**Annexure-I**

## Seventh Semester

## Open Elective-1

| Sl. No. | Course Category | Course Code | Course Title | L | T | P | Contact Hours / week | Credit | Full Marks |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Open Elective - 1 | OE AL 703 | ICT for Development | 3 | 0 | 0 | 3 | 3 | 100 |
| 2. | Open Elective - 1 | OE CE 703 | Water & Waste Water Engineering | 3 | 0 | 0 | 3 | 3 | 100 |
| 3. | Open Elective - 1 | OE CS 703 | JAVA Programming | 3 | 0 | 0 | 3 | 3 | 100 |
| 4. | Open Elective - 1 | OE EC 703 | Introduction to Microcontrollers | 3 | 0 | 0 | 3 | 3 | 100 |
| 5. | Open Elective - 1 | OE EE 703 | Industrial Instrumentation Systems | 3 | 0 | 0 | 3 | 3 | 100 |
| 6. | Open Elective - 1 | OE ME 703 | Thermal Engineering | 3 | 0 | 0 | 3 | 3 | 100 |
| 7. | Open Elective - 1 | OE CC 703 | Traffic Engineering and Management | 3 | 0 | 0 | 3 | 3 | 100 |
| 8. | Open Elective - 1 | OE ES 703 | Optimization Techniques | 3 | 0 | 0 | 3 | 3 | 100 |
| 9. | Open Elective - 1 | OE MI 703 | Fuzzy Logic and Neural Network | 3 | 0 | 0 | 3 | 3 | 100 |

# ICT for Development

(Can be opted by students from all branches)

| | |
|---|---|
| Course Code | OE AL 703 |
| Course Title | ICT for Education |
| Number of Credits | 3 (L: 3, T: 0, P: 0) |
| Prerequisites | NIL |
| Course Category | Open Elective (OE) |
| Number of classes | 36 hours |

**Course Outcome:**

After completing this course, the students will be able to

| CO Number | CO Description | K-level |
|---|---|---|
| CO-1 | Explain the basic terminologies of ICT including hardware, software and networking requirements | K2 |
| CO-2 | Analyze the role of ICT in the development of education system. | K4 |
| CO-3 | Identify the importance of ICT in the healthcare sector | K3 |
| CO-4 | Describe the impact of ICT on e-governance | K2 |

**Course Content:**

**Module 1: Information and Communication Technology Basics: (08 hours)**

History of ICT, fundamentals of ICT, applications, impact and effects of ICT.
Hardware for ICT, Software for ICT, Computer Networks for ICT, ICT tools.

**Module 2: ICT in Education: (10 hours)**

Role of Mass Media in Education, Audio-Visual Aids for Teaching, role of Language Laboratory, New Trends in Education: E-Learning, Mobile Apps for Teaching and Learning, Teachers in the Digital Era, ICT and Distance Education, Role of Free and Open Source Software's (FOSS).

**Module 3: ICT in Healthcare (10 hours)**

Introduction to ICT in healthcare, benefits of using ICT in healthcare sector. Healthcare technology. Role of ICT in healthcare: Health and education, Hospital Management System, Health Research, Health data management, Security and privacy issues. Case study.

**Module 4: ICT in e-Governance (08 hours)**

The process of governance, e-governance, ICT and e-governance, Issues in e-Governance, Role of ICTs in rural development, Case study.

**References / Suggested Learning Resources:**


1. T. T. Sreekumar, ICTs and Development in India Perspectives on the Rural Network Society, Anthem Press
2. Ismail Thamarasseri, Swayam Course on ICT Skills in Education
3. Central Institute of Educational Technology, National Council of Educational Research and Training, Curricula for ICT in Education.
4. Stephan Jones and Frank M. Groom (editor), Information and Communication Technologies in Healthcare, CRC press.
5. Pankaj Sharma, E-Governance, the new age Governance, APH Publishing Company.
6. R P Sinha, E-Governance in India, Concept Publishing Company


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# Water and Waste Water Engineering

(Can be opted by students from all branches except CE and the students who had undergone similar course as program core or program elective)

| | |
|---|---|
| Course Code | OE CE 703 |
| Course Title | Water and Waste Water Engineering |
| Number of Credits | 3 (L:3, T:0, P:0) |
| Prerequisites | Nil |
| Course category | OE |
| Number of classes | 36 hours |

