### List of Open Electives

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

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<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
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<td>EC7693</td>
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<td>9.</td>
<td>IT7692</td>
<td>Introduction to OOPS Concepts</td>
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<td>10.</td>
<td>IT7693</td>
<td>Introduction to Internet of Things</td>
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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 role 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
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

UNIT III COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS
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 (IoT) – Cyber Security for Industrial automation

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS
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
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
- Students will be able to Develop Ladder programmes for PLC
- Will be able to recommend right choice of automation systems for a given application

REFERENCES:
INTRODUCTION TO PROCESS DATA ANALYTICS

COURSE OBJECTIVES:
To introduce students the basic concepts of
- Experimental Design
- Linear Regression Analysis
- Linear Model Selection and Regularization
- Classification
- Process Identification, Performance Monitoring and Soft Sensor Design.

UNIT I INTRODUCTION
9

UNIT II REGRESSION
9
Linear Regression:- Simple Linear Regression, Multiple Linear Regression - K-nearest neighbours regression – Practical Consideration in the Regression Model - Validation methods to assess model quality:-The validation set approach, Leave-One-Out Cross Validation, k-Fold Cross Validation – Bias-variance Trade-off for k-Fold Cross Validation

UNIT III LINEAR MODEL SELECTION & REGULARIZATION
9

UNIT IV SUPERVISED LEARNING WITH REGRESSION AND CLASSIFICATION TECHNIQUES
9
Logistic regression– Linear Discriminant Analysis - Quadratic Discriminant Analysis – Regression & Classification Trees – Support Vector Machines - Random forests, Bagging and boosting - Neural Networks – Deep Learning

UNIT V APPLICATIONS
9
Process data analysis for system identification (under open and closed loops) - Controller Performance Monitoring - Principal components analysis (PCA) for Process Monitoring and Partial Least Squares (PLS) for soft-sensor design - Data-based causality analysis for identification of process topology.

TOTAL: 45 PERIODS

COURSE OUTCOME (Cos):
- Be able to apply Design of Experiments for Problem solving and Process Troubleshooting
- Be able to select the right choice of regression method for a given application.
- Be able to select the right choice of classification method for a given application.
- Be able to systematically carryout System Identification, Process & Performance Monitoring.
- Be able to cohesively analyze alarm data, process data and process connectivity information
REFERENCE BOOKS:

AE7691 CONTROL ENGINEERING PRINCIPLES

OBJECTIVE:
• 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 FEEDBACK CONTROL 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:

AE7692 FUNDAMENTALS OF AERODYNAMICS L T P C
3 0 0 3

OBJECTIVES:
- to introduce the basic concepts of mass, momentum and energy conservation relating to Aerodynamics.
- to make the student understand the fundamentals of theory of airfoils and wing sections.
- to introduce fundamental concepts in supersonic flows and nature of turbulence.

UNIT I FUNDAMENTAL CONCEPTS

UNIT II TWO DIMENSIONAL INVISCID INCOMPRESSIBLE FLOW

UNIT III AIRFOIL AND FINITE WING THEORY
Helmholtz’s theorems -Starting Vortex, Kutta condition -Thin Airfoil theory and its applications – finite wing theory for subsonic flows and its applications

UNIT IV PRELIMINARY ASPECTS OF COMPRESSIBLE FLOW
A brief of thermodynamics. Compressibility - formation of shock waves and expansion waves – Speed of sound - Mach waves – Prandtl-Meyer expansion – change of flow properties across shock waves and expansion waves

UNIT V INTRODUCTION TO LAMINAR AND TURBULENT FLOWS

TOTAL: 45 PERIODS
OUTCOMES:
At the end of the course students will
• have a good foundation knowledge in both subsonic and supersonic flows
• acquire the ability to perform basic calculations on estimation of skin friction drag
• have knowledge on turbulent nature of flows
• have the capability to estimate theoretically aerodynamic coefficients

TEXTBOOKS:

REFERENCES:

OUTCOME:
• Knowledge about various composites Processing Techniques are well known to the students.
TEXT BOOKS:

REFERENCES:

PR7692 OPERATIONS MANAGEMENT
L T P C 3 0 0 3

OBJECTIVE:
The students will be able to use these techniques while managing the manufacturing operations.

UNIT I FORECASTING

UNIT II SCHEDULING AND SEQUENCING

UNIT III INVENTORY CONTROL
Purpose or inventory – Basic EOQ model - Quantity discounts – P system – Q system – ABC analysis– MRP – Manufacturing batch size model – Multi item EOQ models with constraints – Aggregate planning.

UNIT IV PROJECT MANAGEMENT
Project Network analysis – Critical path method (CPM) – Programme Evaluation and Review Technique (PERT) – Project Crashing.

