# Revised List of Open Electives

**To be Offered in the Even Semester (MIT Campus)**

**R-2019**

## Faculty of Mechanical Engineering

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<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
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## Faculty of Electrical Engineering

|             | **Department of Instrumentation Engineering**     |          |                |
| B.E. Electronics and Instrumentation Engineering |             |                                                  |          |                |
| 14.        | EI5691     | Introduction to Industrial Instrumentation and Control | OE   | 3 0 0 3       |
| 15.        | EI5692     | Introduction to Industrial Data Communication    | OE       | 3 0 0 3       |

## Faculty of Information and Communication Engineering

|             | **Department of Information Technology**          |          |                |
| B.Tech. Information Technology |             |                                                  |          |                |
| 16.        | IT5695     | Basics of Programming and Data Structures        | OE       | 3 0 0 3       |
| 17.        | IT5696     | Fundamentals of Information Security             | OE       | 3 0 0 3       |

## Faculty of Electronics Engineering

<p>|             | <strong>Department of Electronics Engineering</strong>         |          |                |
| B.E. Electronics and Communication Engineering |             |                                                  |          |                |
| 18.        | EC5695     | Microcontroller Programming for Industrial Applications | OE | 3 0 0 3       |
| 19.        | EC5696     | Introduction to Communication Systems            | OE       | 3 0 0 3       |</p>
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OBJECTIVES

- The ability to use statistical tools to characterize the reliability of an item.
- The working knowledge to determine the reliability of a system and suggest approaches to enhancing system reliability.
- The ability to select appropriate reliability validation methods.
- To identify and correct the causes of failures.
- To improve effectiveness and efficiency of maintenance.

UNIT I  RELIABILITY BASICS  9

UNIT II  LIFE DATA ANALYSIS  9

UNIT III  RELIABILITY EVALUATION  9
Reliability of simple systems - Different configurations – Redundancy – m/n system – Complex systems: RBD – Boolean truth table – Cut and tie sets – Fault Tree Analysis – Standby system.

UNIT IV  RELIABILITY TRACKING  9

UNIT V  MAINTAINABILITY  9

TOTAL: 45 PERIODS

OUTCOMES:

- Analyse the interference between strength and stress, or life data for estimating reliability;
- Apply the appropriate methodologies and tools for enhancing the inherent and actual reliability of components and systems, taking into consideration cost aspects; specify life test plans for reliability validation

REFERENCES
OBJECTIVES

- To appreciate and follow nature’s design
- To understand living organism body interfaces with surrounding environment
- To learn sensing organs and path navigation in vertebrates
- To understand the working principles of mobility by various living organisms
- To introduce the ways of recreating biomimetic structures

UNIT I  OVERVIEW OF BIOMIMETICS  9
Basic principles, building blocks, material property charts, nature’s designs, examples of successful biomimetic designs.
Mechanical design – hierarchical construction, bio-composites, structure & properties of bamboo, silks, bones, teeth, shells, antlers and beaks, impact resistance, fracture mitigation, damping, self-healing.

UNIT II  BIO INSPIRED SURFACES  9
Biological information, Dealing with friction, Muscles and artificial muscles, lotus effect, gecko adhesion,
Desert beetle, pitcher plants, bio-fouling, coating, Silver ant and heat dissipation, insulation of fur and feathers, constructal theory.

UNIT III  BIO INSPIRED SENSORS  9
Biological sensors, Bio-inspired sensors- structural colours, compound eyes, antireflection, stealth, imaging. Navigation – short & long range navigation techniques of bees, ants, turtles - migratory birds

UNIT IV  BIO INSPIRED MOBILITY  9
Mechanical stiffness and motion, Neural control, Robot controllers, Running, Robustness, Crawling – Soft robotics, Gliding and Flapping flight, Hydrostatic stiffness and motion - Swimming-Macroscale walking, Macroscale flying.

UNIT V  FABRICATION FOR MICRO/NANO STRUCTURES  9

OUTCOMES
- To describe the nature’s design in damping, light weight high strength, self-healing etc.
- To elucidate living organism physical interactions with environment
- To relate the modern electronics to natural sensing organs and path navigation in vertebrates
- To explain the conceptual working principles of mobility by various living organisms
- To state the ways of manufacturing biomimetic nano/micro structures

TEXT BOOKS
2. Lakhtakia A, Martin-Palma RJ (eds); Engineered biomimicry; Elsevier, 2013

REFERENCES
COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Classifying the types of chassis and identify different class of automobiles
2. Outline the hybrid vehicle system architecture and their merits and demerits.
3. Illustrating the functions of various transmission systems.
4. Imparting the working of different braking and steering systems.
5. Understanding the working of electrical and electronic components

UNIT I INTRODUCTION
Types of automobiles, vehicle construction and different layouts, chassis, frame and body, Aerodynamic Drag, Specifications, Performance Parameters, Bharat New Vehicle Safety Assessment Program (BNVSAP) – Crash Test norms.

