Master of Technology - Artificial Intelligence & Robotics

Syllabus - First Semester

ADVANCED DATA STRUCTURE AND ALGORITHMS

Course Code:AIE4101 **Credit Units: 03**

Course Objective:
The objective of this course is to expose the students to the Fundamentals and advance concepts in Data Structure Using C. This course discusses about Problem solving approaches, Structured Programming Concepts, Guidelines for good Program Structure, Arrays, Stacks, Trees, Graphs, Searching & Sorting and File Structure.

Course Contents:

Module I
Overview of data structures, Review of Arrays, sparse matrices, Stacks, Queues, linked lists , doubly linked lists, Applications, dynamic storage management

Module II
Algorithm analysis, Efficiency of algorithms, Asymptotic Notations, Time complexity of an algorithm, Analyzing Recursive Programs using various strategies

Module III
Divide and Conquer Paradigm: Divide and conquer recurrence equations and their solutions, Review of various sorting techniques using divide and conquer approach, Strassen's matrix multiplication.

Module IV
Trees: Basic terminology, Binary Trees and its representations, Binary Search Trees, Binary Search Tree traversals, Red-Black Trees, AVL Trees and B Trees, applications of trees, Graphs: Terminology, representations, traversals, spanning trees, shortest paths, Basic Graph Algorithms, Depth first search and Breadth first Search and its analysis, single source shortest path problem, Dijkstra's algorithm

Module V
Greedy Paradigm: Basic greedy strategy, Algorithms of Kruskal's and Prim's, greedy strategy in algorithms for the knapsack problem and Huffman trees.
Dynamic Programming paradigm, all pairs shortest path problem, longest common subsequence problems.

Module VI
Back Tracking: general method, 4 Queen's Problem, Branch and Bound: general method, Bounding, 0 / 1 Knapsack Problem. NP – Complete and NP hard problem, SAT problems

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:
Text:

- Thomas H. Cormen, Charles E. Leiserson, and Ronald L. Rivest, "Introduction to Algorithms", MIT press and McGraw Hill, 2001.

- Udi Manber, “Introduction to Algorithms: A Creative Approach”, Addison Wesley, 1989.
- Ellis Horowitz, Sartajsahni, “Fundamentals of Data Structures” Galgotia book source, New Delhi, 1983.

References:

- Ellis Horowitz, Sartajsahni, “Fundamentals of Algorithms” Galgotia book source, New Delhi, 1986.
- Jean paul Tremblay and paul G. Soresson, “An introduction to Data structures with applications” Mcgraw Hill International editions.
- Seymour Libschutxz, “Theory and problems of Data structures”, Mcgraw Hill International editions. (Schaum’s outline series).
- Aho, Hopcroft Ullman, “The design and analysis of computer algorithms” Addison Wesley publishing company

ADVANCED DATABASE MANAGEMENT SYSTEM

Course Code: AIE4102 **Credit Units: 03**

Course Objective:
The objective of this course is to expose the students to the implementation techniques of database system. This course explains techniques for query processing and optimization with transaction and concurrency control techniques

Course Contents:

Module I: Relational Databases
Integrity Constraints revisited, Extended ER diagram, Relational Algebra & Calculus, Functional, Muiltivalued and Join Dependency, Normal Forms, Rules about functional dependencies.

Module II: Query Processing and Optimization
Valuation of Relational Operations, Transformation of Relational Expressions, Indexing and Query Optimization, Limitations of Relational Data Model, Null Values and Partial Information.
Objected Oriented and Object Relational Databases
Modeling Complex Data Semantics, Specialization, Generalization, Aggregation and Association, Objects, Object Identity, Equality and Object Reference, Architecture of Object Oriented and Object Relational Databases

Module III: Parallel and Distributed Databases
Distributed Data Storage – Fragmentation & Replication, Location and Fragment
Transparency Distributed Query Processing and Optimization, Distributed Transaction Modeling and concurrency Control, Distributed Deadlock, Commit Protocols, Design of Parallel Databases, Parallel Query Evaluation.
Advanced Transaction Processing
Nested and Multilevel Transactions, Compensating Transactions and Saga, Long Duration Transactions, Weak Levels of Consistency, Transaction Work Flows, Transaction Processing Monitors.

Module IV
Multimedia databases,Databases on the Web and Semi–Structured Data
Case Study: Oracle Xi

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

***Text*:**

- Elmarsi, Navathe, Somayajulu, Gupta, "Fundamentals of Database Systems", 4th Edition, Pearson Education, 2007
- Garcia, Ullman, Widom, "Database Systems, The complete book", Pearson Education, 2007
- R. Ramakrishnan, "Database Management Systems", McGraw Hill International Editions, 1998

***References*:**

- Date, Kannan, Swaminathan, "An Introduction to Database Systems", 8th Edition Pearson Education, 2007
- Singh S.K., "Database System Concepts, design and application", Pearson Education, 2006.
- Silberscatz, Korth, Sudarshan, "Database System Concepts", Mcgraw Hill, 6th Edition, 2006
- W. Kim, "Modern Database Systems", 1995, ACM Press, Addision – Wesley,
- D. Maier, "The Theory of Relational Databases", 1993, Computer Science Press, Rokville, Maryland
- Ullman, J. D., "Principals of database systems", Galgotia publications, 1999
- Oracle Xi Reference Manual
- Dietrich, and Urban, "An Advanced Course in Database Systems", Pearson, 2008.

DIGITAL COMPUTER ORGANISATION

Course Code: AIE4103 **Credit Units: 03**

Course Objective:
With increase in availability of system resources, concept of parallel architecture has obtained immense popularity. This course provides a comprehensive study of scalable and parallel computer architectures for achieving a proportional increase in performance with increasing system resources. In this course we have discussed the theory, technology, architecture (hardware) and software aspects of parallel computer and Vector computers.

Course Contents:

Module I: Parallel computer models
The state of computing, Multiprocessors and multicomputers, Multivector and SIMD computers, Architectural development tracks
Program and network properties: Conditions of parallelism, Data and resource dependences, Hardware and software parallelism, Program partitioning and scheduling, Grain size and latency, Program flow mechanisms, Control flow versus data flow, Data flow architecture, Demand driven mechanisms, Comparisons of flow mechanisms

Module II: System Interconnect Architectures
Network properties and routing, Static interconnection networks, Dynamic interconnection Networks, Multiprocessor system interconnects, Hierarchical bus systems, Crossbar switch and multiport memory, Multistage and combining network.

Module III: Processors and Memory Hierarchy
Advanced processor technology, Instruction-set Architectures,CISC Scalar Processors, RISC Scalar Processors, Superscalar Processors,VLIW Architectures, Vector and Symbolic processors
Memory Technology: Hierarchical memory technology, Inclusion, Coherence and Locality, Memory capacity planning, Virtual Memory Technology

Module IV: Backplane Bus System
Backplane bus specification, Addressing and timing protocols, Arbitration transaction and interrupt, Cache addressing models, Direct mapping and associative caches.
Pipelining: Linear pipeline processor, Nonlinear pipeline processor, Instruction pipeline design, Mechanisms for instruction pipelining, Dynamic instruction scheduling, Branch handling techniques, Arithmetic Pipeline Design, Computer arithmetic principles, Static arithmetic pipeline, Multifunctional arithmetic pipelines

Module V: Vector Processing Principles
Vector instruction types, Vector-access memory schemes.
Synchronous Parallel Processing: SIMD Architecture and Programming Principles, SIMD Parallel Algorithms, SIMD Computers and Performance Enhancement

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

Text:

- Kai Hwang, "Advanced computer architecture"; TMH, 2000.

References:

- J.P. Hayes, "computer Architecture and organization", MGH, 1998.
- M.J Flynn, "Computer Architecture, Pipelined and Parallel Processor Design", Narosa Publishing, 1998.
- D.A. Patterson, J.L. Hennessy, "Computer Architecture: A quantitative approach", Morgan Kauffmann, 2002.
- Hwang and Briggs, "Computer Architecture and Parallel Processing"; MGH, 2000.

ADVANCED COMPUTER NETWORKS

Course Code:AIE4104 Credit Units: 03

Course Objective:
The objective of the course is to provide thorough understanding & in-depth knowledge of concepts in computer networks Such as Internet protocols and routing, local area networks, wireless communications and networking, performance analysis, congestion control, TCP, network address translation, switching and routing, mobile IP, multicasting, IPv6. Peer-to-peer networking, network security, and other current research topics. This course motivates the students to explore current research areas in the same field.

Course Contents:

Module I : Introduction to Networks
Networking introduction, Reference Models, TCP/IP, OSI, Addressing, Protocol Layering, Transmission impairment, performance, Switching, Transmission Media, Introduction to MAC, Channel allocation, MAC protocol classification for LAN's, MAN's, MAC protocols for Adhoc N/ws, MAC Protocol for WLAN's(adhoc and sensor n/ws), Introduction to Ethernet protocol (Fast, Gigabit and standard Ethernet).

Module II: Network Layer
Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, Quality of Service, Internet Working, Network Layer in Internet.
IPv6 basic protocol, extensions and options, support for QoS, security, etc., Changes to other protocols, Application Programming Interface for IPv6.