UNIT V PLANT ENGINEERING AND WORK STUDY

TOTAL: 45 PERIODS
OUTCOMES:
- The student can utilise the knowledge of forecasting, scheduling and sequencing for manufacturing operations.
- The student will be able to apply the knowledge of inventory management, plant engineering and work study on real life industrial problems.

TEXT BOOKS:

REFERENCES:

EC7693 COMPUTER VISION AND MACHINE LEARNING L T P C 3 0 0 3

OBJECTIVES:
- To provide the basic machine learning concepts and their application in computer vision problems.
- To understand simple image processing techniques, and algorithms.
- To give an exposure to selected machine learning concepts, techniques, and algorithms.

UNIT I INTRODUCTION TO COMPUTER VISION 9
Point operators - Linear filtering - neighborhood operators - 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 9
Translational alignment - Parametric motion - Optical flow - 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 and continuous distributions - Generative models for discrete data - Gaussian models.

UNIT V LEARNING ALGORITHMS 9

OUTCOMES:
Upon successful completion of this course, students will be able to:
- Explore the main challenges behind selected contemporary image processing and computer vision problems.
- Demonstrate the principles and applications of contemporary machine learning techniques.
- Implement machine learning algorithms and apply them to image and video-related problems.
EC7694 INTRODUCTION TO COMMUNICATION SYSTEMS L T P C 3 0 0 3

OBJECTIVES:
- To introduce concept of basic analog and digital communication systems.
- To understand the various modulation techniques for analog and digital communication systems
- To study the wired channel on communication systems and digital communication

UNIT I ANALOG COMMUNICATIONS 9
Linear modulation and demodulation - double sideband, amplitude modulation, envelope detection, hilbert transform, analytic signal, single sideband.

UNIT II ANGLE MODULATIONS 9
Frequency Modulation, narrowband signals, bessel functions, Carson’s rule - bandwidth, demodulation, Phase-locked loops,

UNIT III DIGITAL COMMUNICATIONS 9
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 9

UNIT V WIRELESS CHANNEL AND PERFORMANCE OF DIGITAL MODULATION 9
overview of wireless systems-capacity of wireless channel-capacity flat fading channel, channel distribution information known - channel side information at receiver -channel information at transmitter and receiver - capacity with receiver diversity - capacity comparisons, capacity of frequency selective fading channels.

TOTAL: 45 PERIODS

OUTCOMES:
Upon successful completion of this course, students will be able to:
- Understand the basic concepts of communication systems
- Use the modulation techniques for analog and digital communication
- Analyse the performance of wireless channels
IT7692  INTRODUCTION TO OOPS CONCEPTS  L  T  P  C
3  0  0  3

AIM:
The aim is to introduce the concepts Object Oriented Programming and master the OOPS concepts using C++.

OBJECTIVES:
- To introduce the concepts of Object Oriented Programming language.
- To introduce the various concepts related to inheritance and polymorphism.
- To introduce the concepts of Templates and Error Handling.

UNIT I  BASIC C++ PROGRAMMING  9
C++ Programming features – 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 -dynamic memory allocation - 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

TOTAL: 45 PERIODS

TEXT BOOKS:
REFERENCES:

IT7693 INTRODUCTION TO INTERNET OF THINGS L T P C
3 0 0 3

OBJECTIVES:
- To understand the fundamentals of Internet of Things.
- To build a small low cost IoT using sensors and Arduino board.
- To apply the concept of Internet of Things in the real world scenario

UNIT I INTRODUCTION TO THE INTERNET OF THINGS 9
What is the IoT and why is it important? - Elements of an IoT - Technology drivers - Business drivers - Typical IoT applications - Trends and implications.

UNIT II WIRELESS TECHNOLOGIES FOR THE IOT 9
Sensors and sensor nodes - Sensing devices - Sensor modules, nodes and systems - Network connectivity and protocols - Wireless sensor networks - Protocols - RFID, NFC, Zigbee, GSM, GPRS

UNIT III THE CLOUD FOR IOT 9
The Topology of the Cloud - Cloud-to-Device Connectivity - Device Ingress/Egress - Data Normalization and Protocol Translation - Infrastructure - APIs

UNIT IV IOT DESIGN METHODOLOGY 9
IoT systems management – IoT Design Methodology – Specifications Integration and Application Development, Arduino IDE – Programming - APIs

UNIT V IOT APPLICATIONS 9
Home Automation - Smart Lighting - Smart Appliances - Intrusion Detection - Smoke/Gas Detectors - Smart cities. Case Studies: e.g. sensor body-area-network.

TOTAL : 45 PERIODS

OUTCOMES:
Upon the completion of the course the student should be able to
- Design a portable IoT using Arduino boards and relevant protocols.
- Deploy an IoT application and connect to the cloud.
- Analyze applications of IoT in real time scenario

REFERENCES: