Program Elective – I)

OBJECTIVES:

- To provide the knowledge of instruments used in the aircraft, to perform the safe flight and their operating mechanisms.
- To provide exposure of air data instruments, attitude indicating instruments, Heading indicating instruments, power plant instruments and electronic instrumentation systems and recorders.

UNIT I Instrument Elements, Mechanisms and Displays

Aircraft instruments Requirements and standards, Elements of an Instrument, Static and dynamic characteristics, Errors in measurement – Gross errors, systematic errors. Classification of Transducers, Mechanisms – Lever, Rod, Gear and Hair springs, Temperature compensation. Instrument displays – qualitative, quantitative and director displays, Panels and Layouts, Instrument Grouping.

UNIT II Air Data Instruments

Pitot Static system, Pressure error and Alternate pressure sources. Measurement of Altitude, Airspeed indicator - Square Law compensation, Mach meter, Vertical air speed indicators, Aircraft Central Air Data Computer, Angle of attack and side slip angle measurement.

UNIT III Attitude and Heading Indicating Instruments

Gyroscope Principles and its properties; Limitations of a free gyro: - Apparent Drift and Transport Wander. Artificial Horizon, Turn and bank indicator.
Terrestrial Magnetism – Magnetic Dip, Magnetic variation. Direct reading compass: – principal features, construction. Acceleration errors, turning errors. Directional Gyro, Remote indicating compasses – Flux detector element. Compass deviation – Sources of aircraft magnetism, deviation compensation devices.

UNIT IV Power Plant Instruments

Measurement of Engine speed- Mechanical and electrical tachometer Temperature measurement – methods and applications, sensing elements, thermocouple principle and types, exhaust gas temperature, Radiation pyrometer, Pressure measurement- pressure sensing method, Fuel quantity measurement – various techniques, Fuel flow. EPR, Engine vibration monitoring.

UNIT V Electronic Instrumentation systems and Recorders

Display technologies- CRT, LCD and LED, Electronic Flight Instrumentation System (EFIS), Engine Indicating and Crew Alerting Systems (EICAS), Electronic Centralised Aircraft Monitoring (ECAM), Flight Data Recorder (FDR), Cockpit Voice Recorder (CVR).

OUTCOMES:

- The students will understand the mechanism of instrumentation in the flight and their importance in the avionics engineering.

TEXT BOOKS:

1. Pallet, E.H.J. 'Aircraft Instruments & Integrated systems', Longman Scientific and Technical, McGraw-Hill, 1992.
2. U.A. Bakshi and A.V. Bakshi, “Electrical Measurements and Instrumentation”, Technical Publication, 1st edition, 2014.

REFERENCES:

1. Mike Tooley, David Wyatt, “Aircraft Electrical and Electronics Systems“. Elsevier, 2018
2. Mike Tooley, “Aircraft Digital Electronic and Computer System”, Elsevier, 2013
3. David Harris, “Flight instrumentation and Automatic flight control”, 6th edition, Blackwell science, 2004.

I Year I Semester	L	P	C
	3	0	3

ADVANCED DIGITAL IMAGE PROCESSING
(Program Elective– I)

OBJECTIVES:

- To provide exposure to fundamentals of digital image processing, Segmentation, Feature Extraction and Registration.
- To provide exposure to pixel level image fusion, frequency domain transformation.

UNIT I Fundamentals of Digital Image Processing

Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, 2D image transforms-DFT, DCT, KLT, and SVD. Image enhancement in spatial and frequency domain, Review of morphological image processing

UNIT II Segmentation

Edge detection, Thresholding, Region growing, Fuzzy clustering, Watershed algorithm, Active Contour methods, Texture feature based segmentation, Model based segmentation, Atlas based segmentation, and Wavelet based Segmentation methods

UNIT III Feature Extraction

First and second order edge detection operators, Phase congruency, Localized feature extraction-detecting image curvature, shape features Hough transform, shape skeletonization, Boundary descriptors, Moments, Texture descriptors- Autocorrelation, Co-occurrence features, Runlength features, Fractal model based features, Gabor filter, wavelet features

UNIT IV Registration

Registration- Preprocessing, Feature selection-points, lines, regions and templates Feature Correspondence - Point pattern matching, Line matching, region matching, and Template matching. Transformation functions - Similarity transformation and Affine Transformation. Resampling :- Nearest Neighbor and Cubic Splines.

UNIT V Image Fusion

Image Fusion-Overview of image fusion, Fusion types - Pixel level, Feature level and Decision level. Spatial fusion techniques- PCA, Laplacian pyramid. Frequency domain transformation techniques: – DWT, DCT, DST, Curvelet transform.Enhanced Vision System, Synthetic Vision System, Combined Vision System.

OUTCOMES:

- The students will analyze the basics of digital image processing and will acquire necessary knowledge that can be applied in the field of signal and image processing.

TEXT BOOKS:

1. John C.Russ, “The Image Processing Handbook”, CRC Press,2007.
2. Mark Nixon, Alberto Aguado, “Feature Extraction and Image Processing”, Academic Press, 2008.
3. Rafael C. Gonzalez, Richard E. Woods, , Digital Image Processing', PearsonEducation, Inc., Second Edition, 2004.

REFERENCES:

1. Anil K. Jain, “Fundamentals of Digital Image Processing”, Pearson Education, Inc., 2002.
2. Rick S.Blum, Zheng Liu, “Multisensor image fusion and its Applications“, Taylor& Francis,2006.
3. Ardeshir Goshtasby, “2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications”, John Wiley and Sons, 2005.

I Year I Semester	L	P	C
	3	0	3

MISSILE AND SPACE VEHICLE MECHANICS
(Program Elective– I)

OBJECTIVE:

- To provide knowledge of the missile systems – aerodynamics, propulsion.
- To provide the basics of rocket propulsion and orbital mechanics.

UNIT I Missile Systems

Introduction - history - classification - missile system elements, missile ground systems - radars – launchers, coordinate frames, basics of trajectory dynamics.

UNIT II Missile Aerodynamics

Missile aerodynamics- design methodology, aerodynamic prediction method, aerodynamic loads & performance analysis, wind tunnel and flight testing of missile models and missile prototypes.

UNIT III Propulsion

Principles of jet propulsion and rocketry, nozzle theory and performance parameters of solid rockets and ramjet and compound jet engines – evaluation of flight performance - forces acting on vehicle - basic relations of motion.