Module III : Mobile IP
Mobile IP, IP Multicasting. Multicast routing protocols, address assignments, session discovery, etc.

Module IV : Transport Layer and Application Layer
The Transport Protocol: The Transport Service, Elements of transport protocol, a simple Transport Protocol, Internet Transport Protocols UDP, Internet Transport Protocols TCP, TCP extensions for high-speed networks, transaction-oriented applications Performance Issues.
The Application Layer: DNS-(Domain Name System), Electronic Mail, World Wide Web Multimedia.

Module V : Network Security
Overview of network security, Secure-HTTP, SSL, ESP, Key distribution protocols. Digital signatures, digital certificates-mail Security, Web security, Social Issues.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

Text:
- Computer Networks - Andrew S Tanenbaum, 4th Edition. Pearson Education/PHI
- Data Communications and Networking – Behrouz A. Forouzan. Third Edition TMH.

References:
- Computer Communications and Networking Technologies –Michael A.Gallo, William M .Hancock - Thomson Publication.
- W. Stallings. Cryptography and Network Security: Principles and Practice, 2nd Edition, Prentice Hall, 1998.
- W. R. Stevens. TCP/IP Illustrated, Volume 1: The protocols, Addison Wesley, 1994.

- C. E. Perkins, B. Woolf, and S. R. Alpert. Mobile IP: Design Principles and Practices, Addison Wesley, 1997.

ADVANCED DATA STRUCTURE AND ALGORITHMS LAB

Course Code: AIE4105 **Credit Units: 01**

Software Required: Turbo C++

Course Contents:

1 Write a program to implement the following using an array
a) Stack ADT b) Queue ADT

2 Write a program to implement the following using a singly linked list
a. Stack ADT b. Queue ADT

3 Write Program to implement the deque (double ended queue) ADT using a doubly linked list.

4 Write a program to perform the following operations:
a) Insert an element into a binary search tree.
b) Delete an element from a binary search tree.
c) Search for a key element in a binary search tree.

5 Write a program to implement circular queue ADT using an array.

6 Write a program that use non –recursive functions to traverse the given binary tree in
a) Preorder b) inorder and c) post order

7 Write programs for the implementation of BFS and DFS for a given graph

8 Write programs for implementing the following sorting methods:
a) Quick sort b) Merge Sort c) Heap Sort.

9 Write a program to perform the following operations.
a) Insertion into a B-tree b) Deletion from a B-tree

10 Write a program to perform the following operations.
a) Insertion into a AVL-tree b) Deletion from a AVL-tree

11 Write a program to implement Kruskal's algorithm to generate a minimum spanning tree

12. Write a program to implement Dijkstra's algorithm using priority queues

13. Write a program to Implement Prim's and Kruskal's algorithms

14. Write a program to Implement a backtracking algorithm for Knapsack problem

15. Write a program to Implement a branch and bound algorithm for traveling salesperson problem

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

MATLAB

Course Code: AIE4108 **Credit Units: 02**

Course Content:

1. To write a MATLAB program to perform some basic operation on matrices such as addition, subtraction, multiplication.
2. To write a "MATLAB" Program to generate various signals and sequences, such as unit impulse, unit step, unit ramp, sinusoidal, square, saw tooth, triangular, sinc signals.
3. To performs operations on signals and sequences such as addition, multiplication, scaling, shifting, folding, computation of energy and average power.
4. Write a program for finding even and odd parts of sequences Using MATLAB Software& program for finding real and imaginary parts of sequences Using MATLAB Software.
5. Write a program to find the out put with linear convolution operation Using MATLAB Software
6. Write a program to compute auto correlation and cross correlation between signals and Sequences.
7. Write a program to compute linearity and time invariance properties of a given continuous /discrete System.
8. Write a program to Unit Step And Sinusoidal Response Of The Given LTI System And Verifying Its physical reliability and stability properties.
9. Write a program to demonstrate Gibbs Phenomenon using MATLAB.
10. Write a program to obtain Fourier Transform and Inverse Fourier Transform of a given signal / sequence and to plot its Magnitude and Phase Spectra
11. Write a program to perform waveform synthesis using Laplace Transforms of a given signal.
12. Write a program to locating the zeros and poles and plotting the pole zero maps in s-plane and z-plane
13. for the given transfer function.
14. Write a program to Generate Gaussian Noise and to Compute its Mean, M.S. Values, Skew, kurtosis,
15. PS and PDF
16. Write a program to demonstrate Sampling Theorem and aliasing effect using MATLAB.
17. Write a program for removal of noise by auto correlation/cross correlation.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

PYTHON PROGRAMMING LAB

Course Code:AIE4109 **Credit Units: 01**

Course Contents:

1. Write a program which will find all such numbers which are divisible by 7 but are not a multiple of 5,
   between 2000 and 3200 (both included). The numbers obtained should be printed in a comma-separated sequence on a single line.

2. Create a program that asks the user to enter their name and their age. Print out a message addressed to them that tells them the year that they will turn 100 years old.

3. Define a function max() that takes two numbers as arguments and returns the largest of them. Use the if-then-else construct available in Python. (It is true that Python has the max() function built in, but writing it yourself is nevertheless a good exercise.)

4. Define a function max_of_three() that takes three numbers as arguments and returns the largest of them.

5. Define a function that computes the length of a given list or string. (It is true that Python has the len() function built in, but writing it yourself is nevertheless a good exercise.)

6. Write a function that takes a character (i.e. a string of length 1) and returns True if it is a vowel, False otherwise.

7. Write a function translate() that will translate a text into "rövarspråket" (Swedish for "robber's language"). That is, double every consonant and place an occurrence of "o" in between. For example, translate("this is fun") should return the string "tothohisosisosfofunon".

7. Define a function sum() and a function multiply() that sums and multiplies (respectively) all the numbers in a list of numbers. For example, sum([1, 2, 3, 4]) should return 10, and multiply([1, 2, 3, 4]) should return 24.

8. Define a function reverse() that computes the reversal of a string. For example, reverse("I am testing") should return the string "gnitset ma I".

9. Define a function is_palindrome() that recognizes palindromes (i.e. words that look the same written backwards). For example, is_palindrome("radar") should return True.

10. Ask the user for a number. Depending on whether the number is even or odd, print out an appropriate message to the user

11. Take a list, say for example this one:
    a = [1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89]
    and write a program that prints out all the elements of the list that are less than 5.

12. Create a program that asks the user for a number and then prints out a list of all the divisors of that number. (If you don't know what a divisor is, it is a number that divides evenly into another number. For example, 13 is a divisor of 26 because 26 / 13 has no remainder.)

13. Take two lists, say for example these two:
    a = [1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89]
    b = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13]

and write a program that returns a list that contains only the elements that are common between the lists (without duplicates). Make sure your program works on two lists of different sizes.

14. Ask the user for a string and print out whether this string is a palindrome or not. (A palindrome is a string that reads the same forwards and backwards.)

15. Let's say I give you a list saved in a variable: a = [1, 4, 9, 16, 25, 36, 49, 64, 81, 100]. Write one line of Python that takes this list a and makes a new list that has only the even elements of this list in it.

16. Make a two-player Rock-Paper-Scissors game. (Hint: Ask for player plays (using input), compare them, print out a message of congratulations to the winner, and ask if the players want to start a new game)

Remember the rules:

- Rock beats scissors
- Scissors beats paper
- Paper beats rock

18. Write a program that asks the user how many Fibonnaci numbers to generate and then generates them. Take this opportunity to think about how you can use functions. Make sure to ask the user to enter the number of numbers in the sequence to generate.(Hint: The Fibonnaciseqence is a sequence of numbers where the next number in the sequence is the sum of the previous two numbers in the sequence. The sequence looks like this: 1, 1, 2, 3, 5, 8, 13, …)

19. Write a program (function!) that takes a list and returns a new list that contains all the elements of the first list minus all the duplicates.

20. Write a function that takes an ordered list of numbers (a list where the elements are in order from smallest to largest) and another number. The function decides whether or not the given number is inside the list and returns (then prints) an appropriate boolean.

21. Create a program that will play the "cows and bulls" game with the user. The game works like this:

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

ADVANCED DATABASE MANAGEMENT SYSTEMS LAB

Course Code: AIE4106 **Credit Units: 01**

Course Contents:

- Basic SQL
- Intermediate SQL
- Advanced SQL
- ER Modeling
- Database Design and Normalization
- Accessing Databases from Programs using JDBC
- Building Web Applications using PHP & MySQL
- Indexing and Query Processing
- Query Evaluation Plans
- Concurrency and Transactions
- Big Data Analytics using Hadoop

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

ADVANCED COMPUTER NETWORKS LAB

Course Code: AIE4107 **Credit Units: 01**

Course Contents:

Various installations and connections of LAN, WAN, ETC

Working on NS2

Socket Programming using C Language on Linux

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

Syllabus - Second Semester

FUNDAMENTALS OF ROBOTIC SYSTEM AND ROBOT PROGRAMMING

Course Code: AIE4201 **Credit Units: 03**

Course Objective:
The objective of this course is to enlighten the students about the fundamentals of robotic systems. To understand the basics of robot, Robot Transformations and Sensors, Micro/Nano robotic systems and to program them for functioning.