Course Outcome: After completion of this course the student will be able to:

| CO number | **CO Description** | **K-level** |
|---|---|---|
| CO1 | Illustrate precipitation, infiltration, evaporation and runoff and its measurement and estimation. | K2 |
| CO2 | explain groundwater table, different types of well and quantity of water demand for various purposes | K2 |
| CO3 | Demonstrate the different process of water treatment. | K2 |
| CO4 | Plan to manage water resources. | K3 |

**Module 1: Source of Water Supply Scheme** **9 Hours**

Hydrological cycle; sources of water; selection of source for a water supply scheme.

Ground water table, formation of springs, infiltration galleries and wells. Wells-shallow and deep wells. Tube well – different methods of boring; cutters and strainers-tube well assembly; erection, development of tube well.

**Module 2: Quantity of Water and Intake Works** **9 Hours**

Water Demand- Types of demand – domestic, industrial, fire; variation of demand; population forecast; per capita demand, simple numerical problems. Major Irrigation Projects in India Name of the different projects with salient points regarding their purpose, object, capacity, components, etc.

Intake Works & Transportation of Water: Types of intake, type of pipes used for conveyance of water-cast iron, PVC, steel, concrete, prestressed concrete and GI pipes, laying of pipes and their joints.

Distribution of water- Gravity system, direct pumping, pumping with overhead storage, layout of distribution system.

**Module 3: Treatment of Water** **9 Hours**

General flow diagrams of treatment of water, principles of plain sedimentation, coagulation and flocculation, coagulants and chemical equations involved in chemical coagulation, clari-flocculator. Filtration – principle, construction and operation of slow and rapid sand filter. Head loss in filter, negative head, air binding, mud ball formation and remedies. Disinfections – objective, disinfectants, chlorine dose, chlorine demand and residual chlorine, pre and post-chlorination, super chlorination, break point chlorination and chlorination technology in rural water supply. Miscellaneous treatment – removal of taste, odour, colour, iron, manganese and hardness.

**Module 4: Management of Water Resources** **9 Hours**

Erosion control and watershed development: their benefit towards conservation of national water wealth. Rain water harvesting and recharge of ground water: role of society and people's participation for sustainable water resource development. Mitigation strategies for flood damage: structural and non-structural measures.

**References / Suggested Learning Resources:**

1. Environmental Engineering Peavy, H.S.,Rowe,D.R and Tchobanoglous McGraw Hill BookCompany,1985.
2. Water and waste water Engineering fair,G.M.,Geyer,J.C and Okun,D.S fair,G.M.,Geyer,J.CandOkun,D.S
3. Water supply and Pollution Control Viessman,Jr.andHammer,M.J Harper Collins College publishers,1985.
4 Water supply, Waste Disposal A.K.Chatterjee, Khanna Publishers and Environmental Pollution Engineering.
5.Water supply and sanitary S.C.Rangawala, Engineering K.S.RangawalaCharotar publishing P.S.Rangawala housing
6. Water supply and sanitryG.S.Birdie& J.S. Birdie DhanpatRai Engineering publishingCompany, New Delhi.
7. Environmental Engineering Peavy H.S., McGraw Hill Book Row D.R. and Company, 1985 Tchobanoglous G
8. Environmental Engineering (Vol. I) Water Supply Engineering ,S K Garg, Khanna Publishers
9. Sewage Disposal and Air Pollution Engineering S.K.Garg, Khanna Publishers, Pollution Control Engineering 1979. Environmental Engineering Vol.II

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# Java Programming

(Can be opted by students from all branches except CSE and the students who had undergone similar course as program core or program elective)

| | |
|---|---|
| Course Code | OE CS 703 |
| Course Title | Java Programming |
| Number of Credits | 3 (L: 3, T: 0, P: 0) |
| Prerequisites | ES 204 |
| Course Category | Open Elective (OE) |
| Number of classes | 36 hours |

**Course Outcome:**

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

| CO Number | CO Description | K-level |
|---|---|---|
| CO-1 | Use the basic concepts of object-oriented programming in Java | K3 |
| CO-2 | Apply different properties of class and methods in programming | K3 |
| CO-3 | Apply Inheritance and polymorphism concept in programming | K4 |
| CO-4 | Explain the operations of files and exception handling in Java | K4 |

**Course Content:**

**Module 1: Fundamental concepts of Java Programming (8)**

Installing Java, Java Program Development, Java Source File Structure ,Compilation, Executions, Lexical Tokens, Identifiers, Keywords, Literals, Comments ,Primitive Datatypes, Operators Assignments, Class Fundamentals , Object & Object reference , Object Life time & Garbage Collection, Creating and Operating Objects, Array and String.