UNIT II HYBRID ELECTRIC VEHICLES
History and need for electric and hybrid vehicles, Concept of hybrid electric drive train, architecture of series and parallel hybrid electric drive train, merits and demerits, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles, Fuel cell vehicles, comparison of diesel, petrol, electric and hybrid vehicles based on performance and emissions, limitations of electric vehicles and technical challenges.

UNIT III TRANSMISSION SYSTEMS
Clutch-types and construction, gear boxes, manual and automatic, propeller shaft, slip joints, universal joints, Differential, and rear axle.

UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS

UNIT V SAFETY AND COMFORT SYSTEMS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Distinguish the different types of automobiles and chassis.
2. Interpret the various types of engines and their emission control.
3. Select the appropriate transmission systems.
4. Compare the braking and steering systems.
5. Infer the functions of different electrical and electronic components.

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Applying the principles of generic development process; and understanding the organization structure for new product design and development.
2. Identifying opportunity and planning for new product design and development.
3. Conducting customer need analysis; and setting product specification for new product design and development.
4. Generating, selecting, and screening the concepts for new product design and development.
5. Testing and prototyping the concepts to design and develop new products.

UNIT I INTRODUCTION TO PRODUCT DESIGN & DEVELOPMENT 9

UNIT II OPPORTUNITY IDENTIFICATION & PRODUCT PLANNING 9

UNIT III IDENTIFYING CUSTOMER NEEDS & PRODUCT SPECIFICATIONS 9

UNIT IV CONCEPT GENERATION & SELECTION 9

UNIT V CONCEPT TESTING & PROTOTYPING 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply the principles of generic development process; and understand the organization structure for new product design and development.
2. Identify opportunity and plan for new product design and development.
3. Conduct customer need analysis; and set product specification for new product design and development.
4. Generate, select, and screen the concepts for new product design and development.
5. Test and prototype the concepts to design and develop new products.

TEXT BOOK:

REFERENCES:
OBJECTIVES:
- To introduce the various layout of vehicle chassis, engine types.
- To expose the need, constructional details and working principle of various clutches.
- To envisage the working of manual transmission systems.
- To explicate the operating principle of various automatic transmission systems.
- To relate the importance of driveline components, wheels and tyres.

UNIT I  INTRODUCTION

UNIT II  CLUTCH

UNIT III  GEAR BOX

UNIT IV  AUTOMATIC TRANSMISSION

UNIT V  FINAL DRIVE AND DIFFERENTIAL

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course the students will,
- Visualize the power flow of various vehicle layouts.
- Understand the working principle the various positive engagement clutches.
- Appraise upon the constructional details and working principle of the manual transmission systems.
- Compare and contrast between various automatic transmission systems.
- Summarize the significant driveline components, wheels and tyres.

TEXT BOOKS

REFERENCES:
OBJECTIVES
- Identify various Engine layout for Two wheeler.
- Evaluate the necessity of Engine subsystems in Two Wheeler.
- Selection of Transmission system for Two wheeler
- Selection of Brakes, Wheels and Tyres for Two wheeler.
- Evaluate the current Two-wheeler technological advancements.

UNIT I        POWER PLANT  9
Two Stroke and Four Stroke SI and CI Engine Construction and Working, Limitations of CI engines
in Two wheelers, Valve and Port Timing, Scavenging in Engines. Exhaust systems. Introduction to
E-bike and its components.

UNIT II       ENGINE SUB – SYSTEMS AND STARTING SYSTEM  9
Fuel System – Carburetor System, Fuel Injection System. Ignition Systems- Magneto coil and
Battery Coil Spark Ignition System, Electronic Ignition System. Cooling Systems. Lubrication

UNIT III      STRUCTURE AND SUB – SYSTEMS  9
Types of Frame and its Layout, Clutches, Gear box -Types, CVT, Need for Freewheeling devices.

