LIST OF OPEN ELECTIVES
TO BE OFFERED IN THE ODD SEMESTER (MIT CAMPUS)

FACULTY OF MECHANICAL ENGINEERING								
DEPARTMENT OF AEROSPACE ENGINEERING								
B.E. Aeronautical Engineering								
1.	AE5791	Introduction to Space System	OE	3	3	0	0	3
2.	AE5792	Introduction to Avionics System	OE	3	3	0	0	3
3.	AE5793	Composite Materials and Applications	OE	3	3	0	0	3
4.	AE5794	Wind Tunnel Applications	OE	3	3	0	0	3
5.	AE5795	Introduction to Drone Technology	OE	3	3	0	0	3
6.	AE5796	Launch Vehicle Technology	OE	3	3	0	0	3
B.E. Automobile Engineering								
7.	AU5791	Vehicle Safety Systems	OE	3	3	0	0	3
8.	AU5792	Vehicle Technology	OE	3	3	0	0	3
B.E. Production Technology								
9.	PR5791	Design Concept Optimization and Rapid Prototyping	OE	3	3	0	0	3
10.	PR5792	Micro and Nano Manufacturing	OE	3	3	0	0	3
11.	PR5793	Sustainable Production	OE	3	3	0	0	3
FACULTY OF INFORMATION AND COMMUNICATION ENGINEERING								
DEPARTMENT OF INFORMATION TECHNOLOGY								
B.Tech. Information Technology								
12.	IT5794	Introduction to OOPS Concepts	OE	3	3	0	0	3
13.	IT5795	Introduction to Software Engineering Methodologies	OE	3	3	0	0	3
DEPARTMENT OF ELECTRONICS ENGINEERING								
B.E. Electronics and Communication Engineering								
1.	EC5795	Internet of Things	OE	3	3	0	0	3
2.	EC5796	Computer vision and Machine Learning	OE	3	3	0	0	3
3.	EC5797	Embedded System Design using Arduino	OE	3	3	0	0	3
FACULTY OF ELECTRICAL ENGINEERING								
DEPARTMENT OF INSTRUMENTATION ENGINEERING								
1.	EI5791	Industrial Automation Systems	OE	3	3	0	0	3
2.	EI5792	Introduction to Programmable Logic Controller	OE	3	3	0	0	3

FACULTY OF SCIENCE AND HUMANITIES B.E./B.Tech. students can take these electives.								
DEPARTMENT OF ENGLISH								
1.	HS5791	Basic Communication in English	OE	3	3	0	0	3
2.	HS5792	Introduction to Critical Thinking	OE	3	3	0	0	3
3.	HS5793	Reading Fiction	OE	3	3	0	0	3

AE5791 INTRODUCTION TO SPACE SYSTEM L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Introduction to Space Environment-Vacuum and its Effects, Plasma & Radiation Environments and their Effects. Debris Environment and its Effects - Newton's Law of gravitation - Fundamental Physical Principles.

UNIT II SOLAR SYSTEM 9

Nebular theory of formation of Solar System - Solar wind and nuclear reaction as the source of energy - Brief description about shape size of Sun and Planets -Kepler's Laws of planetary motion - correction of Kepler's third law - Brief description of Asteroids - Satellites and Comets.

UNIT III BASICS OF SPACE DYNAMICS 9

Overview of astronomy - reference coordinate system in space, telescopes, flux, magnitudes - Satellite Missions and introduction to orbital mechanics - Elliptic, parabolic and hyperbolic orbits and their characteristics - orbit transfer.

UNIT IV SPACE MISSIONS AND SPACECRAFT 9

Types of spacecraft and spacecraft used for different missions - Types of orbits needed for different missions - space station, Moon mission, and Mars missions - Salient features of space shuttle mission.

UNIT V BASICS OF SPACECRAFT SUBSYTEMS 9

Spacecraft Subsystems involving Space Operations - Spacecraft Architecture , Attitude Determination and Control - Power Systems - Spacecraft Bus electronics - Subsystems involving Command, Control, and Communications Architecture - Spacecraft life time.

TOTAL : 45 PERIODS

TEXT BOOKS

1. J. Wijker, "Spacecraft Structures", Springer-Verlag Berlin Heidelberg, 2008 .
2. George Cary Comstock, "A Text-Book of Field Astronomy for Engineers", J. Wiley & sons, 2009 .
3. K. S. Krishnaswami , "Astrophysics : A modern Perspective", New Age International, 2006
4. Cornelisse , J. W., "Rocket Propulsion and Spaceflight Dynamics", Pitman, London, 1982

AE5792 INTRODUCTION TO AVIONICS SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the role of avionics and its need for civil and military aircraftsand to impart
- Knowledge about the avionic architecture and various avionics data buses.
  To understand the trends in display technology and cockpit displays
- To study gyroscope and its purposes and air data instruments
- To gain knowledge in field of navigation systems.
- To impart knowledge on various guidance and control systems.

UNIT I INTRODUCTION TO AVIONICS 9

Role for Avionics in Civil and Military Aircraft and Space systems - Integrated avionics and weapon systems – Avionics sub-systems and design, defining avionics System/subsystem requirements-importance of ‘ilities’ - Avionics system architecture – Avionics Data buses

UNIT II FLIGHT DECKS AND COCKPITS 9

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Civil and Military aircraft cockpits, MFDs, MFK, HUD, HDD, HMD, DVI, HOTAS - Virtual cockpit

UNIT III GYROSCOPIC INSTRUMENTS AND AIR DATA SYSTEMS 9

Gyroscope and its properties, gyro system, Gyro horizon Direction gyro-direction indicator, Rate gyro-rate of turn and slip indicator, Turn coordinator - Air data quantities – Altitude, Air speed, Vertical speed, Mach number,

UNIT IV INTRODUCTION TO NAVIGATION SYSTEMS 9

Radio navigation – Dead – Reckoning systems, Hyperbolic Navigation - ILS, MLS – Inertial Navigation Systems (INS) – Inertial sensors - INS block diagram – Satellite navigation systems.

UNIT V GUIDANCE AND CONTROL SYSTEMS 9

Introduction to Guidance System. - Primary and secondary Control surfaces - Auto pilot – Basic principles, Longitudinal and lateral auto pilot – Attitude control – DFBW control

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, Students will be able to

CO1: Apply the basics of avionics subsystems architecture.
CO2: Distinguish between the needs of civil and military avionics systems.
CO3: Acquire knowledge on display technologies.
CO4: Design navigation system and ability to design and perform analysis on air data system.
CO5: Know about the various guidance schemes and principle of stability and flight control systems

TEXTBOOKS:

1. Collinson.R.P.G. Introduction to Avionics, Chapman and Hall, 2003.
2. Pallet, E.H.J. Aircraft Instruments & Integrated systems, Longman Scientific and Technical, McGraw-Hill, 1992.

REFERENCES:

1. Middleton, D.H., Ed., Avionics systems, Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.
2. Spitzer, C.R. Digital Avionics Systems, Prentice-Hall, Englewood Cliffs, N.J.,U.S.A.1993.
3. Cary R .Spitzer, The Avionics Handbook, Crc Press, 2000.

AE5793 COMPOSITE MATERIALS AND APPLICATIONS L T P C
3 0 0 3

OBJECTIVES:

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I INTRODUCTION 9

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 9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fiber 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 9

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 9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications- Electrical applications-Microelectronics- Advanced applications in automotive industry.