**Module 2: Class Properties and Methods (10)**

Constructor & initialization code block, Access Control, Modifiers, methods Nested , Inner Class &Anonymous Classes ,Abstract Class & Interfaces Defining Methods, Argument Passing Mechanism , Method Overloading, Recursion, Dealing with Static Members, Finalize() Method, Native Method. Use of "this " reference, Use of Modifiers with Classes & Methods.

**Module 3: Inheritance, Polymorphism and Package (10)**

Use and Benefits of Inheritance in OOP, Types of Inheritance in Java, Inheriting Data members and Methods, Role of Constructors in inheritance,use of "super", Polymorphism in inheritance, Type Compatibility and Conversion Implementing interfaces, Package.

**Module 4: Exceptions and File Operations (8)**

The Idea behind Exception, Exceptions&Errors, Types of Exception, Control Flow in Exceptions, JVM reaction to Exceptions, use of try, catch, finally, throw, throws in Exception Handling, In-built and User Defined Exceptions, Checked and Un-Checked Exceptions, Thread, Working with File Object, File operations.

**References / Suggested Learning Resources:**


1. Introducing Java 8 Author: by Raoul-Gabriel Urma.
2. Object-Oriented vs. Functional Programming Author: by Richard Warburton
3. Data Structures and Algorithm Analysis in Java (3rd Edition) by Mark Allen Weiss, Addison Wesley,(2011).
4. Deitel & Deitel, JAVA : How to Program, Pearson education , 7e (2008)
5. Ivan BayRoss, Web Enabled Commercial Application using Java 2, bpb publication (1998)

# Introduction to Microcontrollers

(Can be opted by students from all branches except ECE and the students who had undergone similar course as program core or program elective)

| | |
|---|---|
| Course Code | OE EC 703 |
| Course Title | Introduction to Microcontrollers |
| Number of Credits | 3 (L: 3, T: 0, P: 0) |
| Prerequisites | Digital Electronics |
| Course Category | Open Elective (OE) |
| Number of classes | 37 hours |

**Course Outcome:**

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

| CO Number | CO Description | K-level |
|---|---|---|
| CO-1 | Understand the basic architecture of microcontroller | K2 |
| CO-2 | Explain the architecture of 8051 microcontroller | K2 |
| CO-3 | Identify the addressing mode of 8051. | K2 |
| CO-4 | Write the simple assembly level language program | K3 |
| CO-5 | Explain basic of AVR family, PIC 16Fxxx, LPC 17xx microcontroller, Motorola 680XX, ARM | K2 |

**Course Content:**

**Module 1: Overview of Microcontroller (08 Hours.)**

Evolution of Microcontroller, Introduction to 8 bit microcontrollers; Basic differences and similarities between Microprocessor and Microcontroller. Application of microcontroller. Types of various architectures; Harvard and Von-Neumann, RSIC and CSIC. Concept of pipelining.

**Module 2: Introduction to 8051 Microcontroller (12 Hours.)**

Overview of 8051 microcontroller, Pin diagram of 8051, 8051-architecture, Registers, Timers Counters, Flags, Special Function Registers, DPTR, PC, PSW, SP etc. Interrupt SFR, Memory organization. Additional features in 8052.

**Module 3: 8051 Assembly Programming**: **(07 Hours.)**

Addressing Modes, Data types and Directives, Jump, Loop and Call instructions, Arithmetic instructions, Logical Instruction and their simple programming applications.

**Module 4: Introduction to Advanced microcontrollers (10 Hours.)**

Overview of AVR family, Microchip PIC 16Fxxx, LPC 17xx microcontroller, Motorola 680XX, ARM etc. and their comparison with 8051.