Course Content:

Module-I: INTRODUCTION
Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems- Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems- Hydraulic, Pneumatic and Electric system.

Module-II: END EFFECTORS AND ROBOT CONTROLS
Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems-Robot controls-Point to point control, Continuous path control, Intelligent robot-Control system for robot joint-Control actions-Feedback devices-Encoder, Resolver, LVDT-Motion Interpolations-Adaptive control.

Module-III: ROBOT TRANSFORMATIONS AND SENSORS
Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, Translation- Homogeneous coordinates, multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors – Robotic vision sensor-Force sensor-Light sensors, Pressure sensors.

Module-IV: ROBOT CELL DESIGN AND MICRO/NANO ROBOTICS SYSTEM
Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle, actuation using MATLAB, NXT Software Introductions-Robot applications- Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting and undersea robot. Micro/Nanorobotics system overview-Scaling effect-Top down and bottom up approach- Actuators of Micro/Nano robotics system-Nanorobot communication techniques-Fabrication of micro/nano grippers-Wall climbing micro robot working principles-Biomimetic robot-Swarm robot-Nanorobot in targeted drug delivery system.

Module-V: BASICS OF ROBOT PROGRAMMING
Robot programming-Introduction-Types- Flex Pendant- Lead through programming, Coordinate systems of Robot, Robot controller- major components, functions-Wrist Mechanism-Interpolation-Interlock commands- Operating mode of robot, Jogging-Types, Robot specifications- Motion commands, end effectors and sensors commands.

Module-VI: VAL,VAL-II, RAPID AND AML LANGUAGE
Robot Languages-Classifications, Structures- VAL- language commands motion control, hand control, program control, pick and place applications, palletizing applications using VAL, Robot welding application using VAL program-WAIT, SIGNAL and DELAY command for communications using simple applications. RAPID- language basic commands- Motion Instructions-Pick and place operation using Industrial robot- manual mode, automatic mode, subroutine command based programming. Move-master command language- Introduction, syntax, simple

problems. VAL-II programming-basic commands, applications- Simple problem using conditional statements-Simple pick and place applications-Production rate
calculations using robot. AML Language-General description, elements and functions, Statements, constants and variables-Program control statements- Operating systems, Motion, Sensor commands-Data processing.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

Text:-

- Craig. J. J. "Introduction to Robotics mechanics and control", Addison- Wesley,1999.

References:-

- S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009
- Mikell P Groover& Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, McGraw Hill, 2012
- Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, Robotics Engineering an Integrated Approach, Phi Learning.,2009.
- Deb. S. R. "Robotics technology and flexible automation", Tata McGraw Hill publishing company limited, 1994
- Mikell. P. Groover, "Industrial Robotics Technology", Programming and Applications, McGraw Hill Co, 1995.
- Klafter. R.D, Chmielewski.T.A. and Noggin's., "Robot Engineering : An Integrated Approach", Prentice Hall of India Pvt. Ltd.,1994.

ADVANCED CONTROL SYSTEMS &DRIVES FOR ROBOTS

Course Code: AIE4202 **Credit Units: 03**

Course Objective:
Course provides comprehensive and insight knowledge of Digital control systems. Objective of the course is to provide the students the core knowledge of Stability theory of Digital systems and State Variable analysis of Digital System

Course Contents:

Module I: Introduction
Configuration of the basic Digital Control Systems, types of sampling operations, Sample and Hold operations, Sampling theorem, Basic discrete time signals.

Module II: Stability Methods
Mapping between s-plane and z-plane, stability methods: Modified Routh Criterion, Jury's method, modified Schur-Cohn criterion.

Module III: Models of Digital Control Systems
Digital temperature control System, Digital position control system, stepping motors and their control. Design of Digital compensator using frequency response plots.

Module IV: Control Systems Analysis Using State Variable Methods
State variable representation, conversion of state variable models to transfer function and vice-versa, Eigen values and eigen vectors, Solution of state equations, Concepts of controllability and observability.

Module V: State Variable analysis of Digital Control Systems
State variable description of digital control systems, conversion of state variable models to pulse transfer function and vice versa, solution of state difference equations, controllability and observability.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

- M. Gopal, Digital Control and State Variable Methods, Tata Mc-Graw-Hill.
- K.Ogata, Discrete Time Control Systems, Pearson Education, (Singapore) (Thomson Press India).
- B.C Kuo, Digital Control Systems, Prentice Hall.
- I.J. Nagrath&M.Gopal, Control System Engg., John Wiley & sons.
- K.K. Aggarwal, Control System Analysis and Design, Khanna Publishers.

MICROPROCESSOR AND INTERFACING

Course Code: AIE4203 **Credit Units: 03**

Course Objective:
This course deals with the systematic study of the Architecture and programming issues of microprocessor family and its applications. The aim of this course is to give the students detailed knowledge of the above microprocessor needed to develop the systems using it.

Course Contents:

Module I: Microprocessor
Intel 8085 - Introduction, register structure, memory Addressing, Addressing Modes,
Instruction Set, Timing Methods, CPU Pins and Associated Signals, Instruction timing and execution. programming I/O. Interrupt System, DMA, SID & SOD lines, Instruction set, 8085 based system design.

Module II: Intel 8086
Introduction, Architecture, Addressing modes, instruction set, memory management, assembler dependent instructions, Input/Output, system design using 8086.

Module III: Pentium Processors
Internal Architecture of 8087, operational overview of 8087, Introduction to 80186,80286, 80386 & 80486 processors and Pentium Processors.

Module IV: Peripheral Interfacing
Parallel versus serial transmission, synchronous and asynchronous serial data transmission. Interfacing or hexadecimal keyboard and display unit, interfacing of cassette recorders and parallel, serial interface standards. Study of Peripheral Devices 8255, 8253,8257, 8251, 8259.

Module V: Microprocessor applications to Power Engineering
Protective Relaying: over-current, impedance, MHO, reactance, bi-directional relays.
Measurements: Frequency, power angle & power factor, Voltage and Current, KVA, KW, & KVAR, maximum demand. Resistance, Reactance, Temperature Controls.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

- Rafiquzzaman, M. Theory & Applications PHI Publications 1993.
- Gaonkar R. S. Microprocessor Architecture, Programming and Applications John Wiley 1989.
- Ram B. Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai & Sons 1995.
- Liu Yu Cheng and Gibson, G.A. PHI 1992.
- Leventhal, L.A. Introduction to Microprocessors: Software, Hardware, Programming.

KINEMATICS AND DYNAMICS OF ROBOTS

Course Code:AIE4204 **Credit Units: 03**

Course Objective:
Objective of this course is systematic study of the Architecture and programming issues of microprocessor family and its applications. And it focus on detailed knowledge of the above microprocessor needed to develop the systems using it.

Course Contents:

Module-I: INTRODUCTION
Introduction, position and orientation of objects, objects coordinate frame Rotation matrix, Euler angles Roll, pitch and yaw angles coordinate
Transformations, Joint variables and position of end effectors, Dot and cross products, coordinate frames, Rotations, Homogeneous coordinates.

Module-II: DIRECT KINEMATICS
Link coordinates D-H Representation, The ARM equation. Direct kinematic analysis for Four axis, SCARA Robot and three, five and six axis Articulated Robots.

Module-III: INVERSE KINEMATICS
The inverse kinematics problem, General properties of solutions. Tool configuration, Inverse kinematics of four axis SCARA robot and three and five axis, Articulated robot.

Module-IV: WORKSPACE ANALYSIS AND TRACJECTORY PLANNING
Workspace Analysis, work envelope of a Four axis SCARA robot and five axis articulated robot workspace fixtures, the pick and place operations, Joint space technique - continuous path motion, Interpolated motion, straight line motion and Cartesian space technique in trajectory planning.

Module-V: MANIPULATOR DYNAMICS
Introduction, Lagrange's equation kinetic and potential energy. Link inertia Tensor, link Jacobian Manipulator inertia tensor. Gravity, Generalized forces, Lagrange-Euler Dynamic model, Dynamic model of a Two-axis planar robot, Newton Euler formulation, Lagrange - Euler formulation, problems.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

- Robert J. Schilling, Fundamentals of Robotics Analysis and Control, PHI Learning., 2009.
- Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, Robotics Engineering an Integrated Approach, Phi Learning., 2009.
- P.A. Janaki Raman, Robotics and Image Processing An Introduction, Tata Mc Graw Hill Publishing company Ltd., 1995.
- Francis N-Nagy AndrasSiegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987.
- Bernard Hodges, Industrial Robotics, Second Edition, Jaico Publishing house, 1993.

ADVANCED APPLIED MATHEMATICS FOR ENGINEERING

Course Code: AIE4205 **Credit Units: 03**

Course Objective:
Objective of this course is to develop analytical capability and to impart knowledge in Mathematical and Statistical methods and their applications in Engineering and Technology and to apply these concepts in engineering problems they would come across.

Course Contents:
Module-I: TRANSFORM METHODS
Laplace transform methods for one-dimensional wave equation - Displacements in a string - Longitudinal vibrations of an elastic bar – Fourier transform methods for one-dimensional heat conduction problems in infinite and semi-infinite rod.

Module-II: ELLIPTIC EQUATIONS
Laplace equation - Fourier transform methods for Laplace equation – Solution of Poisson equation by Fourier transform method.

Module-III: CALCULUS OF VARIATIONS
Variation and its properties - Euler's equation - Functionals dependent on first and higher order derivatives - Functionals dependent on functions of several independent variables - Some applications - Direct methods – Ritzmethods.

Module-IV: NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS
Numerical Solution of Partial Differential Equations - Solution of Laplace's and Poisson equation on a rectangular region by Liebmann's method - Diffusion equation by the explicit and Crank Nicholson implicit methods - Solution of wave equation by explicit scheme.

Module-V: REGRESSION METHODS
Principle of least squares - Correlation - Multiple and Partial correlation - Linear and non-linear regression - Multiple linear regression.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

- Sankara Rao K., Introduction to Partial Differential Equations, 4th printing, PHI, New Delhi, April 2003
- Elsgolts L., Differential Equations and Calculus of Variations, Mir Publishers, Moscow, 1966
- S.S. Sastry, Introductory Methods of Numerical Analysis, 3rd Edition, PHI, 2001
- Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi, Reprint 2003

RESEARCH METHODOLOGY AND TECHNICAL REPORT WRITING

Course Code: AIE4206 **Credit Units: 02**

Course Objectives:
The course will enhance scientific , technical and research writing skills and impart knowledge about various stages of research process, statistical analysis, statistical tests and their applications in statistical decision making.

Course Contents:
Module I: Introduction to research: Definition, motivation, need, objectives, significance and characteristics of research; types of research; steps in research process; planning a research proposal; literature review, web searching.

Module II: Population and sample, parameter and statistic, sampling and data collection, sampling design: steps, types, sample size, sampling methods, large and small samples, primary and secondary data, data processing and analysis. Sample surveys and questionnaire designing, scaling techniques.

Module III: Dependent and independent variables, univariate, bivariate and multivariate analysis, means-arithmetic, geometric and harmonic; measure of dispersion of data, standard deviation, variance, coefficient of variation and degree of freedom. Hypothesis testing: null hypothesis and alternate hypothesis, errors in hypothesis testing, significance and confidence levels, parametric tests and non-parametric tests, one-tailed and two-tailed tests, analysis of variance. Regression analysis and curve fitting, method of least-squares, explained and unexplained variations, coefficient of correlation, coefficient of determination**.**

Module IV: Technical/scientific/research report writing: structure and components of scientific reports, formats of dissertations, research report, report writing skills, report preparation, referencing, bibliography and footnotes. Making presentation-use of visual aids and PPTs. Publication of research papers, citations,. Intellectual property rights and copy rights, plagiarism, patents and patent laws, commercialization and ethical issues.

Examination Scheme:

Attendance	Assignment/Library consultation / Thesis writing	Class test	Final Exam	Total
5	15	10	70	100

Text Books:

- Blake, G. and Bly, R.W. 1993, The Elements of Technical Writing. MacMillan, New York
- Booth, V. 1981. Writing a Scientific Paper and Speaking at Scientific Meetings. The Biochemical Society, London
- Chawla,D and Sondhi, N. 2016, Research Methodology- Concepts and Cases. Vikas Publishing House Pvt Ltd. New Delhi
- Kothari, C.R.2008. Research Methodology- Methods and Techniques, 2nd.ed. New Age International Publishers, New Delhi.

Reference Books:

- Geode, Millian J.& Paul K. Hatl, Methods in Research, McGraw Hills, New Delhi.
- Montomery, Douglas C.(2007), 5th Ed. Design and Analysis of Experiments, Wiley India.
- Panneerselvam, R.2009. Research Methodology, PHI Learning Pvt.Ltd., New Delhi-110001
- Ranjit Kumar 2009. Research Methodology- A step –by- step Guide for beginners; 2nd ed. Dorling Kindersley (India) Pvt. Ltd. Patpargang, Delhi- 110092

FUNDAMENTAL OF ROBOTICS SYSTEM AND ROBOT PROGRAMMING LAB

Course Code: AIE4207 **Credit Units: 01**

Course Contents:

1. Study of different types of robots based on configuration and application.
2. Study of different type of links and joints used in robots
3. Study of components of robots with drive system and end effectors.
4. Determination of maximum and minimum position of links.
5. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
6. Estimation of accuracy, repeatability and resolution.
7. Robot programming exercises

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

ADVANCED CONTROL SYSTEMS & DRIVES FOR ROBOTS LAB

Course Code: AIE4208 **Credit Units: 01**

Course Contents:

List of Experiments:

1. Determination of Transfer functions of an Electrical System.
2. Time Response Characteristics of a Second order System (Typical RLC network).
3. Characteristics of Synchros:

(a) Synchro transmitter characteristics.
(b) Implementation of error detector using synchro pair.

4. Determination of Magnetic Amplifier Characteristics with different possible connections.
5. Process Control Simulator:

(a) To determine the time constant and transfer function of first order process.
(b) To determine the time response of closed loop second order process with Proportional Control.
(c) To determine the time response of closed loop second order process with Proportional-Integral Control.
(d) To determine the time response of closed loop second order process withProportional-Integral-Derivative Control.
(e) To determine the effect of disturbances on a process.

6. To study the compensation of the second order process by using:

(a) Lead Compensator.
(b) Lag Compensator.
(c) Lead- Lag Compensator

7. Realization of AND, OR, NOT gates, other derived gates and ladder logic on Programmable Logic Controller with computer interfacing.
8. To determination of AC servomotor Characteristics.
9. To study the position control of DC servomotor with P, PI control actions.
10. Analog Computer:

(a) To examine the operation of potentiometer and adder.
(b) To examine the operation of integrator.

11. To solve a second order differential equation.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

MICROPROCESSOR & INTERFACING LAB

Course Code: AIE4209 **Credit Units: 01**

Course Contents:

List of Experiments:

1. To load the numbers 49H and 53H ion memory location 9510 & 9511.
2. Respectively and add the contents of memory location 9601.
3. To write the Assembly Language Programming for 8 bit addition with and without carry.
4. To write the Assembly Language Programming for 8 bit subtraction with and without borrow.
5. To write the Assembly Language Programming for 8 bit Multiplication and Division.
6. To write the Assembly Language Programming for sorting an array of numbers in Ascending &Decending order.
7. To write the Assembly Language Programming with Additional Instructions.
8. To write and execute a program using Stacks.
9. To study and program the programmable Peripheral interface (8255 board).
10. To study and program the programmable interval timer (8253 board).
11. To study and program the programmable DMA Controller (8257 board).
12. To study and program the programmable Interrupt Controller (8259 board).
13. To study of programmable Serial Communication interface (8251 board).

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

FUNDAMENTALS OF ARITIFICAL INTELLIGENCE FOR ROBOTICS

Course Code: AIE4210 **Credit Units: 03**

Course Objective:
Objective of this course is to expose the students to the fundamentals of AI and expert systems and its application in Robotics and to familiarize the students with the Fundamental concept of AI and expert system

Course Contents:
Module-I: INTRODUCTION
Introduction – History, Definition of AI, Emulation of human cognitive process, Intelligent agents – The concept of rationality, the nature ofenvironments, the structure of agents.

Module-II: SEARCH METHODS
Problem – Solving Agents : Problem Definitions, Formulating Problems, Searching for solutions – Measuring Problem – Solving Performance with examples. Search Strategies : Uninformed search strategies – Breadth – first Search, Uniform – Cost Search, depth –first search, depth – limited search, Iterative deepening depth – first search, bidirectional search, comparing uniformed search strategies. Informed search strategies – Heuristic information, Hill climbing methods, best – first search, branch – and – bound search, optimal search and A* and Iterative deepening A*.

Module-III: PROGRAMMING AND LOGICS IN ARTIFICIAL INTELLIGENCE
LISP and other programming languages – Introduction to LISP, Syntax and numerical function, LISP and PROLOG distinction, input, output and local variables, interaction and recursion, property list and arrays alternative languages, formalized symbolic logics – properties of WERS, non-deductive inference methods.

Module-IV: EXPERT SYSTEM
Expert system – Introduction, difference between expert system and conventional programs, basic activities of expert system – Interpretation,
Prediction, Diagnosis, Design, Planning, Monitoring, Debugging, Repair, Instruction, Control. Basic aspects of expert system – Acquisition module, Knowledge base – Production rules, semantic net, frames. Inference engine – Backward chaining and forward chaining. Explanatory interface.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:-

- Russell Stuart, Norvig Peter, *"Artificial Intelligence Modern Approach"*, Pearson Education series in AI, 3rd Edition, 2010.
- Dan.W.Patterson, "*Introduction to Artificial Intelligence and Expert Systems*", PHI Learning, 2009.
- Donald.A.Waterman, "*A guide to Expert Systems*", Pearson, 2002.

ROBOTIC SIMULATION AND SIMULTANEOUS LOCALIZATION-MAPPING

Course Code: AIE4211 **Credit Units: 03**

Course Objective:
Objective of this course is to study the techniques of simulation for robot design and location mapping simulation.

Course Contents:
Module-I: INTRODUCTION
Robotics systems, robot movements, quality of simulation, types of simulation, robot applications, robotics simulation displays. Simulation
notation, Auto lisp functions, Features, Command syntax, writing design functions.