UNIT IV       BRAKES AND WHEELS  9
Need for Braking System, Types of Brakes -Construction and Working of Drum Brakes, Disc
Brakes. Types of Wheels – Construction of Wheel. Types of Tyres – Tubeless Tyres and Tubed
Tyres, Radial Tyres and Cross Ply Tyres, Speed and Load Rating. Two wheeler Testing

UNIT V        ELECTRICAL SYSTEM AND RECENT TRENDS  9
Instrumentation and Controls on Handle Bar. Types of Head Lamps – LED, HID. Head Lamp

OUTCOMES
On successful completion of this course students will be able to:
- Understand the assembly and layout pattern of Two Wheelers Engine.
- Understand the Ignition system and Fuel system involved in two wheelers.
- Understand the different types of Suspension systems and Transmission systems.
- Understand the working of Brakes, Types of Wheels and Tyres in Two wheelers.
- Understand the basic Auto Electrical systems and recent trends in Two wheeler.

TOTAL: 45 PERIODS

TEXT BOOKS:
4. K. K. Ramalingam, Two Wheelers, Scitech publications, Chennai

REFERENCES:
OBJECTIVES:

- To introduce the mathematical modeling of systems, open loop and closed loop systems and analyses in time domain and frequency domain.
- To impart the knowledge on the concept of stability and various methods to analyze stability in both time and frequency domain.
- To introduce sampled data control system.

UNIT I  MATHEMATICAL MODELLING
Introduction – transfer function – simple electrical, mechanical, pneumatic, hydraulic and thermal systems – analogies

UNIT II  FEEDBACKCONTROL SYSTEMS
Control system components - Block diagram representation of control systems, Reduction of block diagrams, Signal flow graphs, Output to input ratios

UNIT III  TIME DOMAIN ANALYSIS
Response of systems to different inputs viz., Step impulse, pulse, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.

UNIT IV  STABILITY ANALYSIS
Necessary and sufficient conditions, Routh-Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction, frequency response.

UNIT V  STATE SPACE TECHNIQUE
State vectors – state space models -Digital Controllers – design aspects

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to apply mathematical knowledge to model the systems and analyse the frequency domain.
- Ability to check the stability of the both time and frequency domain.

TEXT BOOKS:

REFERENCES:
OBJECTIVES:

- To give an adequate knowledge about various techniques used for various parameters of measurement in industries.
- To provide exposure to four important process variables namely level, pressure, flow and temperature.
- To understand, analyze and design various measurement schemes that meet the desired specifications and requirements of real time processes.
- To acquire knowledge about the principles of conventional continuous controllers namely ON/OFF and PID controller.
- To get an overview of advanced control schemes used for industrial applications.

UNIT I  LEVEL AND PRESSURE MEASUREMENT


UNIT II  TEMPERATURE MEASUREMENT


UNIT III  FLOW MEASUREMENT


UNIT IV  PROCESS CONTROL


UNIT V  ADVANCED CONTROL SCHEMES

Ratio Control – Feed forward control - Cascade control – Model predictive control – Examples from boiler systems and distillation column.

TOTAL : 45 PERIODS

OUTCOMES :

- Apply the knowledge about the instruments to use them more effectively.
- Ability to select appropriate level and pressure measuring instruments according to the application.
- Ability to design signal conditioning circuits and compensation schemes.
- Able to understand the different conventional control actions, their relative merits, demerits and their typical applications.
- Able to analyze the need for advanced control and methods of implementation of these control techniques.
- Ability to design & implement a suitable control scheme for a given process.

TEXT BOOKS:


REFERENCES:


MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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EI5692 INTRODUCTION TO INDUSTRIAL DATA COMMUNICATION

OBJECTIVES
- To impart the basic concepts of data networks
- To introduce the serial communication interface standards for industrial data networks.
- To familiarize the students with the principles of MODBUS and CANBUS protocols.
- To introduce Foundation Fieldbus and HART Protocols.
- To introduce the principles of Wireless Networks used in Industrial Data Communication

UNIT I DATA NETWORK BASICS

UNIT II SERIAL COMMUNICATION STANDARDS
Introduction to Serial Communication Standards: EIA232, EIA485, \( \text{i}^2 \text{C} \) and USB – Features, Elements, Connections and Handshaking.