UNIT V FAILURE CRITERIA IN LAMINATE 9

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.

TOTAL: 45 PERIODS

OUTCOMES:

- CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know the various reinforcements used in composite materials.
- CO3 – Understand the manufacturing processes of metal matrix composites.
- CO4 – Understand the manufacturing processes of polymer matrix composites.
- CO5 – Analyze the strength of composite materials.

REFERENCES:

1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, West Germany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.
3. Chawla K.K., Composite Materials, 2013.
4. Lubin.G, Hand Book of Composite Materials, 2013.

AE5794 WIND TUNNEL APPLICATIONS L T P C

3 0 0 3

OBJECTIVES:

01 To introduce the basic concepts of Fluids, model studies and layout of wind tunnel.

02 To make the student understand the applications of wind tunnels for various Aerospace applications.

03 To introduce usage of Wind tunnels for various road vehicle designs.

04 To make the student understand the applications of wind tunnels for civil and Environmental applications.

05 To make the student understand the usage of wind tunnels for Marine applications.

UNIT I BASICS OF WIND TUNNELS 9

Fluids - Properties - Non dimensional numbers – Scale effect – Geometric, Kinematic and Dynamic similarities - Wind tunnels and its classification.

UNIT II AEROSPACE APPLICATIONS 9

Aeronautical Wind Tunnels - General Test Procedure - Smoke Tunnels - Aeroacoustic Wind Tunnels - Water Tunnels - Transonic tunnels - Supersonic Tunnels - Hypersonic Tunnels - Applications.

UNIT III ROAD VEHCILE APPLICATIONS 9

Automobile Wind Tunnels - Wind Tunnel Role in Car Design - Methods for Racing Vehicles - Ground Effects- Trucks, Motorcycles and Other Vehicles - Systems For Ground Vehicle Experiments - Velocity Dependence and Scaling of Automotive Noise.

UNIT IV CIVIL AND WIND ENGINEERING APPLICATIONS 9

Climatic Wind Tunnels - General Purpose Wind Tunnels - Environmental Wind Tunnels - Static Loads and Associated Experiments on Buildings - Dynamic Loads on Buildings - Unsteady Aerodynamics in Wind Engineering - Atmospheric Surface Wind Terrain Effects.

UNIT V MARINE APPLICATIONS 9

Surface Vessels: Above The Water - Ship Wind Loads - Surface Vessels: Below The Water - Underwater Vehicles - Sailing Vessels - Wind Tunnel Arrangements for Sail Testing.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course students will be able

CO1: To familiarize themselves with the fundamental concepts of fluid, model design and wind tunnel.

CO2: To acquire knowledge about ideal of using wind tunnels for Aerospace applications.

CO3: To acquire knowledge on usage of road vehicle applications and design.

CO4: Acquire knowledge on the practical elements of wind tunnel usage in civil and wind engineering applications.

CO5: To acquire knowledge on usage of Marine vehicle applications.

TEXT BOOKS:

1. Rae, W.H. and Pope, A., Low Speed Wind Tunnel Testing, John Wiley Publication, 1984.
2. Pope, A., and Goin, L., High Speed Wind Tunnel Testing, John Wiley, 1985.

REFERENCES:

1 Rathakrishnan. E., Instrumentation, Measurements, and Experiments in Fluids, CRC Press Taylor & Francis Group publishers 2007.

2 Robert B Northrop, “Introduction to Instrumentation and Measurements”, 2nd Edition, CRC Press, Taylor & Francis, 2006.

3 Bradsaw "Experimental Fluid Mechanics" Short term course on Flow visualization techniques, NAL , 2009

AE5795 INTRODUCTION TO DRONE TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To introduce the basic concepts of unmanned aerial vehicles and its classification.
2. To impart knowledge on the hardware components and their selection
3. To impart knowledge on the component integration with airframe.
4. To impart knowledge on transmitter receiver and telemetry selection.
5. To impart knowledge on control and testing of drones.

UNIT I INTRODUCTION TO DRONES 9

History of UAV –classification – Introduction to UAV, Drones and its subsystems-Airframe Configurations - Multirotor: Tricopter, Quad, Hexa and Octacopter - Fixedwing- Control surfaces - Applications.

UNIT II COMPONENT SELECTION 9

Selection of the System components: Flight Controller, Sensors, Power plant, Propeller, ESC, Control surface Actuators, Battery- Ground control software- Integration, Installation, Tx-Rx Pairing and Configuration

UNIT III AIRFRAME SELECTION AND INTEGRATION 9

Airframe Selection requirements - Integration of Motors, controllers and payloads with airframe - Motor configuration for multirotor

UNIT IV TRANSMITTER RECEIVER AND TELEMETRY SELECTION 9

Transmitter selection - Frequency Hopping Spread Spectrum - Pairing of transmitter and receiver - Telemetry selection and configuration

UNIT V CONTROL AND TESTING 9

Drone control: Altitude, Pitch, Roll and Heading control - Tuning of controls- System Ground Testing- System In-flight Testing- Trouble shooting -Case Studies

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, Students will be able to

CO1: Explain the importance of UAVs, classification and their applications.
CO2: Select suitable drone component based on design requirements.
CO3: Perform integration of drone components
CO4: Select transmitter, receiver and telemetry system and its configuration
CO5: Demonstrate basic control of drone and perform ground test and troubleshooting with respect to drone operation.

REFERENCES:

1. Armand J. Chaput, “Design of Unmanned Air Vehicle Systems”,Lockheed Martin Aeronautics Company, 2001.
2. Kimon P. Valavanis, “Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy”, Springer, 2007.
3. Paul G Fahlstrom, Thomas J Gleason, “Introduction to UAV Systems”, UAV Systems, Inc,1998.
4. Reg Austin “unmanned aircraft systems UAV design, development and deployment”, Wiley,2010.
5. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.
6. Adam Juniper, The Complete Guide to Drones, Octopus publishing House, 2018.
7. Daniel Tal, Jon Altschuld, Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation, John Wiley & Sons, 2021

AE5796 **LAUNCH VEHICLE TECHNOLOGY** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

1. To understand history of launch vehicles
2. To impart knowledge regarding the requirements of launch vehicles
3. To provide basic knowledge of the working of launch vehicles
4. To understand the basic requirements of propulsion and structures for a launch vehicle
5. To understand the basic requirements of thermal design for a launch vehicle

UNIT I HISTORY OF LAUNCH VEHICLES 9

Inception – Early Developments – Missions During 1960 To 2000 - Last Two Decades and Future

UNIT II REQUIREMENTS FOR LAUNCHING 9

Space transportation functional requirements – Selection of launch site – Mission Definition for space transportation systems

UNIT III WORKING OF LAUNCH VEHICLES 9

Working Principle, Stages – Upper Stages, Fuel and Payload Basics – Ascent mission concept

UNIT IV PROPULSION AND STRUCTURAL REQUIREMENTS 9

Propulsion System Requirements - Propulsion System Selection Criteria - Overall Design Guidelines - Structural Design Requirements - Materials for structures.