UNIT IV Rocket Aerodynamics

Description of various loads experienced by a rocket passing through atmosphere – drag estimation – wave drag, skin friction drag, form drag and base pressure drag – Boat-tailing in missiles – performance at various altitudes – conical and bell shaped nozzles – adapted nozzles – rocket dispersion – launching problems.

UNIT V Orbital Mechanics

Description of solar system – Kepler‟s Laws of planetary motion – Newton„s Law of Universal gravitation – Two body and Three-body problems – Jacobi‟s Integral, Librations points - Estimation of orbital and escape velocities.

OUTCOMES:

- The students will understand the basics of missile systems – its operating mechanism and aerodynamics.
- He will be able to understand the ideology of orbital mechanics.

TEXTBOOKS:

1. Van de Kamp, “Elements of Astromechanics”, Pitman Publishing Co., Ltd., London, 1980.
2. E.R. Parker, “Materials for Missiles and Spacecraft”, McGraw-Hill Book Co., Inc., 1982.

REFERENCES:

1. G. Merrill, “Dictionary of Guided Missiles and Space Craft”, D. Van Nostrand and Company, Inc, 1959.
2. S. S. Chin, “Missile Configuration Design”, McGraw Hill, 1961.

I Year I Semester	L	P	C
	3	0	3

AIRCRAFT COMMUNICATION SYSTEMS
(Program Elective – II)

OBJECTIVES:

- To provide knowledge in the basic concepts of aircraft communications, modulation, access and channel coding schemes.
- To understand the encryption standards in communication systems, aircraft data links, satellite and UAV communication systems.

UNIT I Introduction

The Isotropic Power Source and Free Space Path Loss, Radio Geometry - Radio Horizon Calculations, Earth Bulge Factor – *k* Factor, Great-circle Distances, Radio wave propagation – LOS, Complex Propagation: Refraction, Absorption, Non-LOS Propagation, Communication Frequency Bands and Allotment, Legacy and Modern Communications, Organizational Structure of Aviation.

UNIT II Modulation, Access and Channel coding schemes

Modulation types: AM, FM, PM, FSK, ASK, BPSK, DPSK, QPSK, OQPSK, MSK,GFSK. Multiplexing and Access Schemes: – FDMA, TDMA, CDMA. Channel Coding Schemes: Convolutional, RS Codes, Turbo Product Codes.

UNIT III Encryption standards in Communication Systems

Introduction to Cryptography: – crypto systems and types. Traditional ciphers - Caesar Cipher, Transposition Cipher, Substitution Cipher. Modern ciphers: - DES, AES and RSA Algorithms.

UNIT IV Aircraft and UAV Data Links

Aircraft Data Link: VHF data link – ACARS, VDL 2, VDL 3, and VDL 4. UHF data link - Link-11, Link-16. SELCAL, ALE and HF Data link. UAV Data link functions and attributes, Video & Telemetry Links.

UNIT V Future Airborne Communication Systems

Software Defined Radio (**SDR**)- Need, characteristics and benefits, design principles, RF front end implementation – purpose, receiver topologies and importance of components. Cognitive Radios: - introduction, spectrum sensing algorithms. Aeronautical Mobile Airport Communication System (AeroMACS).

OUTCOME:

- The student will understand the terminology of aircraft communication.
- The student will learn the modulation types to be used for effective communication.
- Student will be aware of encryption standards in communication systems and aircraft data links, communication band allotted for different satellites.
- He will get brief insight of future airborne communication systems – software defined radio.

TEXT BOOKS:

1. Dale Stacey**.,** **"**Aeronautical Radio Communication Systems and Networks", Wiley (March 31, 2008)
2. William Stallings, "Cryptography and Network Security Principles and Practice", Pearson 6th Edition.
3. Jeffrey H. Reed, "Software Radio: A Modern Approach to Radio Engineering", 2002, PEA publication.

REFERENCES:

1. Simon Plass., "Future Aeronautical Communications". InTech**,** September, 2011
2. Bruce R Elbert," Introduction to Satellite communication"(3rd Edition)
2. Nigel Smart., "Cryptography: An Introduction" (3rd Edition)
3. "Software Defined Radios" by Wireless Innovation Forum, July 2016
4. Fette B.A.(ed), "Cognitive Radio Technology", communication engineering Series, Elsevier2006.

I Year I Semester	L	P	C
	3	0	3

CYBER SECURITY
(Program Elective – II)

OBJECTIVE:

- To get an exposure of classical encryption techniques in cyber security and the ideology of cipher text in communication
- To provide the capability to cipher the communication text data by using the techniques studied in the course.

UNIT I Classical Encryption Techniques

Introduction: Security attacks, services & mechanisms, Symmetric Cipher Model, Substitution Techniques, Transportation Techniques, Cyber threats and their defense - Phishing Defensive measures, web based attacks, SQL injection & Defense techniques. Buffer overflow & format string vulnerabilities, TCP session hijacking - ARP attacks, route table modification. UDP hijacking – man in the middle attacks.

UNIT II Block Ciphers & Symmetric Key Cryptography

Traditional Block Cipher Structure, DES, Block Cipher Design Principles, AES-Structure, Transformation functions, Key Expansion, Blowfish, CAST-128, IDEA, Block Cipher Modes of Operations.

UNIT III: Number Theory & Asymmetric Key Cryptography

Number Theory: Prime and Relatively Prime Numbers, Modular Arithmetic, Fermat's and Euler's Theorems, The Chinese Remainder theorem, Discrete logarithms.
Public Key Cryptography: Principles, public key cryptography algorithms, RSA Algorithms, Diffie Hellman Key Exchange, Elgamal encryption & decryption, Elliptic Curve Cryptography.

UNIT IV Cryptographic Hash Functions & Digital Signatures

Secure Hash Algorithm, Message Authentication Functions, Requirements & Security, HMAC &CMAC. Digital Signatures, NIST digital signature algorithm, Key management & distribution.

UNIT V User Authentication, Transport Layer Security & Email Security

User Authentication: Remote user authentication principles, Kerberos Transport Level Security: Web Security Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Shell (SSH) Electronic Mail Security: Pretty Good Privacy (PGP) and S/MIME.

OUTCOMES:

- The student will analyze the importance of encryption in secure communication and will be able to convert the normal text into cipher text.

TEXT BOOKS:

1. William Stallings, “Cryptography & Network Security: Principles and Practices”, PEA, Sixth edition.
2. Chwan Hwa Wu, J.David Irwin., “Introduction to Computer Networks & Cyber Security”, CRC press
3. Russell, Kaminsky, Forest Puppy, “Hack Proofing your Network”, Wiley Dreamtech.

REFERENCES:

1. Keith Martin, “Everyday Cryptography, Fundamental Principles & Applications”, Oxford
2. Bernard Menezes, “Network Security & Cryptography”, Cengage,2010

I Year I Semester	L	P	C
	3	0	3

MULTI SENSOR DATA FUSION
(Program Elective-II)

OBJECTIVE:

- To provide the basics of multi sensor data fusion – sensors and architecture, its representation, alignment and normalization.
- To provide the knowledge of data fusion and sensor management.

UNIT I Sensors and Architecture

Definition, Synergy, Multi-Sensor Data Fusion Strategies, Formal Framework, Catastrophic Fusion organization. Smart. Logical Sensors. Interface File System (IFS). Sensor observation. Sensor Characteristics. Sensor-Sensor Properties. Sensor Model. Fusion Node. Simple Fusion Networks, Network Topology, Software

UNIT II Representation, Alignment and Normalization

Spatial-Temporal Transformation, Geographical Information System, Common Representational Format, Subspace Methods, Multiple Training Sets. Image Registration, Resample/Interpolation, Pair wise Transformation, Image Fusion, Mosaic Image. Dynamic Time Warping, Dynamic Programming, Video Compression. Sensor Value Normalization, Binarization, Parametric Normalization Functions, Fuzzy Normalization Functions, Ranking

UNIT III Bayesian Estimation Theory

Bayesian Inference**,** Bayesian Analysis, Probability Model, A Posteriori Distribution, Model Selection, Computation. Parameter Estimation. Bayesian Curve Fitting, Maximum Likelihood, Least Squares, Linear Gaussian Model, Generalized Millman Formula.

UNIT III Kalman Filter

Robust Parameter Estimation, Classical Robust Estimators, Robust Subspace Techniques, Robust Statistics in Computer Vision. Sequential Bayesian Inference, Recursive Filter, Kalman Filter, Extensions of the Kalman Filter, Particle Filter.

UNIT V Classifiers

Bayesian Decision Theory, Pattern Recognition, Naive Bayes" Classifier, Error Estimation, Pairwise Classifiers. Ensemble Learning, Bayesian Framework, Empirical Framework, Diversity Techniques, Diversity Measures, Classifier Types, Combination Strategies, Boosting.

OUTCOMES:

- The students will understand the basics of multi sensor data fusion, representation, alignment and normalization.
- The student will also have an exposure of different topics such as Bayesian inference, robust parameter estimation, Bayesian decision theory, and pattern recognition and sensor management.

TEXT BOOKS:

1. Mitchell., "Multi-Sensor Data Fusion: An Introduction", Springer (30 July 2007)

REFERENCES:

1. Martin E Liggins, David L. Hall, James Llinas, "Handbook of Multisensor Data Fusion: Theory and Practice", CRC Press; 2 edition (September 26, 2008)
2. HassenFourati (Ed)., "Multisensor Data Fusion: From Algorithms and Architectural Design to Applications (Devices, Circuits, and Systems)", CRC Press (20 August 2015)
3. Jitendra R Raol, "Multi-Sensor Data Fusion with MATLAB", CRC Press (Jan 2010)

I Year I Semester	L	P	C
	2	0	2

RESEARCH METHODOLOGY AND IPR

OUTCOMES:

At the end of this course, students will be able to

- Understand research problem formulation.
- Analyze research related information
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT I

Meaning of research problem, Sources of research problem. Criteria:-Characteristics of a good research problem. Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection,
Analysis, interpretation, Necessary instrumentations

UNIT II

Effective literature studies approaches, analysis Plagiarism and Research ethics

UNIT III

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT IV

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting and development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V

Patent Rights: Scope of Patent Rights. Licensing and transfer oftechnology. Patent information and databases. Geographical Indications.

UNIT VI

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCES:

1. Stuart Melville and Wayne Goddard, "Research methodology: "An Introduction For Science & Engineering Students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guidefor beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.

5. Mayall, “Industrial Design”, McGraw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Propertyin New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

I Year I Semester	**L**	**P**	**C**
	2	**0**	**0**

AUDIT COURSE - I

Note: Please refer Appendix-I

I Year I Semester	L	P	C
	0	4	2

AVIONICS LAB
(Laboratory 1)

I Year I Semester	L	P	C
	0	4	2

LAB BASED ON ELECTIVE I / II
(Laboratory 2)

I Year II Semester	L	P	C
	3	0	3

FLIGHT CONTROL SYSTEMS
(Program Core III)

OBJECTIVE:

- To provide the knowledge of static stability and control of flight system and their equations of motion, aircraft response to control or atmospheric inputs.
- To provide the basic knowledge of classical control theory and modern control theory applied in aircraft design.

UNIT I Static Stability and Control

Introduction: Static Stability and Control, Longitudinal Control, Stick Forces, Definition of Directional Stability, Directional Control, Roll Stability, Roll Control.

UNIT II Aircraft Equations of Motion -1

Introduction , Derivation of rigid Body Equations of Motion, Orientation and Position of the Airplane, Gravitational and Thrust Forces , Small Disturbance theory, Aerodynamic Force and Moment Representation.

UNIT III Aircraft Equations of Motion -2

Pure Pitching Motion, Stick Fixed Longitudinal Motion, Longitudinal Approximations, Influence of Stability Derivatives , Pure Rolling Motion, Pure Yawing Motion, Lateral Direction Equations of Motion.

UNIT IV Aircraft Response to Control or Atmospheric Inputs

Longitudinal Flying Qualities, Lateral Flying Qualities, Inertial Coupling, Equations of Motion in a NonUniform Atmosphere, Pure Vertical or Plunging Motion, Atmospheric Turbulence, Harmonic Analysis – Turbulence Models, Wind Shear.

UNIT V Control Theory applied to Aircraft design

Applications of Classical Control Theory to Aircraft Autopilot Design: - Aircraft Transfer Functions Displacement Autopilot, Stability Augmentation, and Instrument Landing.
Applications of Modern Control Theory to Aircraft Autopilot Design:- Stability Augmentation – Longitudinal Augmentation and Lateral Augmentation, Autopilot Design.

OUTCOMES:

- Students will come to know about static stability of an aircraft and Equations of Motions under different conditions.
- Students will understand the essence of Auto pilot and its design.