UNIT III FUNDAMENTALS OF MODBUS AND CANBUS

UNIT IV INTRODUCTION TO FIELDBUS AND HART

UNIT V WIRELESS NETWORKS FOR INDUSTRIAL DATA COMMUNICATION

TOTAL : 45 PERIODS

OUTCOMES
- Acquire knowledge about basic concepts of data networks
- Gain familiarity with various serial interface standards used in industrial datanetworks.
- Gain knowledge on the principles of MODBUS and CANBUS protocols.
- Get familiarized with Foundation Fieldbus and HART Protocols.
- Gain familiarity with wireless networks for industrial data communication.
- Apply the knowledge of various communication standards for different application and use them more effectively.
TEXT BOOKS

REFERENCES
2 NPTEL Notes on “Fieldbus Networks” and “Computer Networks”, IIT Kharagpur.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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IT5695 BASICS OF PROGRAMMING AND DATA STRUCTURES L T P C
3 0 0 3

OBJECTIVES:
- To introduce the basics of C programming language.
- To learn the concepts of structures and pointers.
- To learn the concepts of Abstract Data Types.
- To understand the concepts of linear data structure like list, stack and queue.
- To understand the concepts of non-linear data structures.

UNIT I C PROGRAMMING FUNDAMENTALS 9

UNIT II C PROGRAMMING - ADVANCED FEATURES 9
Structures – Union – Enumerated Data Types – Pointers - Variation in pointer declarations - Pointers to Variables and Arrays – Dynamic memory allocation – Preprocessor Directives.

UNIT III LINEAR DATA STRUCTURES 9
Abstract Data Types (ADTs) – List ADT – Array-Based Implementation – Linked list based implementation – Doubly-Linked Lists – Circular Linked lists.

UNIT IV STACKS AND QUEUES 9
UNIT V  NON-LINEAR DATA STRUCTURES


TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the students will be able to:

- Develop C programs for any real world/technical application.
- Apply advanced features of C in solving problems.
- Write functions to implement linear and non–linear data structure operations.
- Suggest and use appropriate linear/non–linear data structure operations for solving a given problem.
- Appropriately use stack and queue data structure for a given application.

TEXT BOOKS:

REFERENCES:

IT5696  FUNDAMENTALS OF INFORMATION SECURITY  L T P C

3 0 0 3

OBJECTIVES
- To introduce the need for security in various applications
- To learn the mathematical background of cryptography
- To introduce security services and mechanisms
- To understand secure design and application of security
- To understand and appreciate hardware security

UNIT I  INTRODUCTION

UNIT II  SECURITY SERVICES AND MECHANISMS
UNIT III HARDWARE SECURITY
Hardware security: Side Channel Attacks – Fault Attacks – Countermeasures – Introduction to PUFs, Designs of FPGAs, Machine Learning of PUFs – Introduction to Micro-architectural vulnerabilities - Trusted Computing- Intel SGX.

UNIT IV CYBER SECURITY AND APPLICATIONS

UNIT V APPLICATIONS OF SECURITY

OUTCOMES:
On completion of the course, the students will be able to:
- Understand the goals, services and mechanisms of security
- Apply the security algorithms to real world applications.
- Design secure systems and applications.
- Identify various vulnerabilities in hardware.
- Knowledge on Cybersecurity and protecting critical infrastructure.

TEXT BOOKS:

EC5695 MICROCONTROLLER PROGRAMMING FOR INDUSTRIAL APPLICATIONS

OBJECTIVES
- To study different microcontroller architectures and interfaces.
- To program the microcontroller for real time applications.
- To architect a microcontroller system for different hardware and software.
- To familiarize the students in Microcontroller.
- To provide strong foundation for designing the real world applications.

UNIT I INTRODUCTION TO 8051 MICRO CONTROLLER
Overview of 8051 Micro Controller, Architecture, I/O ports and Memory Organization, Interrupts, Timer/Counter and Serial Communication.

UNIT II PIC MICROCONTROLLER
PIC microcontroller Architecture - Memory - Parallel ports - Interrupts - Timers/Counters - UART- A/D converter - PWM.
UNIT III  PROGRAMMING WITH C
Introduction to C - Microchip MPLAB IDE - CCS PCM C compiler - Proteus VSM - Microchip PICDEM Mechatronics board.

UNIT IV  HUMAN AND PHYSICAL INTERFACES
Human interface from switches to keypads - LED displays - LCD - interfacing to the physical world-simple sensors: micro switch, Light-dependent resistors, Optical object sensing, opto-sensor applied as a shaft encoder, Ultrasonic object sensor - Actuators: DC and stepper motors - Interfacing to actuators.