UNIT V THERMAL DESIGN REQUIREMENTS 9

Thermal Design Requirements - Heating Problems in Launch Vehicles - Approach for Thermal Design-Thermal Protection System Selection

TOTAL: 45 PERIODS

Course Outcomes

Upon completion of the course, students will be able to

CO1 Describe the history of launch vehicles
CO2 Describe the requirements of launch vehicles
CO3 Demonstrate the basic working of launch vehicles
CO4 Explain the basic propulsion and structural requirements for a launch vehicle
CO5 Explain the basic requirements of thermal design for a launch vehicle

REFRENCES:

1. B.N. Suresh, K. Sivan. Integrated Design for Space Transportation System. Springer, New Delhi 2015.
2. Michael Lennick. Launch Vehicles: Heritage of the Space Race. Apogee Books, 2006.
3. Robert A Goehlich. Spaceships: A Reference Guide to International Reusable Launch Vehicle Concepts from 1944 to the Present. Apogee Books, 2007

AU5791 **VEHICLE SAFETY SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVES:

The course should enable the students to:

1. Know about the basics about the vehicle.
2. Understand the safety aspects in the vehicle.
3. Perceive the various safety aspects.
4. Acquire knowledge about sensors in the vehicle to avoid the crash and to detect the defects within the vehicle.
5. Apprehend about the comfort and convenience system.

UNIT I INTRODUCTION
9

Automotive safety: Introduction, Types. Active safety: driving safety, conditional safety, Perceptibility safety, operating safety. Passive safety: exterior safety, interior safety. New Car Assessment Program (NCAP).

UNIT II PASSIVE SAFETY CONCEPTS **9**

Design of Vehicle body for safety, deceleration of vehicle, passenger. Concept of crumble zone, Safety Cage. Optimum crash pulse, deceleration on impact with stationary and movable obstacles. Deformation behavior of vehicle body. Barrier test. Crash tests. Deformation behavior of Lightweight materials.

UNIT III PASSIVE SAFETY EQUIPMENTS AND CONVENIENCE SYSTEM **9**

Seat belt, Seat belt tightener system and its importance, collapsible steering column. Air bags and their activation. Designing aspects of automotive bumpers and materials for bumpers. Adaptive front lighting, central locking system, Tire pressure control system, rain sensor system with automated wiper system.

UNIT IV ACTIVE SAFETY **9**

Antilock braking system, Stability Control. Adaptive cruise control, Lane Keep Assist System, Collision warning, avoidance system, Blind Spot Detection system, Driver alertness detection System. Driving Assistance Technology(DAT), Advanced driver-assistance systems (ADAS).

UNIT V VEHICLE INTEGRATION AND NAVIGATION SYSTEM **9**

Looking out sensors and Looking in sensors, Intelligent vision system, Vehicle Integration system. Global Positioning System. Vehicle Navigation System. Road Network. Vehicle-to-vehicle(V2V) communication, SAE levels of automation

TOTAL: 45 PERIODS

OUTCOMES:

The students should be able to:

- Infer the concept of crumble zone and can calculate the amount of energy absorbed and transferred during a crash.
- Illustrate about various object detection system and working of various comfort, convenience system and environment information system
- Classify the various types of safety aspects such as active and passive safety
- Design and validate the vehicle structure with respect to crash worthiness
- Design a bumper with respect to safety.

TEXT BOOKS:

1) Joseph D. Miller- “Automotive System Safety- Critical Considerations for Engineering and Effective Management” - Wiley (2020)
2) Felipe Jimenez – “Intelligent Vehicles-Enabling Technologies and Future Developments “Butterworth-Heinemann (2017)
3) J. Marek, H.-P. Trah, Y. Suzuki, I. Yokomori - “Sensors for Automotive Applications “- WILEY-VCH Verlag GmbH & Co. (2003)
4) George Peters, Barbara J. Peters - “Automotive Vehicle Safety “- CRC Press (2002)

REFERENCES:

1) Bosch - “Automotive Handbook”, 10th edition, SAE, 2018.
2) Seiffert, Ulrich Wech, Lothar – “Automotive Safety Handbook “- Society of Automotive Engineers, Inc. (2003)
3) AIS Safety standards
4) “Surface Vehicle Recommended Practice” - SAE J 3016-2018, SAE International ,2018

AU5792 VEHICLE TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES

1. Identify various Engine layout and Chassis for vehicles.
2. To recognize the construction and working principle of drive line, final drive and differential systems.
3. To review the knowledge about the constructional feature and working principle of Steering Systems, Conventional and Independent Suspension Systems.
4. To demonstrate working principle of braking system and wheels used in automobile.
5. To understand the need for electrical systems in the vehicle and working of modern vehicle

UNIT I VEHICLE STRUCTURE AND ENGINE 9

History of Automobiles – Types of Automobile –Chassis– Frame -Engines- Types– Construction and Working Principle - Two and Four Stroke Engines – SI and CI Engines– MPFI,GDI and CRDI. Emission Norms, Cooling and Lubrication System.

UNIT II TRANSMISSION SYSTEM 9

Types of Transmission – Clutch – Types, Gear Box – Types – Working Principle and Construction, Automatic Transmission – Fluid Coupling, Torque Converter. Propeller Shaft- Slip Joint – Universal Joint , Differential, Final Drive ,Rear Axle and its types.

UNIT III STEERING AND SUSPENSION SYSTEMS 9

Steering Geometry- Ackermann And Davis Steering Principle, Steering- Hydraulic and Electronic, Suspension System- Types – Conventional and Independent suspension.

UNIT IV BRAKE AND WHEELS 9

Types of Brakes -Construction and Working. Antilock Braking System, TCS. Types of Wheels – Construction of Wheel. Types of Tyres – Tubeless Tyres and Tubed Tyres and its Classifications, Flexible tyre.

UNIT V AUTOMOTIVE ELECTRICAL AND MODERN VEHICLES 9

Batteries- Lead Acid /Lithium Ion Battery. Starting System. Ignition System-types, Laser Ignition. Vehicle Lighting- Head Lamp. Automotive Sensors and its types. Need For Hybrid and Electric Vehicle–Types- Fuel Cell Technology.

TOTAL: 45 PERIODS

OUTCOMES:

After completing the course, the student will able to

1. Assess and critically evaluate various Engine concepts, determine their characteristics, advantages and limitations
2. Interpret different types of drive lines and drives used in Automotive.
3. Examine the working principle of steering systems, conventional and independent suspension systems.
4. Apply knowledge on working principles of brake and its subsystems.
5. Demonstrate understanding of Hybrid and Electric vehicle architectures and their technologies.

TEXT BOOKS:

1. Kirpal Singh, Automobile Engineering, Standard Publisher, New Delhi, 2017
2. K.K.Ramalingam, “Automobile Engineering”, Scitech publication (India), 2011.
3. R.K. Rajput, A Text–Book of Automobile Engineering, Laxmi Publications Private Limited, 2015
4.Jack Erjavec, Automotive Technology,3rd Edition.

REFERENCES:

1. Heinz Hazler, Modern Vehicle Technology, Butterworth, London, 2005.
2. Heldt P.M., Automotive Chassis, Chilton Co., New York, 1990.
3. Newton Steeds and Garret, Motor Vehicles, 13th Edition, Butterworth, London, 2005.
4. N.K. Giri, Automotive Mechanics, Kanna Publishers, 2007.
5. William H Crouse, “Automotive Mechanics”, The McGraw-Hill companies,2007.