TEXT BOOKS:

1. Robert C Nelson., “Flight Stability and Automatic Control”., Tata McGraw-Hill Second 2nd Edition,2007

REFERENCES:

1. RanjanVepa., “Flight Dynamics, Simulation, and Control for Rigid and Flexible Aircraft” CRC Press Taylor & Francis Group, 2015.
2. Blakelock, J.H “Automatic control of Aircraft and missiles” John Wiley Sons, New York, 1990.
3. Stevens B.L & Lewis F.L, “Aircraft control & simulation”, John Wiley Sons, New York, 1992.

I Year II Semester	L	P	C
	3	0	3

AIRCRAFT NAVIGATION SYSTEMS
(Program Core IV)

OBJECTIVE:

- To provide the basics of aircraft navigation systems – radio navigation systems, inertial navigation sensors and systems, satellite navigation system.
- To provide the knowledge of landing aids, air traffic management and SSR, TCAS, ADS-B systems.

UNIT I Radio Navigation Systems

Different Types of navigation, Automatic Direction Finder, VHF Omni-directional Range, Distance Measuring Equipment, Tactical Air Navigation, VORTAC, Doppler Navigation –Beam Configurations, Doppler Frequency Equations, Components of Doppler Navigation System. Radar Altimeters –Pulsed Radar Altimeter, FM CW Radar Altimeter.

UNIT II Inertial Navigation Sensors

Accelerometer - operating principle, classification- open loop pendulous, closed loop pendulous, vibrating beam and interferometric fibre optic accelerometer.
Gyroscope – Coriolis vibrating gyro, optical gyro – RLG, IFOG – Principle of operation, construction and working. MEMS accelerometer and gyro – principle of operation.

UNIT III Inertial Navigation System

Inertial navigation, Geometry of earth, gravitation and gravity, Reference frame ECI, LPI, ECEF and ENU. Navigation in rotating earth frame, Inertial system, Strap-down navigation, error propagation in strap-down INS, strap-down system technology.

UNIT IV Satellite and Hybrid Navigation System

GPS, position and velocity determination- Error sources, GDOP, position computation process. Range error minimization schemes- Differential operation, Dual frequency measurement, Carrier phase measurement. Velocity measurement, Precise Point Positioning (PPP), comparison of INS and GPS. Integrated inertial navigation – processing of measurements, Complimentary nature of sensors, GNSS and INS fusion using Kalman filter.

UNIT V Landing aids, Secondary Surveillance Radar (SSR), TCAS II and ADS-B

Low visibility operation, Mechanics of landing. Instrument Landing System(ILS), Satellite Landing Systems, Carrier-Landing Systems. Introduction, SSR modes, Interrogation, Mode-S. Traffic Alert and Collision Avoidance System (TCAS II) - Introduction, Block diagram. Automatic Dependent Surveillance Broadcast (ADS-B) – benefits, theory of operation.

OUTCOMES:

- The students will analyze the importance of navigation tools and their operation in the heading of aircraft.
- Student will student will understand the operation of SSR, Traffic Alert and Collision Avoidance System and ADS-B.

TEXT BOOKS:

1. Myron Kayton, Walter R. Fried.., "Avionics Navigation Systems". Wiley-Inter science 2nd edition, 2009.
2. Amitava Bose, K.N.Bhat, Thomas Kurian, "Fundamentals of Navigation and inertial sensors" PHI learning Private limited, 2014.
3. Byron Edde, "Radar Principles, Technology, Applications", LPE, Pearson 1995.

REFERENCE:

1. Mike Tooley, David Wyatt, "Aircraft Communications & Navigation Systems: Principles, Operation and Maintenance", Butterworth-Heinemann an imprint of Elsevier, 2009
2. Mohinder S. Grewal, Lawrence R. Weill, Angus P. Andrews., "Global Positioning Systems, Inertial Navigation and Integration". Wiley-Interscience; 2nd edition,2013

I Year II Semester	L	P	C
	3	0	3

AVIONICS EMBEDDED SYSTEMS
(Program Elective-III)

OBJECTIVE:

- To provide the basic knowledge on elements of embedded systems, RTOS and their importance.
- To provide the approach of model based embedded system design.

UNIT I Introduction to Embedded Systems

Categories, Overview of architecture, Characteristics, Recent trends, Architecture of Embedded systems: Hardware Architecture: CPU, Memory, Clock, Watchdog timer, I/O, Debug port, Communication interface, Power Supply. Software Architecture: Operating System, Application software, communication software, Executable image, development/Test tools.

UNIT II Embedded System Development

Development Process, Requirements, Design, Implementation, Integration and Testing, Packaging, Configuration Management. ARP-4754 Standard for systems engineering guidelines. Do-254 Standard for hardware development guidelines. DO-178C Standard for Software development guidelines.

UNIT III RTOS

Real time concepts, Kernel Structure, Tasks and Scheduler, Time Management, Event Control blocks, Semaphore management, Mutex, Event Management, Message mail box management, Message Queue management, memory management.

UNIT IV Modeling Dynamic Behaviors-1

Continuous Dynamics :-Newtonian Mechanics, Actor Models, Properties of Systems, Feedback Control. Discrete Dynamics:-Discrete Systems, The Notion of State, Finite-State Machines, Extended State Machines, Non-determinism, Behaviors and Traces. Hybrid Systems: Modal Models, Classes of Hybrid Systems.

UNIT V Modeling Dynamic Behaviors-2

Composition of State Machines: Concurrent Composition, Hierarchical State Machines. Concurrent Models of Computation: Structure of Models, Synchronous-Reactive Models, Dataflow Models of Computation, Timed Models of Computation.

OUTCOMES:

1. Students will know the key elements and design process of model based embedded system design and different avionics hardware and software standards.

TEXT BOOKS:

1. Edward Ashford Lee and Sanjit Arun kumar Seshia, „Introduction to Embedded Systems: A cyber physical systems approach", second edition, MIT Press 2017.
2. K.V.K.K.Prasad., "Embedded /Real-Time Systems: Concepts, Design & Programming", Dreamtech Press, 2012.

REFERENCES:

1. Frank Vahid, Tony Givargis., "Embedded System Design: A Unified Hardware/Software Approach". Wiley India Edition, 3rd Ed, 2001.
2. Wayne Wolf., "Computers as Components –Principles of Embedded Computer System Design". Morgan Kaufman Publisher, 2006.
3. Raj Kamal. "Embedded Systems Architecture, Programming and Design"., Tata McGraw Hill, 2nd Ed, 2009

I Year II Semester	L	P	C
	3	0	3

AVIONICS NETWORK TECHNOLOGY
(Program Elective-III)

OBJECTIVE:

- To provide the basic knowledge about optical networks, aeronautical telecommunication networks and wireless sensor network attributes.
- To provide the knowledge of wireless sensor network architecture, wideband wireless communication and networks for military avionics.