UNIT V  APPLICATIONS OF 8051 AND PIC MICROCONTROLLERS
LED Chasing circuit - Four digit LED Display interface, Interrupt driven event counter with 4-digit LED display - Simple Buzzer interface, Speaker interface - Electronic Siren - Interfacing Digital temperature sensor - Analog temperature sensor IC with A/D converter.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, the student will be able to:

- Use 8051 microcontroller suitable for industrial applications.
- Design hardware based on PIC microcontroller.
- Develop C Programs for Microcontroller.
- Provide Human & Physical interface for Microcontrollers.
- Apply Microcontrollers for Real Time Application.

TEXT BOOKS:

REFERENCES:

EC5696  INTRODUCTION TO COMMUNICATION SYSTEMS  L  T  P  C
3  0  0  3

OBJECTIVES:
- To introduce the concept of basic Analog and Digital Communication Systems.
- To understand the various modulation techniques for Analog and digital communication Systems.
- To perform a block-diagram design of the transmitter and receiver for a basic Analog and Digital Communications System.
- To identify the performance, in terms of bit error rate, of a Digital Communication System.
- To study the wireless channel and Mobile Communication Systems.

UNIT I  ANALOG COMMUNICATIONS
Basic concepts of Linear Modulation and Demodulation – Modulation Index -Power relation in AM wave- double and single sideband-Generation and Detection of Amplitude Modulation- Hilbert transform-analytic signal.
UNIT II ANGLE MODULATIONS
Frequency Modulation-comparison of frequency modulation and amplitude modulation-narrowband and wideband FM- Bessel functions-Carson’s rule-bandwidth-Generation and Demodulation of frequency and phase modulation-Phase-locked loops.

UNIT III DIGITAL COMMUNICATIONS
Nyquist sampling theorem – Pulse amplitude modulation, Pulse code modulation – quantization noise, delta modulation, DPCM, ADPCM, Multiplexing and Multiple Access Techniques – FDM and FDMA, TDM and TDMA, CDMA.

UNIT IV DIGITAL MODULATION TECHNIQUES

UNIT V WIRELESS CHANNEL AND MOBILE COMMUNICATION
Overview of wireless systems-capacity of wireless channel- Examples of Wireless Communication Systems- Paging system, Cordless telephones systems, Cellular telephone Systems- Cellular concept- Large and small Scale Fading.

TOTAL: 45 PERIODS

OUTCOMES:
- Understand the basic concepts of Analog Communication Systems.
- Use of Angle Modulation techniques for Analog Communication.
- Identify and describe different techniques in modern Digital Communications.
- Explore various Digital Modulation Techniques.
- Analyse the performance of wireless channels for Mobile Communication.

TEXT BOOKS:

REFERENCES:
OBJECTIVES

- To understand arrays and applications such as vectors, matrices, polynomials
- To know about stacks, queues and their applications in handling expressions, strings, scheduling
- To understand dynamic creation of lists and knowing how to apply them for problem solving
- To understand the nonlinear data structure trees and data representation, processing using trees
- To understand sorting and searching of data values using different methodologies

UNIT I


UNIT II

Stacks, Queues, Maze Problem, Expressions Evaluation, String reversal, Circular Queue, Dequeue, Scheduling.

UNIT III

Linked Lists, Doubly Linked List, Polynomial Addition and Multiplication, Linked Stacks and Queues, Nested Lists

UNIT IV


UNIT V

Insertion Sort, Shell Sort, Bucket Sort, Heap Sort, Merge Sort, Quick Sort, Linear search, Binary Search, m-way search, Fibonacci Search.

TOTAL: 45 PERIODS

REFERENCES


CS5694  MACHINE LEARNING USING PYTHON  L T P C

3 0 0 3

COURSE OBJECTIVES:

- To know different types of machine learning algorithms like supervised, unsupervised and semi supervised
- To differentiate between regression and classification problems
- To study applications of classification and clustering algorithms
- To learn deep learning and its applications
- To implement machine learning algorithms using Python libraries
UNIT I  INTRODUCTION TO MACHINE LEARNING AND PYTHON  

UNIT II  NEURAL NETWORKS  

UNIT III  SUPERVISED LEARNING  

UNIT IV  UNSUPERVISED LEARNING  
Clustering –Types: K-Means Clustering, Hierarchical Clustering, Density-Based Clustering- The Curse of dimensionality -Dimensionality Reduction: Principal Component Analysis

UNIT V  ADVANCED LEARNING  

TOTAL: 45 PERIODS

REFERENCES:

RP5691  POLYMER PROPERTIES  
L  T  P  C  
3  0  0  3

OBJECTIVES
To enable the students to
- Understand the fundamentals of polymers, structure and molecular weight
- Know about Tg and its importance
- Know about mechanical properties of polymers
- Understand the importance of electrical and optical properties of polymers

UNIT I  INTRODUCTION
UNIT II STATES OF AGGREGATION IN POLYMERS
Transitions and segmental mobility in polymers – Glass transition, Tg, and flexibility – Multiple transitions in polymers - Significance of transition temperatures – Semicrystalline polymers – Effect of crystallization on properties of polymers – Factors affecting crystallization crystal nucleation and growth – relationship between Tg and Tm – Relationship between properties and crystalline structure- Melting of polymers – Rheology of Polymer melts.

UNIT III DEFORMATION & STRENGTH PROPERTIES OF POLYMERS

UNIT IV ELECTRICAL PROPERTIES OF POLYMER

UNIT V OPTICAL PROPERTIES OF POLYMERS

TOTAL 45 PERIODS

COURSE OUTCOME
The students will be able to
- Understand the fundamentals of polymers and molecular weight
- Realize the importance of transitions in polymers
- Know about deformations in polymers
- Choose right type of polymers for electrical insulation purpose
- Know the importance of optical properties of polymer

TEXT BOOKS

REFERENCE

RP5692 POLYMERS IN ELECTRICAL AND ELECTRONICS APPLICATIONS

OBJECTIVES
To enable the students to
- Understand the fundamentals of polymers and their structure
- Design polymers for electrical applications
- Know about electrical properties of polymers
- Understand the importance of polymers in energy storage applications
UNIT I INTRODUCTION TO POLYMERS
Polymers - Difference between simple organic molecule and macromolecule - classification of polymers - Molecular weight - Polymerization Types and Techniques. Requirements for polymers as insulators, semiconductors and conductors. Design of conjugated polymers for organic electronics - chemical, electrochemical and enzymatic methods - doping - general considerations

UNIT II CONDUCTING/INSULATING POLYMERS AND PROPERTIES
Conducting Polymers- properties and applications of PANI, Polythiophene, polyacetylene and polypyrrole. Photoconducting polymers and its applications. Insulating/Non conducting polymers used in electrical applications -PE, PVC, PF, Aminoplasts, epoxy and other flame retardant polymers. Properties - Electronic properties, electrochemical, electroluminescent properties, electrochromic and electromechanical properties

UNIT III ENERGY HARVESTING POLYMERS
Photovoltaic devices - working mechanism and light harvesting materials. Working mechanism and materials for thermoelectric generator, piezoelectric transducer and triboelectric generator- Dielectric Elastomer based Generating systems-energy harvesting using Magneto Rheological Elastomers and fluids

UNIT IV POLYMERIC ENERGY STORAGE DEVICES
Supercapacitors – Polymer based electrodes and electrolytes. Lithium ion batteries based on polymers – Polymer as active materials in electrode, polymer as separator and electrolyte.

UNIT V APPLICATIONS
Light emitting conjugated polymers - polymer light emitting diodes and electrochemical cells-electret -photoresist - positive and negative photoresist - wire and cable - encapsulation - polymers in optical data storage - optical fibers - corrosion and ESD protection, EMI shielding artificial muscles - electro chromic devices - electromechanical actuators - sensor devices-conductive composites, smart tyres- pressure monitoring systems-3D printing.

TOTAL 45 PERIODS

OUTCOMES
The students will be able to
- Relate the properties of polymers for electronics applications
- Select polymers for electrical applications
- Know about polymers used for harvesting solar energy
- Know about polymeric energy storage devices
- Understand various polymers for electrical applications

TEXT BOOKS

REFERENCES
OBJECTIVES:

01 To introduce the basic concepts of mass, momentum and energy conservation relating to Aerodynamics.
02 To make the student understand the fundamentals of theory of airfoils and wing sections.
03 To introduce characteristics of Airfoils and the concept of Starting Vortex, theory of airfoils and its applications.
04 To introduce concept of Vortex Filament, Horse Shoe Vortex, Lifting Line Theory and its limitations.
05 To introduce the concepts of compressibility, to make the student understand the theory behind the formation of shocks and expansion fans in Supersonic flows.