***REFERENCES / SUGGESTED LEARNING RESOURCES*:**


1. Ayala, K.J., The 8051 Microcontroller Architecture, Programming and applications, Penram International Publishing (India) Pvt. Ltd. (2007).
2. Mazidi, M.A., The 8051 Microcontroller and Embedded System, Pearson Education (2008).
3. Predko, M., Customizing The 8051 Microcontroller, Tata McGraw-Hill (2002).
4. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design,Pearson Education.
5. Microprocessors and Microcontrollers, S K Mandal. WBUT Series by TMH.
6. The AVR Microcontroller and Embedded Systems Using Assembly and C, By Muhammad Ali Mazidi, Sarmad Naimi and Sepehr Naimi, Pearson Education


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# Industrial Instrumentation Systems

(Can be opted by students from all branches except EE and the students who had undergone similar course as program core or program elective)

| | |
|---|---|
| Course Code | OE EE 703 |
| Course Title | Industrial Instrumentation Systems |
| Number of Credits | 3 (L: 3, T: 0, P: 0) |
| Prerequisites | Basic Electrical Engineering, Physics |
| Course Category | Open Elective (OE) |
| Number of classes | 36 hours |

**Course Outcome:**

At the end of this course, students will demonstrate the ability to

| CO Number | CO Description | K-level |
|---|---|---|
| CO-1 | Recall a transducer based on its operating characteristics for the required application. | K1 |
| CO-2 | Understand the working of instruments for measurement of Pressure, temperature and displacement measurement in industries and its application. | K2 |
| CO-3 | Use an appropriate flow meters or level sensor for an application. | K3 |
| CO-4 | Analyze the signal conditioning circuits and gain knowledge about the construction, working and calibration of different type of transmitters. | K4 |

**Module-1: Transducer and Temperature Measurement (10 hours)**

Transducers: Introduction to instrumentation system, static and dynamic characteristics of an instrumentation system, Principles and classification of transducers, Electrical transducers, basic requirements of transducers. Temperature measurement: Different types of filled in system thermometers – Sources of errors in filled in systems and their compensation – Bimetallic thermometers – Resistance type temperature sensors – RTD & Thermister, Thermocouples & Thermopiles, Laws of thermocouple – Radiation methods of temperature measurement – Radiation fundamentals – Total radiation & selective radiation pyrometers – Optical pyrometer – Two colour radiation pyrometers .

**Module-2: Displacement and Pressure Measurement (8 hrs.)**

Displacement Measurement: L.V.D.T., R.V.D.T. and Proximity sensor. Pressure Measurement: Units of pressure – Manometers: Different types, Mechanical devices like

Diaphragm, Bellows, and Bourdon tube for pressure measurement, Measurement of vacuum pressure: McLeod gauge, Thermal conductivity gauge, lionization gauges.

**Module-3: Flow and Level Measurement (10 Hrs.)**

Flow Measurement: Variable head type flow meters : Expression for flow rate through restriction(compressible and incompressible flow) –Orifice plate – Venturi tube – Pitot tube of head flow meters- Variable Area flow meter: Rotameter– Electrical type flow meters : Principle and constructional details of Electromagnetic flow meter – hot wire anemometer, Ultrasonic flow meter. Level Measurement: float & displacer type level sensors, D/P type level sensors, capacitive level sensors, ultrasonic & microwave level sensors, conductivity level sensors, radiation level sensors.

**Module-4: Signal Conditioning and Transmitter (8 hours)**

Signal transmission systems in Industries, Signal Conditioning Systems of Industries. Voltage to Current Converter, Current to Voltage converter. Pneumatic transmitter: Operation - Electronic transmitter: Study of 2 wire and 4 wire transmitters –Operation of Electronics and Smart transmitters – Principle of operation of flow, level, temperature and pressure transmitters.

**References / Suggested Learning Resources:**


1. Industrial Instrumentation & Control by S. K. Singh.TMH Publication
2. Electrical and Electronics Measurement and Instrumentation, By A. K. Shawney, Dhanpatrai & sons publications.
3. Electronic & Electrical Measurements & Instrumentation by J.B. Gupta
4. Measurement Systems – Application and Design By E.O. Doebelin, TMH Publication
5. Principles of Industrial Instrumentation, D Patranabis, 3rd edition, Mc Graw hill
6. Mechanical & Industrial Measurements by R. K. Jain, Khanna pub
7. Transducers and Instrumentation: D. V. S. Murty

# Thermal Engineering

(Can be opted by students from all branches except ME and the students who had undergone similar course as program core or program elective)

| | |
|---|---|
| Course Code | OE ME 703 |
| Course Title | Thermal Engineering |
| Number of Credits | 3 (L: 3, T: 0, P: 0) |
| Prerequisites | NIL |
| Course Category | Open Elective (OE) |
| Number of classes | 36 hours |

## Course Outcome:

After completing this course, the students will be able to

| CO Number | CO Description | K-level |
|---|---|---|
| CO-1 | Explain the basics of different modes of heat transfer | K2 |
| CO-2 | Summarize the principles of refrigeration & air conditioning | K2 |
| CO-3 | Analyze the velocity diagram and compounding of steam turbine | K4 |
| CO-4 | Compare gas turbine with intercooling, reheat & regeneration | K4 |

## Course Content:

**Module 1: Basics of Heat Transfer: (09 hours)**

**Conduction:** Fourier's Law of heat conduction – Thermal Conductivity. Heat transfer through plane homogeneous wall, through composite wall and through hollow cylinder. **Convection:** Explanation of Convective heat transfer, Principle of heat exchanger, classification of heat exchangers, overall heat transfer coefficient and fouling factor. Concepts of LMTD and NTU methods and problems using these methods. **Radiation:** Explanation of heat transfer by radiation, definition of absorptivity, reflectivity, transmissivity, Black Body. Emission characteristics, and laws of black body radiation, Irradiation of total and monochromatic quantities, Heat exchange between two black bodies, concepts of shape factor

**Module 2: Refrigeration & Air Conditioning: (09 hours)**

Reversed Carnot Cycle, Bell-Coleman Cycle, deviation from actual cycle. Vapour Compression Refrigeration Cycle. Electrolux Refrigerator. Refrigerants - designation and trade name; Physical, Chemical & Thermodynamic properties of principal refrigerants. Effective temperature, comfort chart, ventilation requirements. Psychometrics chart, air humidity processes, humidification & dehumidification, By-pass factor.

**Module 3: Steam Turbine: (09 hours)**

Classification of Steam Turbine, Simple Impulse Turbine – Working Principle, Velocity Diagram, Parts of Steam Turbine (Location & Function), blade efficiency, optimum velocity ratio, multistaging & its advantages, velocity compounded impulse turbine, reheat factor. Compounding of Turbine, Working Principle of Reaction Turbine, Concept of Reheating and Regenerating.

**Module 4: Gas Turbine: (09 hours)**

Open cycle gas turbine with intercooling, reheat & regeneration, Effect of intercooling to reheat & regeneration on efficiency, Effect of operating variable on thermal efficiency on Air Rate & on Work Ratio. Closed cycle gas turbine, Advantages of closed cycle gas turbine over the open cycle gas turbine. Advantages & disadvantages of gas turbine over steam turbine power plants**.**

**References / Suggested Learning Resources:**

1. Khurmi R.S. and Gupta J.K, *A Textbook of Thermal Engineering*, S. Chand.
2. R.K. Rajput, *Thermal Engineering* , Laxmi Publications.
3. P. N. Ananthanarayan, *Basic Refrigeration and Air Conditioning*, Tata McGraw Hill, ISBN- 9789383286560.
4. A.CenegelYunus, *Heat Transfer A Practical Approach*, Tata McGraw Hill
5. Soman, *Thermal Engineering*, PHI.

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# Traffic Engineering and Management

(Can be opted by students from all branches except CE&CA and the students who had undergone similar course as program core or program elective)

| | |
|---|---|
| Course Code | OE CC 703 |
| Course Title | Traffic Engineering and Management |
| Number of Credits | 3 (L: 3, T: 0, P: 0) |
| Prerequisites | Transportation Engineering |
| Course Category | Open Elective (OE) |
| Number of classes | 36 hours |

**Course Outcome:** After completion of this course the students will be able to:

| CO Number | CO Description | K-level |
|---|---|---|
| CO-1 | Explain and apply fundamental relation of traffic flow with its parameters. | K-3 |
| CO-2 | Design the signalized and unsignalized intersections | K-6 |
| CO-3 | Develop a clear idea on traffic operation and management, demand relationships | K-3 |
| CO-4 | Elaborate parking study, shockwaves, headway distribution. | K-6 |

**Course Contents:-**

**Module- 1: Traffic flow theory and traffic studies (8 hours)**

Driver behavior, traffic information and control systems, traffic studies- volume, speed and delay studies, elements of traffic flow theory, characteristics of uninterrupted traffic, capacity and LOS of Uninterrupted facilities, Highway capacity: Passenger's car units, level of service, factor affecting capacity and level of service, influence of mixed traffic.