Module-II: ROBOTIC PRINCIPLES
Straight lines, Angles and optimal moves circular interpolation, Robotic functions Geometrical commands, Edit commands. Selecting robot views, standard Robot part, using the parts in a simulation.

Module-III: LOCALIZATION AND MAPPINGS
Introduction, Robotic perception – localization, mappings planning to move – configuration space, cell decomposition methods, skeletonization methods, Planning uncertain movements – Robust methods. Moring –dynamics and control, Potential Field control, reactive control, Robotics software architecture, Applications.

Module-IV: ROBOTICS SIMULATION
Simulation packages, Loading the simulation, Simulation editors, delay, Resume commands. Slide commands, program flow control. Robot motion control, Analysis of robot elements, Robotic linkages.

Module-V: ROBOTIC MOTION
Solids construction, Solid animation. Types of motion, velocity and acceleration, Types of simulation motion Harmonic motion, parabolic
motion, uniform motion velocity and acceleration analysis for robots.

Module-VI: ROBOT DESIGN
Linkages, Types, Transmission elements Flexible connectors, pulley-and- Belt drives, variable speed transmission. Design of Robot for particular applications – A case study.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:-

- Daniel L. Ryan, Robotics Simulation, CRC Press Inc., 1994.
- Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, Robotics Engineering an Integrated Approach, Phi Learning., 2009.
- Robert J. Schilling, Fundamentals of Robotics Analysis and Control, PHI Learning, 2009.
- Mikell P Groover& Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, McGraw Hill, 2012.

Syllabus - Third Semester

AUTOMATION IN MANUFACTURING SYSTEMS

Course Code: AIE4301 **Credit Units: 03**

Course Objective:
Objective of this course is to highlight the basic concepts and procedure for Automation of Manufacturing systems and the technology behind the automation of a manufacturing system.

Course Contents:
Module-I: OVER VIEW OF MANUFACTURING AND AUTOMATION:
Production systems, Automation in production systems, Automation principles and strategies, Manufacturing operations, production facilities. Basic elements of an automated system, levels of automation; Hardware components for automation and process control, programmable logic controllers and personal computers.

Module-II: MATERIAL HANDLING AND IDENTIFICATION TECHNOLOGIES:
Material handling, equipment, Analysis. Storage systems, performance and location strategies, Automated storage systems, AS/RS, types. Automatic identification methods, Barcode technology, RFID.

Module-III: MANUFACTURING SYSTEMS AND AUTOMATED PRODUCTION LINES: Manufacturing systems: components of a manufacturing system, Single station manufacturing cells; Manual Assembly lines, line balancing Algorithms, Mixed model Assembly lines, Alternative Assembly systems. Automated production lines, Applications, Analysis of transfer lines.

Module-IV: AUTOMATED ASSEMBLY SYSTEMS: Fundamentals, Analysis of Assembly systems. Cellular manufacturing, part families, cooling, production flow analysis. Group Technology and flexible Manufacturing systems, Quantitative Analysis.

Module-V: QUALITY CONTROL AND SUPPORT SYSTEMS: Quality in Design and manufacturing, inspection principles and strategies, Automated inspection, contact Vs non contact, CMM. Manufacturing support systems. Quality function deployment, computer aided process planning, concurrent engineering, shop floor control, just in time and lean production.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:-

- Automation, production systems and computer integrated manufacturing/ Mikell.PGroover/PHI/3 rd edition/2012.
- Automation, Production Systems and CIM/ Mike J P. Grower/PHI
- CAD/CAM/CIM/ P. Radha Krishnan & S. Subrahamanyarn and Raju/New Age International Publishers/2003.
- System Approach to Computer Integrated Design and Manufacturing/ Singh/John Wiley /96.
- Computer Aided Manufacturing/Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang/ Pearson/ 2009.
- Manufacturing and Automation Technology / R Thomas Wright and Michael Berkeihiser / Good Heart/Willcox Publishers.

ROBOTICS SENSORS, VISION AND HARDWARE IMPLEMENTATION

Course Code: AIE4302 **Credit Units: 03**

Course Objective:

Objective of this course is to impart basic knowledge of robot vision, image processing sensors and hardware implementation

Course Contents:

Module-I: SENSORS IN ROBOTICS

An Introduction to sensors and Transducers, History and definitions, Smart Sensing, AI sensing, Need of sensors in Robotics. Position sensors – optical, non-optical, Velocity sensors, Accelerometers, Proximity Sensors – Contact, non-contact, Range Sensing, touch and Slip Sensors, Force and Torque Sensors. Different sensing variables – smell, Heat or Temperature, Humidity, Light, Speech or Voice recognition Systems, Tele-presence and related technologies.

Module-II: VISION IN ROBTICS

The Nature of Vision- Robot vision – Need, Applications - image acquisition –illumination techniques- Point sensor, line sensor, planar sensor, camera transfer characteristic, Raster scan, Image capture time, volume sensors, Image representation, picture coding techniques. Robot Control through Vision sensors, Robot vision locating position, Robot guidance with vision system, End effector camera Sensor.

Module-III: ELEMENTS OF IMAGE PROCESSING TECHNIQUES

Discretization, Neighbors of a pixel-connectivity- Distance measures - preprocessing Neighborhood averaging, Median filtering. Smoothening of binary Images- Image Enhancement- Histogram Equalization-Histogram Specification –Local Enhancement-Edge detection- Gradient operator-Laplace operators-Thresholding-Morphological image processing

Module-IV: OBJECT RECOGNITION AND FEATURE EXTRACTION

Image segmentation- Edge linking-Boundary detection-Region growing- Region splitting and merging- Boundary Descriptors-Freeman chain code- Regional Descriptors- recognition-structural methods- Recognition procedure, mahalanobic procedure

Module-V: COLLISON FRONTS ALGORITHM

Introduction, skeleton of objects. Gradients, propagation, Definitions, propagation algorithm, Thinning Algorithm, Skeleton lengths of Top most objects.

Module-VI: MULTISENSOR CONTROLLED ROBOT ASSEMBLY

Control Computer, Vision Sensor modules, Software Structure, Vision Sensor software, Robot programming, Handling, Gripper and Grippingmethods, accuracy – A Case study.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:-

- Paul W Chapman, "*Smart Sensors*", an Independent Learning Module Series, 1996.
- Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, Robotics Engineering an Integrated Approach, Phi Learning., 2009.
- John Iovice, "*Robots, Androids and Animatrons*", Mc Graw Hill, 2003.
- K.S. Fu, R.C. Gonzalez, C.S.G. Lee, "*Robotics – Control Sensing, Vision and Intelligence*", Tata McGraw-Hill Education, 2008.
- Mikell P Groover& Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, Tata McGraw-Hill Education, 2012.
- SabrieSoloman, Sensors and Control Systems in Manufacturing, McGraw-Hill Professional Publishing, 2nd Edition, 2009.

PATTERN RECOGNITION AND IMAGE PROCESSING

Course Code: AIE4303 **Credit Units: 03**

Course Objective:
This course covers the theory and methods for learning from data, with an emphasis on pattern classification. Digital Image Processing is designed to give professionals and students a powerful collection of fundamental and advanced image processing tools on the desktop

Course Contents:

Module I: Introduction
Machine perception, pattern recognition example, pattern recognition systems, the design cycle, learning and adaptation
Bayesian Decision Theory
Introduction, continuous features – two categories classifications, minimum error-rate classification-zero–one loss function, classifiers, discriminant functions, and decision surfaces

Module II:
Normal density:
Univariate and multivariate density, discriminant functions for the normal density-different cases, Bayes decision theory – discrete features, compound
Bayesian decision theory and context

Module III: Un-supervised learning and clustering
Introduction, mixture densities and Identifiability, maximum likelihood estimates, application to normal mixtures, K-means clustering. Date description and clustering, similarity measures, criteria function for clustering

Module IV: Image Fundamentals and Transforms
Elements of visual perception – Image sampling and quantization, Basic relationship between pixels, Some basic grayscale transformations, Introduction to Fourier Transform and DFT, Properties of 2D Fourier Transform, FFT, Separable Image Transforms, Walsh, Hadamard, Discrete Cosine Transform, Haar, Slant, Karhunen, Loeve transforms.

Module V: Image Segmentation and Edge Detection:
Region Operations, Crack Edge Detection,
Edge Following, Gradient operators, Compass and laplace operators. Threshold detection methods, optimal thresholding, multispectral thresholding, thresholding in hierarchical data structures; edge based image segmentation- edge image thresholding, edge relaxation, border tracing, border detection,

Examination Scheme:

Components	CT	H	V/S/Q	EE
Weightage (%)	10	07	08	70

Text & References:
Text:
- "*Fundamentals of speech Recognition"*, LawerenceRabiner, Biing – Hwang JuangPearson education.
- "*Pattern classifications"*, Richard O. Duda, PeterE. Hart, David G. Stroke. Wiley student edition, Second Edition.
- R.C Gonzalez and R.E. Woods, "*Digital Image Processing",* Addison Wesley.

***References*:**
- "Pattern Recognition and Image Analysis" – Earl Gose, Richard John baugh, Steve Jost
- A.K.Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India.
- "Digital Image Processing"– M. Anji Reddy, BS Publications.