UNIT I Optical Networks

Fiber channel- WDM LAN- Fiber channel-RF over fiber- Highly integrated photonics (HIP)-Routing in optics- Amplification in optics.

UNIT II ATN (Aeronautical Telecommunication Network)

ATN Concepts – ATN functionality – ATN Components – End Systems – ATN physical and administrative structures – ATN planning and implementation process – ATN Router. Military Gigabit type – Ethernet Architecture – Modems - Wideband mobile routers – Smart router – IP Address in cockpit.

UNIT III Wireless Sensor Network Attributes

Introduction-Challenges for wireless sensor networks-Comparison of sensor network with ad hoc network-single node architecture-Hardware components-energy consumption of sensor nodes.

UNIT IV Wireless Sensor Network Architecture

Network architecture-sensor network scenarios-types of sources and sinks-single hop versus multihop networks-multiple sinks and sources-Design principles:-Development of wireless sensor networks-Application-military-Target detection tracking-Habitat monitoring-Environmental disaster monitoring.

UNIT V Wideband Wireless Communication and Networks for Military Avionics

Communication data link (CDL) - IP based routing in FBW-Smart antenna networking.

OUTCOMES:

- The students will analyze the basics of avionics network technology.

TEXTBOOKS:

1. Carry Spitzer, “Avionics Data Buses”, Fifth edition 2005.
2. Frank Gross, “Smart Antennas for Wireless Communication”, Wiley Publications, second edition 2004.
3. Hamed Al-Raweshidy, Shozo Komaki. “Radio Over Fiber Technology for Mobile Communication Network”, Artech House 2002.
4. Fengzhao, Leonidas Guibas, “Wireless Sensor Networks: An Information Processing Approach”, Elsevier publication, 2004.

REFERENCES:

1. C.S.Raghavendra Krishna, M.Sivalingam and Taripznati, “Wireless Sensor Networks”, Springer publication, 2004.
2. H.Callaway, “Wireless Sensor Networks: Architecture and Protocol”, Edgar, CRS press 2004.

I Year II Semester	L	P	C
	3	0	3

MISSILE AND SPACE VEHICLE GUIDANCE AND CONTROL
(Program Elective-III)

OBJECTIVE:

- To provide the basics of missile airframes, autopilots, missile guidance laws and control.
- To provide the knowledge of strategic missiles, orbital mechanics, satellite guidance.

UNIT I Missile Airframes, Autopilots and Control

Missile aerodynamics:- Force Equations, Moment Equations, Phases of missile flight, Missile control configurations. Missile Mathematical Model, Autopilots - Definitions, Types of Autopilots, Example Applications.Open-loop autopilots, Inertial instruments and feedback. Autopilot response, stability, and agility: - Pitch Autopilot Design, Pitch-Yaw-Roll Autopilot Design.

UNIT II Missile Guidance Laws

Tactical Guidance Intercept Techniques, Derivation of the Fundamental Guidance Equations, explicit, Proportional Navigation, Augmented Proportional Navigation, beam riding, bank to turn missile guidance, Three-Dimensional Proportional Navigation, comparison of guidance system performance, Application of Optimal Control of Linear Feedback Systems.

UNIT III Strategic Missiles

Introduction, The Two-Body Problem, Lambert„s Theorem, First-Order Motion of a Ballistic Missile Correlated Velocity and Velocity-to-Be-Gained Concepts, Derivation of the Force Equation for Ballistic Missiles, Atmospheric Reentry, Ballistic Missile Intercept, Missile Tracking Equations of Motion, Introduction to Cruise Missiles , The Terrain-Contour Matching (TERCOM) Concept.

UNIT IV Orbital Mechanics

Orbital Transfers:-Impulse Transfer between Circular Orbits, Hofmann Transfer, Other Coplanar and Non-coplanar Transfers-Orbital Plane Changes.

UNIT V Satellite Guidance

Space Flight, Space Vehicle Trajectories, Launch Vehicle Guidance Implicit and Explicit Guidance-Open loop and Closed loop Guidance, FE guidance- E guidance-VG guidance-Q guidance-Delta guidance.

OUTCOMES:

- The students will analyze the basic concepts of missiles and their design system.
- The students will also have an exposure on various topics such as satellite missiles, orbital transfers, space flight, Space vehicle guidance.

TEXTBOOKS:

1. Roger R. Bate, 'Fundamentals of Astrodynamics", Dover Publications Inc., New York, 1971.
2. Francis Joseph Hale, 'Introduction to Space Flight", Prentice-Hall Inc., 1994.
3. Marshall H. Kaplan , „Modern Spacecrafts Dynamics and Control", John Wiley & Sons.
4. Edward V. B. Stearns, „Navigation and Guidance in Space", Prentice-Hall Inc., Englewood Cliffs, New Jersey.

REFERENCES:

1. William E. Wiesel, „Space Flight Dynamics", McGraw-Hill Book Company, Third Edition, 2010.
2. Siouris, G.M, "Missile Guidance and control systems", Springer, 2003.

I Year II Semester	L	P	C
	3	0	3

AIRCRAFT UTILITY SYSTEMS
(Program Elective-IV)

OBJECTIVE:

- To provide the basics of aircraft utility systems – fuel systems, Engine control systems, Electrical systems.
- To provide the knowledge of Environmental control and emergency systems, hydraulic systems in the aircraft.

UNIT I Fuel Systems

Characteristics, Fuel system components, Fuel System Operating Modes:-pressurisation, Engine feed, Fuel transfer, Refuel Defuel, Fuel jettison. Integrated Civil Aircraft Systems, Fuel Tank Safety, Polar Operations, Cold Fuel Management.

UNIT II Engine Control Systems

Engine/Airframe Interfaces, The control problem- Fuel flow, Air flow, control system. Engine starting, Engine Oil Systems, Engine Off takes, Reverse Thrust, Engine Control on Modern Civil Aircraft-FADEC.

UNIT III Electrical and Hydraulic Systems

Electrical Power Evolution, Aircraft Electrical system, Aircraft Electrical power generation types, Primary Power Distribution, Secondary Power Distribution, Typical Aircraft DC System, Electrical loads, Emergency Power Generation.