**Module- 2: Unsignalized and signalized intersections (8 hours)**

Hours Characteristics of interrupted traffic, traffic characteristics at un-signalised intersections, design of signalized intersections, types of traffic signals, advantages, determination of optimal cycle time and signal setting for an intersection with fixed time signals, actuated signal control, signal coordination, Rotary design.

**Module- 3: Traffic operation and management, design hourly volume, demand relationships (10 hours)**

Traffic Operation and Management- Various measures and their scope, relative merits and demerits Traffic congestion, circulation, Planning, control devices, Speed change Lane- Different type of speed change lane, Design of speed change lane, Advantages and Disadvantages of one way lane and reversible lane. Street lighting. Design Hourly Volume For

Varying Demand Conditions: Concept of Design vehicle units and determination of PCU under mixed traffic conditions, Price-volume relationships, demand functions & relationships.

**Module- 4: Parking studies, gap acceptance, shockwaves, headway distribution (10 hours)**

Parking- On street parking, parallel parking and angle parking, Off street parking,Advantages and Disadvantages of on street and off street parking,Accident- Spot map, Collision Map, Condition diagram, Introduction to intelligent transportation systems, Introduction to advanced computational techniques for transportation planning. Shock waves; Queuing theory and applications, Vehicle arrivals, distribution models, gaps and headway distribution models; gap acceptance merging parameters, application of simulation techniques in traffic engineering

**References / Suggested learning Resources:-**


1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017
2. L R Kadiyali, N B Lal, Principles and practice of highway engineering, Khanna Publications, 2005
3. Principles of Transportation Engineering, Partha Chakraborty, PHI Learning, 1st edition
4. Principles of Highway Engineering and Traffic Analysis, 4th Edition, Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski, John Wiley
5. Morlok, E.R., An Introduction to Transportation Engineering and Planning, McGraw Hill, NY, 1970
6. Hay W.W., Introduction to transportation Engineering, John Wiley & Sons, NY, 1988.
7. Papacostas C.S., Fundamentals of transportation Engineering, Prentice Hall of India, 1987.
8. Srinivasa Kumar, R, Textbook of Highway Engineering, Universities Press, 2011.

# Optimization Techniques

(Can be opted by students from all branches except ECSE and the students who had undergone similar course as program core or program elective)

| | |
|---|---|
| Course Code | OE ES 703 |
| Course Title | Optimization Techniques. |
| Number of Credits | 3 (L: 3, T: 0, P: 0) |
| Prerequisites | Exposure to relevant concepts at undergraduate level and instructor consent. |
| Course Category | Open Elective. |
| Number of classes | 38 Hours |

**Course Outcome:**

| CO Number | CO Description | K-level |
|---|---|---|
| CO-1 | Students will be able to understand basic theoretical principles for optimization models and its solution. | K2 |
| CO-2 | Students will be able to learn the unified and exact mathematical basis as well as the general principles of various soft computing techniques. | K3 |
| CO-3 | Students should be able to apply detailed theoretical and practical aspects of intelligent modelling, optimization and control of linear and non-linear systems. | K3 |
| CO-4 | Use MATLAB to implement important optimization methods. | K4 |

**Module 1: Introduction to Optimization**
**(10Hours)**

Historical Development, Engineering applications of Optimization, Design vector and constraints, Constraint surface, Objective function, Classification of Optimization Problems, Engineering application of Optimization – Statement of an Optimization problem - Optimal Problem formulation - Classification of Optimization problem. Optimum design concepts: Definition of Global and Local optima.

**Module 2: Optimization algorithms** **(10 Hours)**

Optimization algorithms for solving unconstrained optimization problems – Gradient based method: Cauchy's steepest descent method, Newton's method, Conjugate gradient method.

Optimization algorithms for solving constrained optimization problems – direct methods – penalty function methods – steepest descent method - Engineering applications of constrained and unconstrained algorithms.

**Module 3: Classical Optimization Techniques (10 Hours)**

Single variable optimization, Constrained and unconstrained multi-variable optimization, direct substitution method, Lagrange's method of multipliers, Karush-Kuhn-Tucker conditions

**Module 4: Modern methods of Optimization (08 Hours)**

Modern methods of Optimization: Genetic Algorithms - Simulated Annealing - Ant colony optimization - Tabu search – Neural-Network based Optimization – Fuzzy optimization techniques – Applications. Use of MATLAB to solve optimization problems.

**References / Suggested Learning Resources:**

1. Engineering Optimization Theory and Practice, S.S.Rao, New Age International (P) Ltd, Publishers.

2. Kalyanmoy Deb Multi-objective optimization using evolutionary algorithms John Wiley Publications.

3. Jasbir S. Arora Introduction to Optimum Design McGraw Hill Publication

4. An introduction to Optimization by Edwin P K Chong, Stainslaw Zak.

5. Nonlinear Programming by Dimitri Bertsekas.

# Fuzzy Logic and Neural Network

(Can be opted by students from all branches except AMIA and the students who had undergone similar course as program core or program elective)

| | |
|---|---|
| Course Code | OE MI 704 |
| Course Title | Fuzzy Logic and Neural Network |
| Number of Credits | 3 (L: 3; T: 0; P: 0) |
| Prerequisites | Mathematics |
| Course Category | Open Elective (OE) |
| Number of classes | 38 hours |

**Course Outcome: -**

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

| CO No | CO Description | K-level |
|---|---|---|
| CO-1 | To Expose the students to the concepts of feed forward neural networks | K-1 |
| CO-2 | To provide adequate knowledge about feedback networks | K-2 |
| CO-3 | To teach about the concept of fuzziness involved in various | K-2 |
| CO-4 | To provide comprehensive knowledge of fuzzy logic control and adaptive fuzzy logic and to design the fuzzy control using genetic algorithm. | K-6 |
| CO-5 | To provide adequate knowledge of application of fuzzy logic control to real time systems. | K-2 |

**Course Content:-**

**Module- 1: ARCHITECTURES**: **(10 Hours)**

Introduction –Biological neuron-Artificial neuron-Neuron modelling Learning rules-Single layer-Multi layer feed forward network-Back propagation-Learning factors

**Module- 2: NEURAL NETWORKS FOR CONTROL**: **(10 Hours)**

Feedback networks-Discrete time hop field networks-Schemes of neuro –control, identification and control of dynamical systems-case studies (Inverted Pendulum, Articulation Control).

**Module- 3: FUZZY SYSTEMS** **(10 Hours)**

Classical sets-Fuzzy sets-Fuzzy relations-Fuzzification –Defuzzification- Fuzzy rules.

FUZZY LOGIC CONTROL:Membership function – Knowledge base-Decision –making logic – Optimizations of membership function using neural networks-Adaptive fuzzy systems-Introduction to generate to genetic algorithm.

**Module- 4: APPLICATION OF FLC** **(8 Hours)**

Fuzzy logic control-Inverted pendulum-Image processing-Home Heating system-Blood pressure during anesthesia-Introduction to neuro fuzzy controller.

**Text Books:**

1. Kosko, B, "Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence", PrenticeHall, NewDelhi, 2004.

2. Timothy J Ross, "Fuzzy Logic with Engineering Applications",John Willey and Sons, West Sussex, England, 2005.

**References / Suggested Learning Resources:-**

1. Jack M. Zurada, "Introduction to Artificial Neural Systems", PWS Publishing Co., Boston, 2002.

2. Klir G.J. &Folger T.A., "Fuzzy sets, Uncertainty and Information", Prentice –Hall of India Pvt. Ltd., New Delhi, 2008.

3. Zimmerman H.J., "Fuzzy set theory and its Applications", Kluwer Academic Publishers Dordrecht, 2001.

4. Driankov,Hellendroonb, "Introduction to fuzzy control", Narosa Publishers,2001.

5. LauranceFausett, Englewood cliffs, N.J., "Fundamentals ofNeural Networks", PearsonEducation, New Delhi, 2008.