PR5791 DESIGN CONCEPT OPTIMIZATION AND RAPID PROTOTYPING L T P C
3 0 0 3

COURSE OBJECTIVES:

The main objectives of this course are to:

1. Applying the design processes to develop a successful product.
2. Applying scientific approaches to provide design solutions.
3. Apply Taguchi and Response surface method for parameter Optimization
4. To introduce the development of Additive Manufacturing (AM), various business opportunities and applications
5. To familiarize various software tools, processes and techniques to create physical objects that satisfy product development / prototyping requirements, using AM.

UNIT I INTRODUCTION TO DESIGN PROCESSES 9

Basic modules in design process-scientific method and design method-Need identification, importance of problem definition-structured problem, real life problem- information gathering - customer requirements- Quality Function Deployment (QFD)- product design specifications-generation of alternative solutions- Analysis and selection-Detail design and drawings-Prototype, modelling, simulation, testing and evaluation

UNIT II CREATIVITY IN DESIGN 9

Creativity and problem solving-vertical and lateral thinking-invention-psychological view, mental blocks-Creativity methods-brainstorming, synectics, force fitting methods, mind map, concept map-Theory of innovative problem solving (TRIZ) - conceptual decomposition creating design concepts.

UNIT III TAGUCHI METHODS AND RESPONSE SURFACE METHODOLOG 9

Design of experiments using Orthogonal Arrays, Data analysis from Orthogonal experiments-Robust design- case studies. Response surface methodology, parameter – optimization - case studies.

UNIT IV RAPID PROTOTYPING 9

Rapid Prototyping- Rapid Tooling – Rapid Manufacturing – Additive Manufacturing. AM Process Chain- Classification – Benefits and Applications.

UNIT V DESIGN FOR ADDITIVE MANUFACTURING 9

Concepts and Objectives- Additive Manufacturing Unique Capabilities: Part Consolidation-Topology Optimization- Lightweight Structure - DFAM for Part Quality Improvement. Data Processing - CAD Model Preparation -Part Orientation and Support Structure Generation -Model Slicing - Tool Path Generation-Customized Design and Fabrication for Medical Applications- Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course student should be able to:

CO1 Apply the design processes to develop a successful product.

CO2 Apply scientific approaches to provide design solutions.

CO3 Understand and apply the design concept and analyse the importance of response surface methodology in design of experiments

CO4 Recognize the development of Additive Manufacturing technology

CO5 Acquire knowledge on process of transforming a concept into the final product in Additive Manufacturing technology.

TEXT BOOKS:

1. Douglas C. Montgomery, Design and Analysis of Experiments, John Wiley & Sons, Inc., 9th edition, 2017.
2. Andreas Gebhardt and Jan-Steffen Hötter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.
3. Ian Gibson, David W. Rosen and Brent Stucker "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", 2nd edition, Springer., United States, 2015, ISBN-13: 978-1493921126.

REFERENCE BOOKS

1. George Dieter, Linda C. Schmidt, Engineering Design, McGraw-Hill, 2012.
2. Philip J. Rose, Taguchi Techniques for quality Engineering, Prentice Hall, 2000.
3. Krishnaiah K, and Shahabudeen P, "Applied Design of Experiments and Taguchi Methods", PHI,1st Edition, 2011.
4. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.
5. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
6. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States ,2006, ISBN: 978-1-4614-9842-1.
7. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press., United States, 2011, ISBN: 9780849334092.
8. Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies, and Applications", Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.

PR5792 MICRO AND NANO MANUFACTURING L T P C

3 0 0 3

COURSE OBJECTIVES:

The main objectives of this course are to:

1. To acquaint the students with the principles, basic machine tools, and developments in the micro/nano manufacturing process and research trends in the area of micro and nano manufacturing process.
2. To give awareness of different techniques used in micro and nano manufacturing
3. To give in-depth idea of the techniques used in micro manufacturing
4. To introduce micro-nano deposition techniques
5. To introduce Laser based Nanofabrication Techniques and other processing routes in Micro and nano manufacturing

UNIT – I PRINCIPLES OF MICRO AND NANO MANUFACTURING 9

Introduction to Micro Fabrication: basics, flowchart, basic chip making processes Introduction to Nanofabrication, Nanofabrication using soft lithography – principle, applications – Examples (Field Effect Transistor, Elastic Stamp) Manipulative techniques – process principle, applications.

UNIT – II MACRO, MICRO, BULK MACHINING AND NANO FINISHING 9

Introduction to Precision engineering, macro milling and micro drilling, Micro-electromechanical systems – merits and applications, Micro phenomenon in Electro-photography – applications. Bulk micromachining, Surface micromachining steps, Nano finishing – finishing operations.

UNIT – III ENERGY BASED MICRO MACHINING 9

Introduction to Micro-energy and chemical system (MECS), Space Micro-propulsion, e-Beam Nanolithography – important techniques, Micro instrumentation – applications, Micro Mechatronics.

UNIT – IV MECHANICAL MICROMACHINING PROCESSES 9

Introduction to mechanical micromachining, Micro drilling – process, tools and applications Micro turning – process, tools and applications, Diamond Micro turning – process, tools and applications – Micro milling and Micro grinding – process, tools and applications, Micro extrusion- process and applications.

UNIT – V LASER BASED MICRO AND NANO MANUFACTURING 9

Laser fundamentals – Laser technology in micro manufacturing – Laser Micro welding – Laser Micro bending, description and applications, Defects. Industrial Applications of micro and Nano manufacturing: MEMS, IC and micro scale features

TOTAL : 45 PERIODS

TEXT BOOK:

1. Mark J. Jackson, (2010) Micro and Nano fabrication, CRC Press, Taylor & Francis Group

REFERENCE BOOKS:

1. Yi Qin,(2010), Micro-Manufacturing Engineering and Technology, Elsevier Publisher, ISBN: 978-0-8155-1545-6.
2. V.K.Jain, (2013), Micro manufacturing processes, CRC Press, Taylor and Francis Group 3.
3. MuammerKoc, TrugelOzel, (2011) Micro manufacturing, Design and manufacturing of micro products, Wiley Publishers
4. Mark. J. Jackson, Micro and Nano-manufacturing, Springer, 2006.
5. Mark. J. Jackson, Micro-fabrication and Nano-manufacturing - Pulsed water drop micromachining CRC Press 2006.
6. Nitaigour Premchand Mahalik, Micro-manufacturing and Nanotechnology, 2006.

COURSE OUTCOMES:

Upon successful completion of the course the students will

CO1 Gain awareness of different techniques used in micro and nano manufacturing.
CO2 Obtain in-depth idea of the macro, micro, bulk machining and nano finishing Processes.
CO3 Acquire the knowledge in energy based micro machining.
CO4 Acquire the knowledge in mechanical micromachining processes**.**
CO5 Acquire the knowledge in micro and nano manufacturing with laser based Equipment.

PR5793 SUSTAINABLE PRODUCTION L T P C
3 0 0 3

COURSE OBJECTIVES:

- To expose the students to the basics of green Manufacturing
- To incorporate knowledge about the green energy and sustainable manufacturing systems.
- To enlighten the students with knowledge about air and noise pollution and its effects on the environment.
- To impart the knowledge of fire safety and its production.
- To impart the knowledge about the need, procedure and benefits of Green-Co rating

UNIT I INTRODUCTION TO GREEN MANUFACTURING 9

Motivations and Barriers to Green Manufacturing, Environmental Impact of Manufacturing, Strategies for Green Manufacturing. Present Atmosphere and Challenges for Green Manufacturing towards Social Environment and policy environment. Overview of Currently Used Metrics for green manufacturing. Environmental impact assessment objectives.

UNIT II GREEN ENERGY AND SUSTAINABLE MANUFACTURING 9

Introduction to green energy concepts – Green house effect – Global warming – Climate change - Environmental degradation- Environmental pollution – Pollution due to manufacturing industries - Remedies. Definition of sustainable manufacturing – Environmental, Economical and Social dimensions of sustainability – Sustainable Development Models – Strong and Weak Sustainability.

UNIT III AIR AND NOISE POLLUTION 9

Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution. Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human, Environment and properties, Natural and Atherogenic Noise Sources, Measuring Instruments for frequency and Noise levels.

UNIT IV FIRE SAFETY 9

Basic Elements, Causes, Industrial Fires, Explosions, Effects on Environmental, Property and Human Loss, Prevention technique, Building Design, Fire Protection System, contingency plan, Emergency preparedness, Evacuation.

UNIT V ASSESSMENT OF GREENCO RATING 9

Green Rating for Integrated Habitat Assessment. Ecological Footprint - Need For Green Co-Rating – Green Co-Rating System – Intent – System Approach – Weightage- Assessment Process – Types of Rating – Green Co-Benefits – Case Studies of Green Co-Rating.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

CO1 :understand the basic Concepts of green manufacturing and environmental impact assessment objectives

CO2 :apply suitable schemes towards design of green energy and sustainable manufacturing requirements.

CO3 : understand towards minimization or prevention of air and noise pollution.

CO4 : have some knowledge on fire safety.

CO5 : Predict the green co-rating and its benefits.

TEXT BOOKS:

1. Ronald G. Askin and Jeffrey B. Goldberg, “Design and Analysis of Lean Production Systems”, John Wiley and Sons, 2003.
2. Davim J Pauls, Green Manufacturing Processes and Systems, Springer, 2013
3. “Green Co Case Study Booklet”, CII – Sohrabji Godrej Green Business Centre, 2015

REFERENCES:

1. Clive George, Collin.C, Kirkpolarice.H, “Impact Assessment and sustainable development”, Edward Elgar Publishing 2007.
2. “Green Manufacturing: Case Studies in Lean and Sustainability, Association for Manufacturing Excellence”, CRC press,2007
3. Dornfield David, Green Manufacturing, Springer, 2012

IT5794 INTRODUCTION TO OOPS CONCEPTS L T P C
3 0 0 3

OBJECTIVES:

- To introduce the basic concepts of Object Oriented Programming language.
- To learn the concepts of class and object encapsulation.
- To introduce the various concepts related to inheritance.
- To learn the concepts of polymorphism.
- To understand the concepts of virtual functions and abstract classes.
- To introduce the concepts of Templates and exception Handling.

UNIT I BASIC C++ PROGRAMMING 9

Object oriented programming concepts – C++ programming: Data types, variables and arrays – Operators – Pointers - references – functions - String Handling.

UNIT II OBJECT ORIENTED PROGRAMMING CONCEPTS 9

Data Abstraction - Encapsulation - Class - Object – Constructors - Destructors - Static members – Constant members – Member functions - Friend functions- Role of **this** pointer – Storage classes – Copy Constructor.

UNIT III INHERITANCE 9

Inheritance –Types of Inheritance –public, protected and private inheritance – Method overriding – Abstract and concrete class – Virtual class - Virtual functions – Nested classes.

UNIT IV POLYMORPHISM 9

Polymorphism – compile time and run time polymorphisms – function overloading – operators overloading – Dynamic binding - Exception handling.

UNIT V ADVANCED OOPS FEATURES 9

Standard libraries - Generic Programming - templates – class template -function template – iterators – function adaptors – allocators - File handling concepts. `

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Understand the problem specifications as per the requirements.
- Design practical applications using OOP concepts.
- Solve the given problem using object oriented programming concepts.
- Implement inheritance concepts for an application.
- Understand the concepts of polymorphism
- Use the STL libraries for implementation of an application.

TEXT BOOKS:

1. Bjarne Stroustrup,“The C++ Programming Language”,4th edition, Pearson Education, 2013.
2. K R Venugopal, Rajkumar Buyya,“Mastering C++”, 2nd Edition,McGraw Hill Education, 2013.

REFERENCES:

1. Ira Pohl, “Object Oriented Programming using C++”, 2nd edition, Pearson Education, 1997.
2. Herbert Schildt, “C++: The Complete Reference”, 4th Edition, McGraw Hill Education, 2003.
3. Paul Deitel, Harvey Deitel, “C++ How to Program”, Tenth Edition, Pearson Education, 2017.

IT5795 INTRODUCTION TO SOFTWARE ENGINEERING METHODOLOGIES L T P C
3 0 0 3

OBJECTIVES:

- To gain knowledge about various software development life cycle (SDLC) models.
- To learn how to elicit and formulate requirements.
- To be aware of designing a software considering the various perspectives of end user.
- To analyze the software using metrics and measurement and predict the complexity and the risk associated.

UNIT I SOFTWARE PROCESS MODELS 9

A Generic View of Process – Process Models-The Waterfall Model-Incremental Model-Evolutionary Model-Specialized Model-The Unified Process–Agile Process – Agile Models – Planning – Human aspects of Software Engineering

UNIT II REQUIREMENT ENGINEERING 9

System Engineering Hierarchy – System Modeling – Requirements Engineering: Tasks- Initiating The Process-Eliciting Requirements-Developing Use Cases- Negotiating Requirements-Validating requirements

UNIT III ANALYSIS MODELING AND DESIGNING 9

Building the Analysis Models: Concepts - Design Concepts – Design Models – Pattern Based Design – Architectural Design – Component Level Design – User Interface design.

UNIT IV TESTING 9

Software Testing – Strategies: Conventional - Object Oriented – Validation Testing – Criteria – Alpha – Beta Testing- System Testing – Recovery – Security – Stress – Performance – Testing Tactics – Testing Fundamentals-Black Box – While Box – Basis Path-Control Structure

UNIT V QUALITY MANAGEMENT 9

Software Configuration And Management - Risk management - Software quality Assurance - Software review techniques

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Obtain an insight into the concepts of software engineering.
- Analyze and resolve information technology problems through the application of systematic approaches and diagnostic tools for end to end solutions.
- Elicit the requirements for real-time problems.
- Estimate the cost of software, risks of handling, do software planning and configuration management.
- Maintain documentation for software engineering process.

TEXT BOOK

1. Roger Pressman.S., Bruce R Maxim, “Software Engineering: A Practitioner's Approach”, 9th Edition, McGrawHill, 2020.

REFERENCES
1. P. Fleeger, “Software Engineering”, 4th edition, Prentice Hall, 2010.
2. Carlo Ghezzi, Mehdi Jazayari, Dino Mandrioli, “Fundamentals of Software Engineering”, 2nd edition, Prentice Hall Of India, 2003.
3. I. Sommerville, “Software Engineering”, 9th Edition: Addison Wesley, 2011.

EC5795 INTERNET OF THINGS L T P C
3 0 0 3

OBJECTIVES:
- To understand the fundamentals of networking
- To understand the basics of Internet of Things.
- To apply the concept of Internet of Things in the real world scenario.
- To learn about python programming for IoT system development
- To understand the various case studies.

UNIT I NETWORK FUNDAMENTALS 9
Definition of layers, services, interface and protocols, OSI reference model - TCP/IP reference model–layers and duties, LLC – Flow control & Error control, MAC – IEEE standards, Routing - IPv4, Process to Process delivery – TCP, UDP.

UNIT II IoT BASICS 9
Introduction to IoT - Definition, Characteristics, functional requirements, motivation. Physical design- things in IoT, IoT protocols, Logical Design- functional blocks, Communication models, Communication APIs, Applications–Home Automation, Cities, Environment, Energy, Agriculture, Health, Industry.

UNIT III INTERNET OF THINGS DEVELOPMENT 9
Introduction - M2M,Difference between M2M and IoT. IoT methodology-Purpose & Requirements specification, process specification, domain model specification, information model specification, service specification, IoT level specifications.

UNIT IV PYTHON PROGRAMMING FOR IoT 9
IoT systems logical design using python-python data types & data structures, control flow, functions or modules, remote access enablement using cloud.

UNIT V CASE STUDIES 9
Case study for weather monitoring system-modules & package of python, python packages of interest for IoT- JSON, XML, HTTP& URL Lib, SMTP Lib. Exemplary device- Raspberry pi, Linux on Raspberry pi.

TOTAL:45 PERIODS

OUTCOMES:
Upon the completion of the course the student will be able to
- Understand the need for different protocols at different layers and their interworking.
- Understand IoT Basics.
- Develop an IoT application and connect to the cloud.
- Develop an IoT system with the knowledge of Python.
- Analyze real time IoT applications.

TEXTBOOKS:

1. Arshdeep Bahga, madisetti, "Internet of Things" A hands on approach, Universities Press (india) Private Limited, 2014.
2. Behrouz.A.Forouzan,"Data Communication and Networking ,4th Edition, Tata McGraw Hill, 2007.

REFERENCES:

1. Olivier Hersent, David boswarthick, Omar Elloumi, "The internet of things-key applications and protocols, Wiley 2012.
2. Manoel Carlos Ramon, "Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers", Apress, 2014.
3. Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014.

EC5796	COMPUTER VISION AND MACHINE LEARNING	LT P C
		3 0 0 3

COURSE OBJECTIVES:

- To provide the basic understanding of computer vision concepts
- To give an exposure of algorithms related to region selection, motion estimation and recognition
- To understand the methodology behind different computer vision applications
- To familiarize with the fundamentals of machine learning concepts
- To give an exposure to selected machine learning techniques and algorithms

UNIT I INTRODUCTION TO COMPUTER VISION 9

Image formation - Point operators - Linear filtering - neighborhood operators – Fourier transforms – Pyramids and wavelets – Geometric transformations - Feature detection and matching

UNIT II SEGMENTATION 9

Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods

UNIT III MOTION ESTIMATION AND RECOGNITION 9

Structure from motion - Translational alignment - Parametric motion - Optical flow - Layered motion - Object detection - Face recognition- Instance recognition -Category recognition - Context and scene understanding

UNIT-IV MACHINE LEARNING MODELS 9

Types - Supervised and Unsupervised - Parametric and non-parametric models – discrete, continuous and joint probability distributions – Transformation of random variables - Generative models for discrete data - Gaussian models

UNIT-V LEARNING ALGORITHMS 9

Linear regression – Logistic regression – Classification and Regression Trees (CART) - Multilayer Perceptrons – Ensemble learning - Kernel Machines - hidden Markov models - Deep learning - Applications of deep networks

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to:

- Understand the fundamentals related to computer vision and machine learning
- Work on algorithms for region extraction and motion estimation from images or videos
- Understand the methodology behind object detection and recognition tasks
- Have complete understanding of machine learning models and learning algorithms
- Have basic understanding of algorithms in relation to computer vision and machine learning applications

TEXT BOOKS:

1. Richard Szeliski , 'Computer Vision: Algorithms and Applications' Springer, 2011.
2. Kevin P. Murphy 'Machine Learning - A Probabilistic Perspective', The MIT Press Cambridge, Massachusetts, London, England, 2012.

REFERENCES:

1. E.R.Davies, "Computer Vision – Principles, Algorithms, Applications, Learning", Fifth Edition, Academic Press, 2018.
2. Ethem Alpaydın , 'Introduction to Machine Learning' The MIT Press Cambridge, Massachusetts London, England, II Edition , 2010
3. Simon J.D. Prince, Computer Vision: Models, Learning, and Inference' Cambridge University Press 2012.

EC5797 EMBEDDED SYSTEM DESIGN USING ARDUINO L T P C
3 0 0 3

COURSE OBJECTIVES:

- To conceptualize the fundamentals of Arduino Board and its usage in building real time Embedded Applications
- To educate the students on the programming aspects of Arduino boards
- To make the students to understand the basic principles of interfacing I/O devices with Arduino boards
- To facilitate the students with the knowledge of readily available Arduino prototyping shields
- To encourage the students in building real time embedded applications

UNIT I INTRODUCTION 9

Embedded Systems – Definition, Classification and Building Blocks, Arduino Boards and Software Packages, Development Tools, Arduino features and Capabilities, Electrical characteristics, Programming the Arduino and AVR Microcontrollers, Embedded C Basics.

UNIT II AVR MICROCONTROLLER 9

AT mega 2560 MCU, Architecture, Features, Memory, Packages, Ports, Pin Functions, Analog comparator, Analog to Digital Convertor, Serial Interfaces – USART, SPI and TWI, Timer/Counter, Interrupts, Watchdog Timer.

UNIT III ARDUINO AND I/O DEVICES 9

Light Emitting Diode, Liquid Crystal Display, Push Button/Switch, Sensors - Fire, Passive Infrared, Tilt, Ultrasonic, Temperature, Humidity, Light dependent resistor and Light intensity, Relay, Actuators – DC Motor, Servo Motor, Stepper Motor and AC Motor, Wireless Communication – RF Modem (2.4 GHz), Global System for Mobile Modem.

UNIT IV ARDUINO SHIELDS 9

Input/output Expansion Shields, Relay Shields, Signal Routing Shields, Memory, Communication, Serial I/O and MIDI, Ethernet, Bluetooth, USB, ZigBee, CAN, Motion Control Shields, Display, Instrumentation and Adapter Shields.

UNIT V ARDUINO PROJECTS 9

Temperature Monitoring System using RF Modem, Accelerometer based laboratory automation system, Emergency Hooter in the case of a Disaster, 2.4 GHz RF Modem based security system for restricted area, A Programmable Signal Generator.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to:

- Have complete understanding of Arduino boards and Programming methodologies
- Understand the features, architecture and functionality of ATmega 2560 MCU
- Interface peripherals with Arduino boards
- Know about the different supporting shields available for designing an embedded system
- Develop a real time embedded system for commercial applications.

TEXT BOOKS:

1. J. M. Hughes, "Arduino: A technical Reference – A Handbook for technicians, Engineers and Makers", O'Reilly Media., 2016.
2. Rajesh Singh, Anita Gehlot, Bhupendra Singh and Sushabhan Choudhury, "Arduino – based Embedded Systems: Interfacing, Simulation and LabVIEW GUI", CRC Press, 2018.