ROBOTICS SENSORS, VISION AND HARDWARE IMPLEMENTATION LAB

Course Code: AIE4304 **Credit Units: 02**

Course Objective:
Objective of this course is to impart basic knowledge of robot vision, image processing sensors and hardware implementation

Course Contents:
Generation in Robot Language – Robot language structure, the textual robot languages. Online and Offline programming.

Cartesian Trajectories – Joint space planning, Cartesian trajectories, path primitives. Coordinate system used to determine the position of TCP and direction of the tool.

Basic Syntax- RAPID introduction, Constant, data objects and variables, data declaration, expressions , using data and aggregates in expression , Functions , function call in expression , priority between operators, Various Instructions, WAIT , SIGNAL and DELAY commands.

Routine and subroutine – Input/output interrupts priority between interrupts, Program control and subroutine function call, task modules, error recovery, system and time, Builtin subroutines in RAPID, Inter-task Objects.

Optical sensors- Photodiodes, phototransistors and photo resistors based sensors, light-to-light detectors, Infrared sensors (thermal, PIR, AFIR, thermopiles).

Magnetic and Electromagnetic Sensors and Actuators-
Motors as actuators (linear, rotational, stepping motors), magnetic valves, inductive sensors (eddy current, LVDT, RVDT, Proximity, switches), Hall Effect sensors, Magneto resistive sensors.

Mechanical Sensors- Accelerometers, Force sensors (strain gauges, tactile sensors), Pressure sensors (semiconductor, piezoresistive, capacitive, VRP).

Industrial Networks & Fieldbus-
Types of bus – DN, PB, ProfiNet, Eth/IP Interfacing to Controller : Connecting sensors to controller directly or through fieldbus. Configuration of digital, group, and analog IO. Use of instructions and logic. Strobing and handshaking with PLC as master, Encoder and Resolvers.

PLC- Various hardware types of PLC (CPU and I/O modules).Centralized configuration of PLC.On-line with PLC (using serial port).Various languages and its over-view. Sample program down-load, Task configuration. Configuration of IP address & sample program download. Decentralized configuration of PLC (Profibus protocol).Configuration I/O modules on Profi-bus protocol. Mod-bus configuration (Master & Slave configuration). Mod-bus RTU (Remote Telemetry Unit) and Mod-bus TCP/IP communication with PCbased software .

***Student have to submit a Small Working Prototype Model.**
Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

PATTERN RECOGNITION AND IMAGE PROCESSING LAB

Course Code: AIE4305 **Credit Units: 01**

Course Contents:

1. Study of functions in MATLAB.
2. Linear and Non-linear operations on Images.
3. Implementation of different geometric transformations (Scaling, Rotation, Translation, Shear).
4. Implementation of Identity transformation, Contrast Stretching, Threshold and Log Transformation.
5. Plotting of Histogram for Low contrast, High Contrast, Blurred Images, Black & white images and Gray Images.
6. Smoothening and Sharpening of Images using spatial filters.
7. Implementation of Fourier Transformation of different types of Images.
8. Implementation of Edge detection in different-2 images.
9. Implementation of clustering.
10 Implementation of different algorithms in pattern recognition.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

Text & References:

- Rafael C. Gonzalez & Richard E. Woods, "Image Processing Using MATLAB", 2nd edition, Pearson Education.
- "Pattern classifications**"**, Richard O. Duda, PeterE. Hart, David G. Stroke. Wiley student edition, Second Edition

SUMMER INTERNSHIP EVALUATION

Course Code: AIE4335 **Credit Units: 06**

Guidelines:
There are certain phases of every Intern's professional development that cannot be effectively taught in the academic environment. These facets can only be learned through direct, on-the-job experience working with successful professionals and experts in the field. The internship program can best be described as an attempt to institutionalize efforts to bridge the gap between the professional world and the academic institutions. Entire effort in internship is in terms of extending the program of education and evaluation beyond the classroom of a university or institution. The educational process in the internship course seeks out and focuses attention on many latent attributes, which do not surface in the normal classroom situations. These attributes are intellectual ability, professional judgment and decision-making ability, inter-disciplinary approach, skills for data handling, ability in written and oral presentation, sense of responsibility etc.

In order to achieve these objectives:

- **Each student will be allotted a supervisor** for proper guidance.
- **Student will first submit synopsis in the format given by coordinator/supervisor.**
- Student will maintain a file (**Internship File/Project Report**). **Further, coordinator will provide NTCC project guidelines and sample to help in preparation of file.** The Internship File aims to encourage students to keep a personal record of their learning and achievement throughout the Programme. It can be used as the basis for lifelong learning and for job applications. Items can be drawn from activities completed in the course modules and from the workplace to demonstrate learning and personal development. The File will assess the student's analytical skills and ability to present supportive evidence, whilst demonstrating understanding of their organization, its needs and their own personal contribution to the organization.

The **layout guidelines** for the Project Report

1. File should be in the following specification

- A4 size paper
- **Font**

For normal text Font Type and Size must be- Times New Roman, 12 pt. The minimum font size of materials within a table or a figure can be 10 point.

- **Margins**

A margin of 3.75 cm (1½ inch) is to be given on the binding edge while on the other sides it is to be 2.5 cm (1 inch). The text of the report, including headings, figures, tables, and notes, but excluding page numbers, must be accommodated within the page area.

- **Line Spacing**

The line spacing in the main text must be between one-and-a-half (1.5). Single line spacing should be given for figure captions, table titles, figure legends, and footnotes. Equations, tables, figures, and quotations should be set off from the main text with adequate space (not less than the normal line spacing adopted for the main text). Two consecutive paragraphs should be separated by a spacing which must be larger than the line spacing adopted for the text.

- **Tables and Figures**

Each sketch, drawing, graph and photograph should have a figure number and title below the figure etc. Numbering should be sequential, chapter wise. For instance, if there are 24 figures chapter 3 spread over all of its sections the figure numbers run from Figure 3.1 through Figure 3.24. In figures experimental data should typically be represented by centered symbols, and theoretical data by continuous curves.

Each table should have a table number and caption above the table. Numbering should be sequential, chapter wise, as in the case of Figure numbers. For instance, if there are 18 tables in chapter 3 the table numbers run from Figure 3.1 through Figure 3.18.

Make sure that figures and tables are complete in other respects such as legends, references (if any) and coordinate labels with units. Each figure and table must be explicitly referred to in the text and located where its first reference occurs, preferably after the reference.

- **Drawings**

All engineering drawings must conform to relevant Standards and should include a title block. If drawings are large they should be included at the back of the report in a separate pocket. In case drawings are made using CAD packages, a CD ROM should be included which contains all the files and details of the packages used.

- **Equations**

The numbering of equations should be sequential, chapter wise. Numbered equations must be explicitly referred to in the text.

2. Report Size: The maximum number of pages of the Report should be preferably between 50-80 pages.

3. Report Layout: The report should contain the following components
Front Page
Table of Content
Acknowledgement
Student Certificate
Company Profile (optional)
Introduction
Main Body
References / Bibliography

The File will include ***five sections*** in the order described below. The content and comprehensiveness of the main body and appendices of the report should include the following:

1. **The Title Page**--Title - An Internship Experience Report For (Your Name), name of internship organization, name of the Supervisor/Guide and his/her designation, date started and completed, and number of credits for which the report is submitted.
2. **Declaration by the Students-**This is page number (i), the beginning of the small case Roman numeral page numbers. The student has to give a declaration to the effect that the data used for the work, the work depicted in the report, and the written material contained in the report are not copied from others and that due permission has been taken from, and due credit has been given to, the sources whenever they are used.
3. Certificate-This is page number (ii). The certificate will be signed by the Faculty Supervisor(s) before the viva-voce after verifying the format and by the Head of the Department after review with the Supervisor(s).
4. Acknowledgements-This is page number (iii). Keep this brief and avoid using informal language. This page must be signed by the candidate.
5. Abstract and **Keywords-**This is page number (iv). The abstract (preferably one page) should contain the context/relevance of the problem at hand, a description of what was done and a gist of the significant observations/results.
The keywords (maximum 6) are a hint that what is contained in the report.
7. Contents-This is page number (v). The table of Contents should be titled just *Contents* (not Table of Contents). Try to fit it into one or two pages.
8. **Introduction**--short, but should include how and why you obtained the internship experience position and the relationship it has to your professional and career goals.
9. **Main Body**--should include but not be limited to daily tasks performed. Major projects contributed to, dates, hours on task, observations and feelings, meetings attended and their purposes, listing of

tools and materials and their suppliers, and photographs if possible of projects, buildings and co-workers.

10. **References / Bibliography** --This should include papers and books referred to in the body of the report. These should be ordered alphabetically on the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

ASSESSMENT OF THE INTERNSHIP FILE

Continuous Internal Assessment — 40 Marks

Final Assessment — 60 Marks

Continuous Internal Assessment consists of topic relevance, progress report and synopsis marks. Final Assessment includes viva, presentation and report marks.

Examination Scheme:

Components	**V**	**S**	**R**	**PR**	**FP**
Weightage (%)	20	20	20	20	20

V – Viva, S – Synopsis, FP – Final Presentation, R – Report, PR-Progress Report

PROJECT-DISSERTATION-I

Course Code: AIE4337 **Credit Units: 05**

GUIDELINES FOR DISSERTATION

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critiqued by the faculty guide and corrected by the student at each stage.

The File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

In general, the File should be comprehensive and include

A short account of the activities that were undertaken as part of the project;

A statement about the extent to which the project has achieved its stated goals.

A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;

Any activities planned but not yet completed as part of the DISSERTION, or as a future initiative directly resulting from the project;

Any problems that have arisen that may be useful to document for future reference.

- Report Layout

The report should contain the following components:

- **Title or Cover Page**

The title page should contain the following information: Project Title; Student's Name; Course; Year; Supervisor's Name.

- **Acknowledgements** (optional)

Acknowledgment to any advisory or financial assistance received in the course of work may be given.

- **Abstract**

A good"Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project

- **Table of Contents**

Titles and subtitles are to correspond exactly with those in the text.

- **Introduction**

Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.

- **Materials and Methods**

This section should aim at experimental designs, materials used. Methodology should be mentioned in details including modifications if any.

- **Results and Discussion**

Present results, discuss and compare these with those from other workers, etc. In writing these section, emphasis should be given on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.

Note that in writing the various secions, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or

captions. All major equations should also be numbered and unless it is really necessary never write in "point" form.

- **Conclusion**

A conclusion should be the final section in which the outcome of the work is mentioned briefly.

- **Future prospects**

- **Appendices**

The Appendix contains material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.

- **References / Bibliography**

This should include papers and books referred to in the body of the report. These should be ordered alphabetically on the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

Examples

For research article

Voravuthikunchai SP, Lortheeranuwat A, Ninrprom T, Popaya W, Pongpaichit S, Supawita T. (2002) Antibacterial activity of Thai medicinal plants against enterohaemorrhagic*Escherichia coli* O157: H7. *ClinMicrobiol Infect*, **8** (suppl 1): 116–117.

For book

Kowalski,M.(1976) Transduction of effectiveness in *Rhizobium meliloti*. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), **7**: 63-67

ASSESSMENT OF THE DISSERTATION FILE

Essentially, marking will be based on the following criteria: the quality of the report, the technical merit of the project and the project execution.
Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project.
Project execution is concerned with assessing how much work has been put in.
The File should fulfill the following ***assessment objectives:***

Range of Research Methods used to obtain information

Execution of Research

Data Analysis

Analyse Quantitative/ Qualitative information
Control Quality

Draw Conclusions

Examination Scheme:

Dissertation	50
Viva Voce	50
Total	**100**

ata, leading to production of a structured report.

Selecting the Dissertation Topic

It is usual to give you some discretion in the choice of topic for the dissertation and the approach to be adopted. You will need to ensure that your dissertation is related to your field of specialization.

Deciding this is often the most difficult part of the dissertation process, and perhaps, you have been thinking of a topic for some time.

It is important to distinguish here between 'dissertation topic' and 'dissertation title'. The topic is the specific area that you wish to investigate. The title may not be decided until the dissertation has been written so as to reflect its content properly.

Few restrictions are placed on the choice of the topic. Normally we would expect it to be:

- relevant to business, defined broadly;
- related to one or more of the subjects or areas of study within the core program and specialisation stream;
- clearly focused so as to facilitate an in-depth approach, subject to the availability of adequate sources of information and to your own knowledge;
- of value and interest to you and your personal and professional development.

Planning the Dissertation

This will entail following:

- Selecting a topic for investigation.
- Establishing the precise focus of your study by deciding on the aims and objectives of the dissertation, or formulating questions to be investigated. Consider very carefully what is worth investigating and its feasibility.
- Drawing up initial dissertation outlines considering the aims and objectives of the dissertation. Workout various stages of dissertation
- Devising a timetable to ensure that all stages of dissertation are completed in time. The timetable should include writing of the dissertation and regular meetings with your dissertation guide.

The Dissertation plan or outline

It is recommended that you should have a dissertation plan to guide you right from the outset. Essentially, the dissertation plan is an outline of what you intend to do, chapter wise and therefore should reflect the aims and objectives of your dissertation.

There are several reasons for having a dissertation plan

- It provides a focus to your thoughts.
- It provides your faculty-guide with an opportunity, at an early stage of your work, to make constructive comments and help guide the direction of your research.
- The writing of a plan is the first formal stage of the writing process, and therefore helps build up your confidence.
- In many ways, the plan encourages you to come to terms with the reading, thinking and writing in a systematic and integrated way, with plenty of time left for changes.
- Finally, the dissertation plan generally provides a revision point in the development of your dissertation report in order to allow appropriate changes in the scope and even direction of your work as it progresses.

Keeping records

This includes the following:

- Making a note of everything you read; including those discarded.
- Ensuring that when recording sources, author's name and initials, date of publication, title, place of publication and publisher are included. (You may consider starting a card index or database from the outset). Making an accurate note of all quotations at the time you read them.
- Make clear what is a direct a direct quotation and what is your paraphrase.

Dissertation format

All students must follow the following rules in submitting their dissertation.

- Front page should provide title, author, Name of degree/diploma and the date of submission.
- Second page should be the table of contents giving page references for each chapter and section.
- The next page should be the table of appendices, graphs and tables giving titles and page references.
- Next to follow should be a synopsis or abstract of the dissertation (approximately 500 words)
- Next is the 'acknowledgements'.

- Chapter I should be a general introduction, giving the background to the dissertation, the objectives of the dissertation, the rationale for the dissertation, the plan, methodological issues and problems. The limitations of the dissertation should also be hinted in this chapter.
- Other chapters will constitute the body of the dissertation. The number of chapters and their sequence will usually vary depending on, among others, on a critical review of the previous relevant work relating to your major findings, a discussion of their implications, and conclusions, possibly with a suggestion of the direction of future research on the area.
- After this concluding chapter, you should give a list of all the references you have used. These should be cross - references with your text. For articles from journals, the following details are required e.g.

  Draper P and Pandyal K. 1991, The Investment Trust Discount Revisited, Journal of Business Finance and Accounting, Vol18, No6, Nov, pp 791-832.

  For books, the following details are required:
  Levi, M. 1996, International Financial Management, Prentice Hall, New York, 3rd Ed, 1996

- Finally, you should give any appendices. These should only include relevant statistical data or material that cannot be fitted into the above categories.

The Layout Guidelines for the Dissertation

- A4 size Paper
  - Font: Arial (10 points) or Times New Roman (12 points)
  - Line spacing: 1.5
  - Top and bottom margins: 1 inch/ 2.5 cm; left and right margins: 1.25 inches/ 3 cm

Guidelines for the assessment of the Dissertation

While evaluating the dissertation, faculty guide will consider the following aspects:

1. Has the student made a clear statement of the objective or objective(s).
2. If there is more than one objective, do these constitute parts of a whole?
3. Has the student developed an appropriate analytical framework for addressing the problem at hand.
4. Is this based on up-to-date developments in the topic area?
5. Has the student collected information / data suitable to the frameworks?
6. Are the techniques employed by the student to analyse the data / information appropriate and relevant?
7. Has the student succeeded in drawing conclusion form the analysis?
8. Do the conclusions relate well to the objectives of the project?
9. Has the student been regular in his work?
10. Layout of the written report.

Assessment Scheme:

Continuous Evaluation:		40%
(Based on Abstract, Regularity, Adherence to initial plan, Records etc.)		
Final Evaluation: Based on,		60%
Contents & Layout of the Report,	20	
Conceptual Framework,	05	
Objectives & Methodology and	05	
Implications & Conclusions	10	
Viva & Presentation	20	

OPTIMIZATION TECHNIQUES

Course Code: AIE4306 **Credit Units: 03**

Course Objective:
This course objective is to study the principles of optimization and various techniques which can be used for Engineering optimization along with applications.

Course Contents:
Module-I: INTRODUCTION
Introduction to optimization – adequate and optimum design – principles of optimization – statement of an optimization problem – classification – formulation of objective function, design constraints.

Module-II: CLASSICAL OPTIMIZATION TECHNIQUES
Single variable optimization –multivariable optimization with no constraints – exhaustive search, Fibonacci method, golden selection, Random, pattern and gradient search methods – Interpolation methods: quadratic and cubic, direct root method.

Module-III: MULTIVARIABLE–UNCONSTRAINED AND CONSTRAINED OPTIMIZATION
Direct search methods – descent methods – conjugate gradient method. Indirect methods – Transformation techniques, penalty function method

Module-IV: NON – TRADITIONAL OPTIMIZATION TECHNIQUES
Genetic Algorithms -steady state algorithm, fitness scaling, inversion. Genetic programming:- Genetic Algorithm in problem solving, Implementing a Genetic Algorithm:- computer implementation, operator (reproduction, crossover and Mutation, Fitness Scaling, Coding, Discretization). Knowledge based techniques in Genetic Algorithm. Advanced operators and techniques in genetic search:- Dominance, Diploidy and Abeyance. Inversion and other reordering operators, Niche and speciation andTabu search methods.

Module-V: OPTIMUM DESIGN OF MACHINE
Desirable and undesirable effects – functional requirement – material and geometrical parameters – Design of simple axial, transverse loaded members for minimum cost and minimum weight.