Hydraulic Systems – Introduction, Hydraulic Circuit Design, Hydraulic Actuation, A380 and B767 Hydraulic system. Landing Gear Systems:- Nose Gear, Main Gear, Braking Anti-Skid and Steering, Electronic Control, Automatic Braking, Multi-Wheel Systems, Brake Parachute.

UNIT IV Environmental Control and Emergency Systems

Need for a Controlled Environment, Environmental Control System Design, Cabin pressurization system, Hypoxia, oxygen system, g- tolerance, Anti-Misting and De-Misting, Aircraft Icing.

Emergency Warning Systems, Fire Detection and Suppression, Explosion Suppression, Emergency Oxygen, Passenger Evacuation, Crew Escape, Computer Controlled Seats, Emergency Landing.

UNIT V Flight Management System (FMS)

Introduction: Fundamentals, Navigation – Performance and receiver management. Flight planning-Flight plan construction; Lateral flight planning, Vertical flight planning. Trajectory predictions:-Lateral profile, vertical profile. Performance computations – Speed schedule computation, Maximum and optimum altitudes. Guidance: – Lateral and vertical guidance.

OUTCOMES:

- The students will understand the mechanical, electrical and avionics subsystems in the aircraft.
- Students will get an exposure of environmental controls and emergency systems in the aircraft.

TEXT BOOKS:

1. Ian Moir, Allan Seabridge., "Aircraft Systems - Mechanical, electrical, and avionics subsystems integration". Wiley; 3rd edition, 2008

REFERENCES:

1. EHJ Pallet**.,** **"**Aircraft Electrical systems*"*. Prentice Hall; 3 edition , 1997
2. Ian Moir, Allan Seabridge., "Military Avionics Systems". AIAA ,2006
3. Ian Moir, Allan Seabridge, Malcolm Jukes., "Civil Avionics Systems". Wiley; 2nd edition, 2013

I Year II Semester	L	P	C
	3	0	3

FLYING ROBOTICS
(Program Elective-IV)

OBJECTIVE:

- To provide the basic knowledge of embedded robotics – controllers, sensors and actuators, multitasking and wireless communication.
- To provide the exposure of mobile robot design, localization, navigation and maze exploration, map generation and real-time image processing.

UNIT I Robots & Controllers, Sensors and Actuators

Mobile Robots Embedded Controllers, Interfaces, Operating System. Sensor Categories, Binary Sensor, Analog versus Digital Sensors, Shaft Encoder, A/D Converter, Position Sensitive Device, Compass, Gyroscope, Accelerometer, Inclinometer, Digital Camera. DC Motors, H-Bridge, Pulse Width Modulation, Stepper Motors, Servos

UNIT II Control, Multitasking and Wireless Communication

On-Off Control, PID Control, Velocity Control and Position Control, Multiple Motors – Driving, Straight, V-Omega Interface. Cooperative Multitasking, Preemptive Multitasking, Synchronization, Scheduling, Interrupts and Timer-Activated Tasks. Communication Model, Messages, Fault-Tolerant Self-Configuration, User Interface and Remote Control, Sample Application Program

UNIT III Localization & Navigation and Maze Exploration

Localization ,Probabilistic Localization ,Coordinate Systems, Dijkstra"s Algorithm, A* Algorithm, Potential Field Method ,Wandering Standpoint Algorithm, DistBug Algorithm, Micro Mouse Contest ,Maze Exploration Algorithms ,Simulated versus Real Maze Program

UNIT IV Map Generation and Real-Time Image Processing

Control System and Sensors, Path Planning, Mapping Algorithm, Data Representation, Boundary-Following Algorithm, Algorithm Execution, Camera Interface, Auto-Brightness, Edge Detection, Motion Detection, Color Space Color Object Detection, Image Segmentation, Image Coordinates versus World Coordinates.

UNIT V Neural Networks and Genetic Algorithms

Neural Network Principles, Feed-Forward Networks, Back propagation, Neural Network Example, Neural Controller. Genetic Algorithm Principles, Genetic Operators, Applications to Robot Control, Example Evolution, Implementation of Genetic Algorithms.

OUTCOMES:

- The students will analyze the basics of embedded robotics and their design and operation.
- The students will also have an exposure on various topics such as neural networks and genetic algorithms.

TEXT BOOKS:

1. Thomas Bräunl, "Embedded Robotics", Second Edition, Springer-Verlag Berlin Heidelberg, 2006.
2. Ben-Zion Sandier, "ROBOTICS-Designing the Mechanisms for Automated Machinery", Second Edition 1999

I Year II Semester	L	P	C
	3	0	3

NETWORK CENTRIC WARFARE
(Program Elective – IV)

OBJECTIVE:

- To provide the basic knowledge of electronic warfare systems, signal emitters and sensors of avionics engineering.
- To provide the understanding of electronic warfare RF band sensor systems, RF direction finding, emitter location techniques and electronic counter measure techniques.

UNIT I Introduction to Electronic Warfare Scenarios

Definitions and EW Role in the Military Field, Main Weapons Systems of Interest to EW- Artillery Systems, Missile Systems, Active Homing Missiles, Track via Missile Systems, Passive IR-Guided Missiles, Sea-Skimming Missiles, Anti-Radiation Missiles. EW in Symmetric Conflicts, EW in Asymmetric Conflicts.

UNIT II Signal Emitters and Sensors

Signal Electromagnetic spectrum and Atmospheric Propagation, Radar Principles and types- Radar Equation, Radar Structure, Radar Clutter Signal Processing, radar signal Processing Fundamentals, EO Thermal Imagers- MRT, IR Missile Seekers, IR Missile Detection Range, IR Missile Seeker CCM, Missile Approach Warner, Laser Radar Systems- Laser Target Designation and Ranging, Laser Radar Receivers, Laser Radar Range Equation, Target Detection.

UNIT III Electronic Warfare RF Band Sensor Systems

EW Radar Band Sensors-RWR Architecture, ESM Architecture, ELINT Architecture. EW Sensor Sensitivity, Probability of Interception, EW Radar Band Sensor Architectures, Detection and Classification of LPI Radars, Emitter De-interleaving and Sorting, Emitter Identification, Communications ESM, CESM, COMINT, SIGINT.

UNIT IV RF Direction-Finding and Emitter Location Techniques

Amplitude Comparison DF Methods, Phase Comparison, Mono pulse DF Measurement Methods, Time-Difference DF, Emitter Location - Triangulation, Trilateration, Frequency Difference on Arrival, Passive Location Technique, Inverse Passive Location.

UNIT V Electronic Countermeasure Systems and Electronic Counter- Counter Measures (ECCM)

Typical RECM Requirements and Missions, EW Radar Jamming Equation, Radar ECM Architecture, Digital Radio-Frequency Memory, Phase-Sampled DRFMs, Radar ECM Transmitters, Chaff, Communication ECM Systems, Infrared ECM Systems, Flares.

ECM Principles and Techniques Used Against Surveillance Radars and Related ECCMs, ECM Principles and Techniques Used Against Tracking Radars and Related ECCMs, ECM Principles and Techniques Used Against Communication Systems.

OUTCOMES:

- The student will understand equipment associated with electronic warfare and their operating mechanism.

TEXT BOOKS:

1. Andrea De Martino, “Introduction to Modern EW Systems”., Artech House,2012
2. D. Curtis Schleher., “Introduction to Electronic Warfare”., Artech House Publishers;1st edition,1986.

REFERENCES:

1. Sergei A. Vakin, Lev N. Shustov, Robert H. Dunwell., “Fundamentals of Electronic Warfare”., Artech Print on Demand; 1st edition (June 15,2001)
2. D. Curtis Schleher., “Electronic Warfare in the Information Age”., Artech House (June 30,1999).

I Year II Semester	**L**	**P**	**C**
	2	**0**	**0**

Audit Course II

Note: Please refer Appendix-I

I Year II Semester	L	P	C
	0	4	2

GUIDANCE, NAVIGATION AND CONTROL LAB

(Laboratory 3)

I Year II Semester	L	P	C
	0	4	2

LAB Based on Program Electives III / IV

(Laboratory 4)

I Year II Semester	L	P	C
	0	4	2

MINI PROJECT WITH SEMINAR

II Year III Semester	**L**	**P**	**C**
	3	**0**	**3**

AEROSPACE ELECTROMAGNETIC COMPATIBILITY
(Program Elective-V)

OBJECTIVE:

- To provide the basic knowledge of sources of EMI and EMC, electromagnetic environment in aircraft and effects of EMI on aircraft and analysis.
- To provide the knowledge of avionics subsystems radiated and conducted measurements, EMI effects in flight control systems and their mitigations.

UNIT I Introduction to Sources of EMI and EMC

Electromagnetic environment, Concepts, Practical experiences & concerns, Natural and Nuclear sources of EMI, Electromagnetic emissions, Noise from relays and switches, Non-linearities in circuits, passive inter-modulation, Cross talk in transmission lines, Transients in power supply lines, Electromagnetic Interference Principles and types of grounding, Shielding and bonding,

UNIT II Effects of EMI on Aircraft and Analysis

HEMP Threat to Aircraft, HEMP Coupling to Aircraft, Shielding and Shielding topology, General Approach to Analysis of HIRF/ Lighting effects, Functional Hazard Analysis, Outline of Coupling Process, Lighting interactions with Aircraft, Avionic Equipment functional verification in presence of lighting induced electrical transients, Precipitation Static (P-Static)

UNIT III Avionics Subsystems Radiated and Conducted Measurements

Aim of Subsystem Level Testing, Motivations for Testing, Test Plans for Avionics Sub-Systems.
Open area test sites and measurements. Anechoic chamber, TEM cell, GTEM Cell, Characterization of conduction currents and voltages, Conducted EM noise on power lines, Conducted EMI from equipment, Immunity to conducted EMI, Detectors and measurements.

UNIT IV EMI Effects in Flight Control Systems and their Mitigations.

Analysis of the Contemporary Aerial EME, The Sensitivities of a Flight-Critical System, Elements of FBW System and Their Susceptibility to EMI, EMI Susceptibilities of FMS, Relevant EMC Standards, EMC Test Methodologies of FCS.

UNIT V EMI Effects on Unmanned Flight Control Systems

EMI Susceptibilities of UAV Flight Control System, How EMI Couples to FCS, Modeling and Simulation, Some Special Considerations for EMI Mitigation.

OUTCOMES:

- The students will analyze the sources of EMI and EMC, Electromagnetic environment in aircraft, Effects of EMI on aircraft.
- The students will also have an exposure on EMI mitigation techniques and industrial standards of avionics system engineering.

TEXT BOOKS:

1. Dr. V.P. Kodali., "Engineering Electromagnetic Compatibility", IEEE Publication, Printed in India by S. Chand & Co. Ltd., New Delhi, 2010.

2. Reinaldo J. Perez, “Handbook of Aerospace Electromagnetic Compatibility”, IEEE Publication, Published by John Wiley & Sons.

REFERENCES:

1. Clayton R Paul., “Introduction to Electromagnetic Compatibility”, John Wiley, 2010
2. Christos Christopoulos, “Principles and Techniques of EMC”, CRC press, 2nd Ed, 2007.

II Year III Semester	L	P	C
	3	0	3

UNMANNED AIRCRAFT SYSTEMS
(Program Elective-V)

OBJECTIVE:

- To introduce basic concepts of UAV.
- To understand the basics of airframe.
- To understand the avionics hardware.
- To know communication payloads and controls and design considerations.
- To study path planning, Micro Aerial Vehicles and UAV certification standards and application.

UNIT I Introduction to UAV

History and Overview, Classes and Missions of UAV"s, System composition, some applications of Unmanned Aircraft Systems

UNIT II Design of UAV Systems

Introduction to design and selection of the system, Aerodynamics and airframe configurations, Characteristics of Aircraft Types, Aspects of airframe design, Design for stealth, Data links – Data link functions and attributes.

UNIT III Communication and Navigation of UAV

Communication media: Radio communication, Mid-air collision (MAC) Avoidance, Communications Data Rate and Bandwidth Usage, Antenna Types, NAVSTAR Global Positioning System, TACAN, LORAN C, Inertial Navigation, Radio Tracking, Way-point Navigation, Control Stations, Support Equipment and Transportation.

UNIT IV Development of UAV Systems

Introduction to 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, System in-flight testing – Test sites, Preparation for In-flight Testing, In-flight Testing and Certification.

UNIT V UAV Payloads

Reconnaissance/Surveillance payloads-overview, image sensors, search process, other considerations. Weapon payloads – History of lethal unmanned aircraft, Design issues related to carriage and delivery of weapons, other issues related to combat operations, other payloads.

OUTCOMES:

- Upon completion of this course, students will explain the advanced concepts of UAV System Design to the engineers and provide the necessary mathematical knowledge that is needed in modeling and analyzing an unmanned system.
- The students will have an exposure on various topics such as Design and development of UAVs, payloads and design standards, concluding with case studies of different such unmanned systems and will be able to deploy these skills effectively in the solution of problems in avionics engineering.

TEXTBOOKS:

1. Paul Gerin Fahlstorm and Thomas James Gleason, „Introduction to UAV systems", Wiley Publicaion-2012.
2. Reg Austin, „Unmanned Aircraft Systems – UAVS Design, Development and Deployment", Wiley Publication-2010

REFERENCES:

1. Haiyang Chao and Yang Quan Chen, "Remote sensing and actuation using UAV", IEEE Press.

II Year III Semester	**L**	**P**	**C**
	3	**0**	**3**

ARTIFICAL INTELLIGENCE AND MACHINE LEARNING
(Program Elective-V)

Note: This subject will be offered through MOOCS program.

II Year III Semester	**L**	**P**	**C**
	3	**0**	**3**

(Open Elective)

Open Elective choices

1. Business Analytics
2. Industrial Safety
3. Operations Research
4. Cost Management of Engineering Projects
5. Composite Materials
6. Waste to Energy

Note: Please refer Appendix-II for Syllabus

Appendix I:

Audit 1& 2 Syllabus

ENGLISH FOR RESEARCH PAPER WRITING

Course objectives:
Students will be able to:
1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

Unit 1
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit 2
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

Unit 3
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Unit 4
key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Unit 5
skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

Unit 6
useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Suggested Studies:
1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
Model Curriculum of Engineering & Technology PG Courses [Volume-I]
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman‟s book .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

DISASTER MANAGEMENT

Course Objectives: -Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

1. Introduction

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

2 .Repercussions Of Disasters And Hazards

Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods,Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills,Outbreaks Of Disease And Epidemics, War And Conflicts.

3. Disaster Prone Areas In India

Study Of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

4. Disaster Preparedness And Management

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

5. Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People"s Participation In Risk Assessment. Strategies for Survival.

6. Disaster Mitigation

Meaning, Concept and Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

Suggested Readings:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects
4. enhancing the memory power
5. The engineering scholars equipped with Sanskrit will be able to explore the
6. huge knowledge from ancient literature

Unit 1

Alphabets in Sanskrit,
Past/Present/Future Tense,
Simple Sentences

Unit 2

Order
Introduction of roots
Technical information about Sanskrit Literature

Unit 3

Technical concepts of Engineering-Electrical, Mechanical,
Architecture, Mathematics

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India‟s Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

VALUE EDUCATION

Course Objectives

Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Unit 1

- 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 2

- 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 3

- 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 4

- 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

Suggested reading

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

Course outcomes

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. 3. Developing the overall personality

CONSTITUTION OF INDIA

Course Objectives:
Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals" constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Unit 1 History of Making of the Indian Constitution:
History Drafting Committee, (Composition & Working)

Unit 2 Philosophy **of the Indian Constitution:**
Preamble Salient Features

Unit 3 Contours **of Constitutional Rights & Duties:**

- Fundamental Rights
- Right to Equality
- Right to Freedom
- Right against Exploitation
- Right to Freedom of Religion
- Cultural and Educational Rights
- Right to Constitutional Remedies
- Directive Principles of State Policy
- Fundamental Duties.

Unit 4 Organs **of Governance:**

- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions
- Executive
- President
- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

Unit 5 Local **Administration:**

- District"s Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.
- Pachayati raj: Introduction, PRI: Zila Pachayat.
- Elected officials and their roles, CEO Zila Pachayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,

- Importance of grass root democracy

Unit 6 Election Commission:

- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the welfare of SC/ST/OBC and women.

Suggested reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

PEDAGOGY STUDIES

Course Objectives:

Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

Unit 1 Introduction and Methodology:

- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

Unit 2

- Thematic overview: Pedagogical practices are being used by teachers informal and informal classrooms in developing countries.
- Curriculum, Teacher education.

Unit 3

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers" attitudes and beliefs and Pedagogic strategies.

Unit 4

- Professional development: alignment with classroom practices and follow- 4 up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

Unit 5

- **Research gaps and future directions**
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, „learning to read" campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

STRESS MANAGEMENT BY YOGA

Course Objectives

1. To achieve overall health of body and mind
2. To overcome stress

Unit 1 Definitions of Eight parts of yog. (Ashtanga)

Unit 2 Yam and Niyam.
Do`s and Don"t"s in life.
i) Ahinsa, satya, astheya, bramhacharya and aparigraha
ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Unit 3 Asan and Pranayam
i) Various yog poses and their benefits for mind & body
ii)Regularization of breathing techniques and its effects-Types of pranayam

Suggested reading

1. „Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Outcomes:

Students will be able to:
1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Objectives
1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Unit 1
Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont"s)
- Verses- 71,73,75,78 (do"s)

Unit 2

- Approach to day to day work and duties.
- Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17,23, 35,
- Chapter 18-Verses 45, 46, 48.

Unit 3

- Statements of basic knowledge.
- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Suggested reading
1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication
2. Department), Kolkata
3. Bhartrihari"s Three Satakam (Niti-sringar-vairagya) by P.Gopinath,
4. Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes
Students will be able to
1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

Appendix II:

Open Elective Syllabus

BUSINESS ANALYTICS

OBJECTIVE:

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

UNIT1

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and
estimation methods overview.

UNIT II

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT III

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT IV

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with
Casual Variables, Selecting Appropriate Forecasting Models.Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT V

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

UNIT VI

Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

OUTCOMES:

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

REFERENCE:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

INDUSTRIAL SAFETY

UNIT I

Industrial safety: Accident, causes, types, results and control, mechanical and electricalhazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii.Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

REFERENCE:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

OPERATIONS RESEARCH

UNIT I
Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT II
Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

UNIT III
Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

UNIT IV
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT V
Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

OUTCOMES:
At the end of the course the student should be able to,
1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2. Students should able to apply the concept of non-linear programming.
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

REFERENCES:
1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

COST MANAGEMENT OF ENGINEERING PROJECTS

UNIT I
Introduction and Overview of the Strategic Cost Management Process

UNIT II
Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT III
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities.Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts.Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

UNIT IV
Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis.Various decision-making problems.Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector.Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets.Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT V
Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

REFERENCES:
1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

COMPOSITE MATERIALS

UNITI

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites.Functional requirements of reinforcement and matrix.Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures.
Isostrain and Isostress conditions.

UNIT III

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT IV

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT V

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain
criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

REFERENCES:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

WASTE TO ENERGY

UNIT I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

UNIT II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixedbed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion – Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

REFERENCES:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons,1996.

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