REFERENCES:

1. Simon Monk, "Designing 30 Arduino Projects for the Evil Genius", The McGraw-Hill Companies, 2010.
2. Steven F. Barrett, "Atmel AVR Microcontroller Primer: Programming and Interfacing", Morgan & Claypool publishers, 2008.
3. Dhananjay V. Gadre, "Programming and Customizing the AVR Microcontroller", The McGraw-Hill Companies, 2001.

EI5791 INDUSTRIAL AUTOMATION SYSTEMS LT PC
3 0 0 3

COURSE OBJECTIVES:

- To introduce the concept of PLC, DCS and SCADA
- To expose students to different types of transmitters, Final Control elements and actuators
- To teach students about the roll of Computers in Process Industries
- To familiarize students on Programming of PLC with typical case studies
- To teach about the various sub systems of DCS

UNIT I INTRODUCTION 9

Need for automation systems - Architecture of Industrial Automation system. Introduction to PLC, SCADA and DCS – Introduction to Industrial Data Networks:- Foundation Field Bus and Profibus.

UNIT II FIELD DEVICES 9

Conventional / Smart Process Transmitters:- Temperature, Pressure, Flow, Level and pH Measurement - Final Control Elements:- Actuators: Pneumatic and electric actuators - Control Valves - Thyrister Power Controller. Introduction to DC and AC Servo Drives for motion control – Interfacing Field devices with I/O Sub Systems.

UNIT III COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS 9

Role of computers in measurement and control - Elements of computer aided measurement and control:- Man-Machine interface, computer aided process control hardware and software – Industrial Internet of things (I^2oT) – Cyber Security for Industrial automation

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS 9

Programmable Logic Controllers:- Hardware of PLC - PLC programming:-Ladder diagram with examples - PLC Communication and networking - Case studies:- Bottle filling application and Elevator control.

UNIT V DISTRIBUTED CONTROL SYSTEM 9

DCS:- LCU-Shared communication facility- Display Hierarchy- High Level and Low Level interfaces - Case studies:- DCS in cement plant and thermal power plant.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Gain knowledge on basics of Industrial Automation
- Ability to select appropriate Transmitters, Final control elements and Controllers for different application
- Gain familiarity with Computer aided measurement and control
- Students will be able to Develop Ladder programmes for PLC
- Acquire knowledge about Distributed Control System
- Will be able to recommend right choice of automation systems for a given application

REFERENCES:

1. S.K.Singh, "Industrial Instrumentation", Tata Mcgraw Hill, 2nd edition companies,2003.
2. C D Johnson, "Process Control Instrumentation Technology", Prentice Hall India, 8thEdition, 2006.
3. E.A.Parr, Newnes , NewDelhi, "Industrial Control Handbook", 3rd Edition, 2000.
4. Gary Dunning, Thomson Delmar, "Programmable Logic Controller", Ceneage Learning, 3rdEdition,2005.
5. Lucas, M.P., "Distributed Control System", Van Nostrand Reinhold Company, New York,1986.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
COOE3.1											S	S			S
COOE3.2											S	S	S		
COOE3.3											S	S		S	
COOE3.4											S	S		S	
COOE3.5											S	S	S		
COOE3.6											S	S			M

EI5792 INTRODUCTION TO PROGRAMMABLE LOGIC CONTROLLER L T P C

3 0 0 3

COURSE OBJECTIVES

- To provide an over view on the role of PLC in an Industrial Automation.
- To introduce the basics of PLC Programming Languages.
- To expose the IEC 61131-3 standard for PLC Programming
- To teach the Ladder Diagram and Function Block Diagram based PLC Programmingwith examples.
- To teach typical applications of PLC.

UNIT I INTRODUCTION 9

Introduction to Hardwired Relay Logic and Solid-state Logic - Examples — Introduction to Programmable Logic - Examples - Role of PLC in an Industrial automation.

UNIT II PLC ARCHITECTURE 9

Architecture of PLC - Input/output modules:- Analog/Digital Input/output modules - Scan cycle of PLC. Introduction to PLC Programming languages:- Ladder Diagram(LD), Function Block Diagram(FBD), Sequential Function Charts(SFC), Instruction List(IL), Structured Text(ST).

UNIT III IEC 61131-3 PLC PROGRAMMING STANDARD 9

IEC 61131-3 Standard Building Blocks of IEC 61131-3 - Elements of Program Organization Unit: - Variables, Data types and Common elements - Standard Functions.

UNIT IV PLC PROGRAMMING 9

Ladder Logic Programming: - Relay Logic Instructions, Timer, Counter, Math and Program Control instructions - Function Block Diagram – Examples.

UNIT V CASE STUDIES 9

Case studies: Burner Management System in a Thermal Power Plant - Traffic Light ControlSystem - Bottle filling application - Elevator Control – Robotic Arm Control.

TOTAL : 45 PERIODS

COURSE OUTCOMES

- Ability to understand the role of PLC in the Factory Automation and Process Automation
- Get exposed to different ways of Programming PLC.
- Get exposed to IEC 61131-3 standard
- Ability to develop Ladder Diagram and Functional Block Diagram for typical Industrialapplications.
- Ability to apply various logic instruction for different application
- Apply the knowledge of PLC for various application

REFERENCE BOOKS

1. Petruzella.F.D. “Programmable Logic Controllers”, 3rd Edition, Tata McGraw-Hill, 2010.
2. Hughes.T.A. “Programmable Logic Controllers: Resources for Measurements and Control Series”, 3rd Edition, ISA Press, 2004.
3. Karl-Heinz John, Michael Tiegelkamp, “IEC 61131–3: Programming Industrial Automation Systems”, 2001.
4. Gary Dunning and Thomson Delmar, “Programmable Logic Controller”, 3rd Edition, Ceneage Learning, 2005.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
COOE4.1											S	S			M
COOE4.2											S	S	S		
COOE4.3											S	S	S		
COOE4.4											S	S	S		
COOE4.5											S	S	S		
COOE4.6											S	S			M

HS5791 BASIC COMMUNICATION IN ENGLISH L T P C
3 0 0 3

OBJECTIVES:

The Course will enable Learners with limited proficiency in English to,

- Learn the fundamental features of communicating in English.
- Develop the skills and sub skills of reading and comprehending the content read.
- Read and comprehend both short and longer texts in English.
- Listen and comprehend lectures in English.

UNIT I **9**

Listening - Listening to individual phonemes in English, identification and practice of phonemes.
Reading- Reading aloud of texts- short stories/ scenes from plays.
Speaking- Self-introduction in informal contexts- (necessary expressions to be given)
Writing- Development of hints
Grammar- Use of articles- countable and uncountable nouns.

UNIT II **9**

Listening- Listening to announcements in public places such as made on social media.
Reading- Short texts and answering questions.
Speaking- Asking and answering questions of a personal kind (hobbies, home, favourite sports person, ambitions,)
Writing- Using given expressions/ keywords to develop a story.
Grammar- Use of pronouns, verbs- regular & irregular, Adjectives- degrees of comparison.