UNIT I  FUNDAMENTAL CONCEPTS  9

UNIT II  POTENTIAL FLOWS  9

UNIT III  INCOMPRESSIBLE FLOW OVER AIRFOILS  9
Airfoil Nomenclature-Aerofoil characteristics- Starting Vortex, Kutta condition - Thin Airfoil applications.

UNIT IV  SUBSONIC FLOW OVER FINITE WINGS  9
Downwash and Induced Drag- Vortex Filament -Helmholtz's theorems - Biot - Savart Law, Bound Vortex and trailing Vortex, Horse Shoe Vortex, Lifting Line Theory applications.

UNIT V  PRELIMINARY ASPECTS OF COMPRESSIBLE FLOW  9

OUTCOMES:
At the end of the course students will be able

CO1: To familiarize themselves with the fundamental concepts of mass, momentum, energy conservation equations and their applications.
CO2: To acquire knowledge about ideal and real flow over the bluff and streamlined bodies.
CO3: Have the capability to estimate theoretically aerodynamic coefficients of airfoils.
CO4: Have the capability to estimate theoretically aerodynamic coefficients of finite wing.
CO5: To acquire knowledge on the effect of compressibility at high-speeds and effect of shocks and expansion waves.

TEXT BOOKS:
REFERENCES:

AE5693 PRINCIPLES OF FLIGHT L T P C
3 0 0 3

COURSE OBJECTIVES: of this course are
- To introduce the basic concepts of aeronautics.
- To impart knowledge about the different layers in International standard atmosphere.
- To provide basic knowledge on low speed aerodynamics.
- To describe about various systems and instruments used in airplanes.
- To provide basic knowledge on rocket motion.

UNIT I BASICS OF AERONAUTICS

UNIT II AIRCRAFT STRUCTURES
Introduction to Aircraft structures -Types of construction of wing and fuselage- Different types of load carrying members on Wing and Fuselage. Materials used on modern airplane and their requirements.

UNIT III AIRCRAFT PROPULSION
Principles of piston and jet engines - Thrust equation- Construction and working of Turbo jet, Turbo prop, Turbo fan and Turbo shaft engines - Advantages and Disadvantages. Need for ramjet and scramjet engines.

UNIT IV AIRCRAFT SYSTEMS

UNIT V FUNDAMENTALS OF SPACE FLIGHT

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, Students will be able to
CO1 Determine the properties of atmosphere at a given altitude in ISA.
CO2 Demonstrate different types of construction of aircraft structures.
CO3 Explain the operating principle of various systems used on airplane.
CO4 Explain the basics of flight mechanics of fixed wing airplane.
CO5 Demonstrate the equations pertaining to rocket motion.

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES: Of this course are
1. To make the students learn thermodynamics principle and general thrust equation.
2. To impart knowledge on piston and gas turbine engines of aircrafts.
3. To make the students familiarize with the ducted propulsive systems.
4. To give exposure on various types of rocket propulsion and propellant used in rocket engines.
5. To make the students learn the principle operation of space propulsion.

UNIT I  BASIC LAWS AND THRUST EQUATION  9
Newton’s law of motion, basics of thermodynamics, classification of jet propulsion, thrust equation, factors affecting thrust, methods of thrust augmentation, and performance parameters of aircraft engines.

UNIT II  AIRCRAFT ENGINES  9
Operating principles of piston and gas turbine engines, gas turbine engine classification, basics of gas turbine engine components, operating characteristics of turboprop, turbofan and turbojet.

UNIT III  DUCTED PROPULSION  9
History of ducted propulsion, ramjet engine, pulse jet, scramjet engine, combined cycle engine, Integral ramjet engines.

UNIT IV  ROCKET PROPULSION  9
Classification of rocket propulsion, specific impulse, propellant classification, solid rocket motor, liquid rockets engine, monopropellant engines, bipropellant engines and hybrid rockets engine.

UNIT V  SPACE PROPULSION  9
Basic of electrical propulsion, electrothermal thruster, electrostatic thruster, electromagnetic thruster, nuclear propulsion and solar sail.

TOTAL: 45 PERIODS

COURSE OUTCOMES: Upon completion of the course, Students will be able to
CO1: Apply different laws and basics of thermodynamic process to get thrust.
CO2: Acquire knowledge on the operation of piston and gas turbine engines and their operating characteristics.
CO3: Get exposure the knowledge on ducted propulsion system used in missile applications.
CO4: Acquire knowledge on the operation of rocket propulsion and various kinds of propellants.
CO5: Acquire knowledge on the working of space propulsion systems.