UNIT III **9**

Listening- Listening to lectures and summarizing information.
Speaking- Reporting flow of Events (Sequence)
Reading – Reading summaries
Writing-Writing a précis
Grammar and Vocabulary- Needs based Grammar

UNIT IV **9**

Listening- Listening to description of a place/
Speaking –Role play (practicing conversations)
Reading- Newspaper Articles.
Writing- Dialogue Writing
Grammar and Vocabulary- Needs based Grammar

UNIT V **9**

Listening- Listening to a process.
Speaking- Describing an experience.
Reading- Reading essays.
Writing –Short essays.
Grammar and Vocabulary- Needs based Grammar Teaching Methods:

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the Course, Learners will be able to,

- Listen and comprehend information being given in English.
- Read and comprehend English texts.
- Speak English with confidence
- Produce a well-organized essay with adequate support and details.
- Write comprehension answers in English.

TEXT BOOK:

1. Y Prabhavati, M Lalitha Sridevi, Ruth Z Hauzel, " English All Round- Communication Skills for Undergraduate Learners" Orient BlackSwan, 2019.

REFERENCE BOOKS:

1. N. M. White " Unlock- Listening and Speaking Skills 1" Cambridge University Press, 2014.
2. N. M. White " Unlock- Reading and Writing Skills 1" Cambridge University Press, 2014.
3. Sadanand, Kamlesh. Susheela Punitha. "Spoken English Part 1- A Foundation Course" Orient BlackSwan, 2014.
4. A. Amin, R, Eravelly, F.J.Ibrahim. "Grammar Builder 2- A grammar guidebook for students of English" Cambridge University Press, 2004.

Suggested evaluation methods:

Assessment-25 (Listening & speaking)

Assessment -25 (Reading &Writing)

End semester-100

Teachers can use quizzes, visual inputs etc. to get their Learners to communicate in English

HS5792 INTRODUCTION TO CRITICAL THINKING L T P C
3 0 0 3

COURSE OVERVIEW

This is an open elective course offered for B.E/B.Tech/ M.E/M.Tech students who are interested in learning 21st Century skills that will help them in their academics and career.

COURSE OBJECTIVES:

The main objectives of this course is

- To distinguish between assumptions, fact and opinions
- To identify strong and weak points, reasons and claims in an argument.
- To infer and interpret evidence, verbal and visual materials etc.
- To analyse various perspective and learn to be objective.
- To evaluate the empirical data objectively that will help in honing problem-solving skills

UNIT I INTRODUCTION TO CRITICAL THINKING 9

Introduction to critical thinking - Defining critical thinking –Elements of critical thinking - Distinguishing between facts and opinions –Elenctic method (asking relevant questioning)– small group discussions

UNIT II INDUCTING & INDUCTIVE REASONING 9

Classification of content - Interpreting & Evaluating verbal and visual content (Infographics) – Reading comprehension – Drawing inferences – Blooms Taxonomy – Deductive & Inductive Reasoning

UNIT III ANALYZING VISUAL AND VERBA MEDIA 9

Critically reviewing and analysing visual media like advertisement, news reports, documentaries & movies – Critical review writing of the visual media – Identifying and analysing symbols used in the content

UNIT IV IDENTIFYING FALLACIES 9

Rhetorical devices – Ambiguities in argument – Expressing opinions - Types of Fallacies – Discourse rules in group discussion – Group discussion – Components of Critical Thinking - Analzying & solving problems- Case Study

UNIT V CRITICAL THINKING AND MEDIA 9

Critiquing an article – Electronic Media & Critical thinking – Online sources of information & critical thinking – Lateral thinking –Critical thinking in Social media - Writing an article after collecting and evaluating data

TOTAL: 45 PERIODS

LEARNING OUTCOMES:

By the end of the course students will be able to

- Accurately interpret evidence, statements, graphics, questions etc.
- Identify relevant arguments, reasons, claims, supporting arguments, pros and cons etc.
- Analyze and evaluate different perspectives and be more objective in decision making
- Distinguish between assumptions, facts and opinions and also to discern real news from fake news.
- Give importance to evidence and reason and be fair in making judgments.

REFERENCES:

1. Abrami, Philip C., Robert M. Bernard, Eugene Borokhovski, David I. Waddington, C. Anne Wade, and Tonje Person, 2015, "Strategies for Teaching Students to Think Critically: A Meta-analysis", *Review of Educational Research*, 85(2): 275–314. doi:10.3102/0034654314551063
2. Center for Assessment & Improvement of Learning, 2017, *Critical Thinking Assessment Test*, Cookeville, TN: Tennessee Technological University.
3. A.L.Costa, "Developing minds: A Resource Book for Teaching Thinking", 3 rd Edition, Association for Supervision and Curriculum Development Alexandria, 2001.
4. R.Paul, "Critical Thinking: What every student needs to survive in a rapidly changing world", Foundation for Critical Thinking, Dillon Beach, CA, 1992.
5. Diane F Halpern, "Thinking Critically about Critical Thinking", Lawrence Erlbaum Associates, Mahwaj,NJ, 1996.

HS5793 READING FICTION L T P C
3 0 0 3

COURSE DESCRIPTION

This course is designed to give students an introduction to fiction in English from around the world.

COURSE OBJECTIVES

- To give students who are already proficient in the use of the English language some exposure to fiction from different parts of the world
- To help students appreciate the nuances of literary language.
- To help students understand the denotative and connotative meanings in literary texts.
- To provide students with the material to discuss common themes of human concern.
- To provide students with the opportunity to practice their reading skills

UNIT I HISTORICAL FICTION 9

Defining history and fiction and the intersection between the two - The language of historical fiction – historical truth vs literary truth - Text for study: **The Diary of Anne Frank.**

UNIT II FANTASY / HORROR / GOTHIC FICTION 9

Introduction to Gothic fiction –Different sub genres of Gothic fiction – origins and development Text for study: Edgar Allan Poe – **The Pit and the Pendulum.**

UNIT III WOMEN'S FICTION 9

Introduction to fiction by women writers – Women's writing – characteristics - Text for study: Muriel Spark: **The Driver's Seat.**

UNIT IV MYTHOLOGICAL FICTION 9

Introduction to mythological retellings in fiction - novel, short story, flash fiction, Drabble, 55 fiction - Text for study: Anand Neelakantan: **Asura: Tale of the Vanquished.**

UNIT V FICTION IN TRANSLATION 9

Translation and intertextuality – adaptation, stylistic equivalence, tranference of cultural information, literary conventions -Text for study: M.T. Vasudevan Nair: **Naalukettu: The House around the Courtyard** (translated by Gita Krishnankutty)

TOTAL: 45 PERIODS

LEARNING OUTCOMES

Students will be able to

- read texts with insight into their meaning and context
- use different reading strategies to identify construction of narratives
- identify and use the literary tools and strategies used by writers to communicate their meaning
- collect, organize and present details about the writers, the historical and general contexts of the texts.
- discuss, analyse and argue about general issues related to society.

REFERENCES:

1. Barnet, Sylvan , William E. Burto , William E. Cain **An Introduction to Literature (16th Edition),** 2010
2. Kennedy & Gioia, **Literature: An Introduction to Fiction, Poetry, Drama and Writing**, Longman, 2015
3. Mays, Kelly J. (Ed) **The Norton Introduction to Literature** 2012
4. Mehrotra, Aravind Krishna. **A Concise History of Indian Literature in English.** New York: Palgrave Macmillan, 2009.
5. http://opencourselibrary.org/engl-111-introduction-to-literature-i/
6. http://everyday-education.com/literature/eng1.shtml
7. http://oyc.yale.edu/english/engl-300/lecture-1