TEXT BOOKS:

REFERENCE BOOKS:
AE5695 MANNED SPACE MISSIONS

UNIT I INTRODUCTION
The physics of space environment - A brief description on some space missions like space station, Moon mission and Mars missions - technological challenges involved in Manned vs. unmanned missions - benefits from space missions - Salient features of some international space missions with examples

UNIT II EARTH AND SPACE ENVIRONMENTS
Structure and Composition of Earth environment - Meteoroid, Orbital Debris & Radiation Protection - Safety of Crewed Spaceflight - Magnetosphere - Radiation Environment: Galactic Cosmic Radiation (GCR), Solar Particle Events (SPE) - Radiation and the Human Body - Impact of microgravity and g forces on humans - space adaptation syndrome

UNIT III HUMAN LIFE SUPPORT SYSTEMS

UNIT IV PLANNING OF MANNED SPACE MISSION
Ground Communication and Support - Space Resources and Mission Planning - Selection of Rockets and Launch Vehicles for the planned mission - Orbital Selection and Astrodynamics - Entry, Descent, Landing, and Ascent, Designing and Sizing Space elements - Designing, Sizing, and Integrating a Surface Base and Planetary Surface Vehicles

UNIT V OPERATIONAL ASPECTS IN MANNED SPACE MISSIONS

TOTAL = 45 PERIODS

TEXT BOOKS

AE5696 FUNDAMENTALS OF SATELLITE TECHNOLOGY

OBJECTIVE:
To understand the concepts of orbital mechanics, satellite systems, configuration, functions, control and make the students eligible to enter into R&D organization.

UNIT I INTRODUCTION TO SATELLITE MISSION AND SYSTEMS
Mission Overview – Requirements for different missions - Common satellite applications – Space Environment, Spacecraft configuration - Satellite systems and their functions
UNIT II       INTRODUCTION TO ORBITAL MECHANICS  9
Typical spacecraft orbits- Types - special orbits - Time and coordinate systems - Theory of elliptical orbits - Two body equation - kepler laws - First and second constant of motion - Orbital elements - Disturbances

UNIT III       POWER SYSTEM AND BUS ELECTRONICS  9

UNIT IV       ATTITUDE AND ORBIT CONTROL SYSTEM  10
AOCS requirements – Environment effects – Attitude stabilization – Attitude sensors – Actuators – Station keeping types - orbit maintenance and control – introduction to control algorithms .

UNIT V       PROPULSION, STRUCTURE AND THERMAL CONTROL SYSTEMS  12
Propulsion systems-importance-Types-Theory of operation - Need for satellite structure-requirements-guiding factors-Various loads-Importance of thermal control-Heat transfer-Types- Thermal control systems: active and passive methods.

TOTAL: 45 PERIODS

OUTCOMES:
1. Aware of the Satellite Mission, Configuration, Applications and Systems
2. Understand the concepts of Orbital theory
3. Understand the theory of satellite power and TTC subsystems
4. Understand the theory and design procedure of satellite AOC systems
5. Understand the theory and concepts of satellite propulsion, structure and TCS
6. Graduate will acquire knowledge about satellite systems up on completion of this course.

REFERENCES:

PR5693       PRODUCT DESIGN AND DEVELOPMENT FOR ENGINEERS  L T P C
3 0 0 3

COURSE OBJECTIVES:
1. To understand the global trends and development methodologies of various types of products and services
2. To conceptualize, prototype and develop product management plan for a new products
3. To understand requirement engineering and know how to arrive the requirements for new product development
4. To implement the modeling for system, sub-system and their interfaces
5. To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I       FUNDAMENTALS OF PRODUCT DEVELOPMENT  9

UNIT II  REQUIREMENTS AND SYSTEM DESIGN  9

UNIT III  DESIGN AND TESTING  9

UNIT IV  SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT  9

UNIT V  BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able to:
CO1: Define, formulate and analyze a problem
CO2: Solve specific problems independently or as part of a team
CO3: Gain knowledge of the Innovation and Product Development process in the Business Context
CO4: Work independently as well as in teams
CO5: Manage a project from start to finish

TEXT BOOKS:
1. Ali Jamnia "Introduction to Product Design and Development for Engineers" 1st edition 2018

REFERENCES:
2. Anoop Desai, Anil Mital "Sustainable Product Design and Development" 2020
3. Ronak Gandhi " Product design and value engineering " Kindle Edition 2020