Examination Scheme:

Components	CT	H	V/S/Q	EE
Weightage (%)	10	07	08	70

Text & References:

- Rao, S.S., "*Optimization – Theory and Applications*", Wiley Eastern, New Delhi, 1978
- Fox, R.L., Optimization Methods for Engineering Design, Addition – Wesley, Reading, Mass, 1971.
- Wilde, D.J., "*Optimum Seeking Methods*", Prentice Hall, Englewood Cliffs, New Jersey, 1964

COMPUTER NUMERICAL CONTROL (CNC) MACHINES AND ADAPTIVE CONTROL

Course Code: AIE4307 **Credit Units: 03**

Course Objective:
This course objective is to understand NC,CNC and DNC manufacturing and generate manual part program for CNC machining. Concept of adaptive control and its various applications

Course Contents:
Module-I:
Concepts of NC, CNC, DNC. Classification of CNC machines, Machine configurations, Types of control, CNC controllers characteristics, Interpolators. Cutting tool materials, carbide inserts classification, qualified, semi qualified and preset tooling, tooling system for Machining centre and Turning centre, work holding devices, of CNC Machines.

Module-II:
Programming CNC machines, Part print analysis and Process planning, Advanced Programming features , Canned cycles, Subroutines, Macros, special cycles etc. APT part programming using CAD/CAM, Parametric Programming. Manual part programming for CNC turning, milling and machining center. Computer assisted part programming techniques , Conversational and Graphics based software, Solids based part programming. Freeform surface machining. Simulation and Verification of CNC programs.

Module-III:
Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement. Robot activation and feedback components. MOTION ANALYSIS AND CONTROL: Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control, robot dynamics, configuration
of robot controller.

Module-IV:
END EFFECTORS: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design. SENSORS: Desirable features, tactile, proximity and range sensors, uses sensors in robotics. Positions sensors, velocity sensors, actuators sensors, power transmission system.
MACHINE VISION: Functions, Sensing and Digitizing-imaging, Devices, Lighting
techniques, Analog to digital single conversion, image storage, Image processing and Analysis-image

Module-V:
Review of Lyapunov analysis, model Reference Adaptive Control, Composite Adaptation, Parameter Convergence: Persistency of Excitation /Uniform Complete Observe-ability, Adaptive Control in the Presence of Input Constraints, Direct MRAC for Nonlinear systems with Matched Structured Nonlinearities, Robustness of MRAC: Parameter Drift, Adaptive Control in the Presence of Uniformly Bounded Residual Nonlinearity, Disturbance Rejection, Input-to-State Stability,
fast adaptation.

Examination Scheme:

Components	CT	H	V/S/Q	EE
Weightage (%)	10	07	08	70

Text & References:

- Krar, S., and Gill, A., "CNC Technology and Programming", McGraw Hill publ Co, 1990.
- Gibbs, D., "An Introduction to CNC Machining", Casell, 1987.
- Seames, W.S., "Computer Numerical Control Concepts and Programming", Delmar Publishers, 1986.
- Lynch, M., "Computer Numerical Control for Machining", McGraw Hill, 1992.
- Koren Y, "Computer Control of Manufacturing Systems", McGraw, 1986.

NEURAL NETWORK AND FUZZY LOGIC

Course Code: AIE4308 **Credit Units: 03**

Course Objective:
Fuzzy sets and fuzzy logic find many applications in the areas of stability theory, pattern recognition, controls etc. Neural Networks offer fundamentally alternative approaches to procedural programming. These systems proved their applicability to the problems where there are missing data or information or the problems which could not be defined in an algorithm. The integration of fuzzy systems and neural networks gives a tremendous potential which can be applied to many complicated problems of Artificial Intelligence and other applications in Real World Computing.This course provides a comprehensive treatment of neural network architectures and learning algorithms, with an in-depth look at problems in data mining and in knowledge discovery.

Course Contents:
Module I
Basic neural computation models: Network and node properties. Inference and learning algorithms.
Unsupervised learning: Signal hebbian learning and competitive learning. Supervised learning: Back propagation algorithms.

Module II
Self organizing networks: Kohonen algorithm, bi-directional associative memories.
Hopfield Networks: Hopfield network algorithm.
Adaptive resonance theory: Network and learning rules. Neural network applications.

Module III
Fuzzy Sets: Operations and properties.
Fuzzy Relations: Cardinality, Operations and properties.
Value Assignments: Cosine amplitude and max-min method.
Fuzzy classification: Cluster analysis and validity, Fuzzy e-means clustering, hardening the Fuzzy e-partition.

Module IV
Fuzzification, Membership value assignments: Inference, rank ordering and angular Fuzzy sets, defuzzification methods, fuzzy logic, approximate reasoning.
Fuzzy –based systems: Canonical rule forms, decomposition of compound rules, likelihood and truth qualification, aggregation of Fuzzy rules, graphical techniques of inference.

Module V
Non linear simulation using Fuzzy rule-based systems, Fuzzy associative memories. Decision making under Fuzzy states and Fuzzy actions. Fuzzy grammar and syntactic recognition. General Fuzzy logic controllers, special forms of Fuzzy logic control system models, examples of Fuzzy control system design and control problems, industrial applications.
Mandatory Disclosure-2006
Muffakham Jah College of Engineering and Technology, Hyderabad

ExaminationScheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text&References:

- Limin Fu. “Neural Networks in Computer Intelligence” McGraw Hill, 1995.
- Freeman J. A., and Skapura D. Mu. “Neural Networks Algorithms applications and Programming Techniques”, Addison Wesley New York, 1991.
- Timoty J. Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill1997.
- Bart Kosho “Neural Network and Fuzzy Systems”, Prentice Hall of India,1994

NEURAL NETWORK AND FUZZY LOGIC LAB

Course Code: AIE4309 **Credit Units: 01**

Course Contents:

List of Experiments:

1. Write a program to implement single layer perception algorithm.
2. Write a program to implement back propagation learning algorithm
3. Design multilayer feed forward network using back-propogation algorithm
4. Study of fuzzy inference system
5. To study fuzzy logic controller using fuzzy logic toolbox
6. Write a program to implement SDPTA
7. Write a program to implement RDPTA
8. To Study various defuzziification techniques
9. Write a program to implement of fuzzy set operation

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

Text & References:

- Limin Fu. “Neural Networks in Computer Intelligence” McGraw Hill, 1995.
- Freeman J. A., and Skapura D. Mu. “Neural Networks Algorithms applications and Programming Techniques”, Addison Wesley New York, 1991.

DECISION MAKING SYSTEM

Course Code: AIE4310 **Credit Units: 03**

Course Objective:
To develop semantic-based and context-aware systems to acquire, organize, process, share and use the knowledge embedded in multimedia content. Research will aim to maximize automation of the complete knowledge lifecycle and achieve semantic interoperability between Web resources and services.

Course Contents:
Module I: Introduction
Soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing. Artificial Intelligence : Introduction, Various types of production systems, characteristics of production systems, breadth first search, depth first search techniques, other Search Techniques like hill Climbing, Best first Search, A* algorithm, AO* Algorithms and various types of control strategies. Knowledge representation issues, Prepositional and predicate logic, monotonic and non monotonic reasoning, forward Reasoning, backward reasoning, Weak & Strong Slot & filler structures, NLP.

Module II: Neural Network
Structure and Function of a single neuron: Biological neuron, artificial neuron, definition of ANN, Taxonomy of neural net, Difference between ANN and human brain, characteristics and applications of ANN, single layer network, Perceptron training algorithm, Linear separability, Widrow&Hebb;s learning rule/Delta rule, ADALINE, MADALINE, AI v/s ANN. Introduction of MLP, different activation functions, Error back propagation algorithm, derivation of BBPA, momentum, limitation, characteristics and application of EBPA

Module III
Counter propagation network, architecture, functioning & characteristics of counter Propagation network, Hopfield/ Recurrent network, configuration, stability constraints, associative memory, and characteristics, limitations and applications. Hopfield v/s Boltzman machine. Adaptive Resonance Theory: Architecture, classifications, Implementation and training. Associative Memory.

Module IV: Fuzzy Logic
Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, Fuzzy systems: crisp logic, fuzzy logic, introduction & features of membership functions, Fuzzy rule base system : fuzzy propositions, formation, decomposition & aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making & Applications of fuzzy logic.

Module V: Genetic algorithm
Fundamentals, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modeling: Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator, Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional methods.

Examination Scheme:

Components	CT	H	V/S/Q	AT	EE
Weightage (%)	10	8	7	5	70

Text & References:

- S, Rajasekaran& G.A. VijayalakshmiPai, Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & Applications, PHI Publication.
- S.N. Sivanandam& S.N. Deepa, Principles of Soft Computing, Wiley Publications
- Rich E and Knight K, Artificial Intelligence, TMH, New Delhi.
- Bose, Neural Network fundamental with Graph , Algo.&Appl, TMH
- Kosko: Neural Network & Fuzzy System, PHI Publication
- Klir& Yuan, Fuzzy sets & Fuzzy Logic: Theory &Appli.,PHI Pub.
- Hagen, Neural Network Design, Cengage Learning

DECISION MAKING SYSTEM LAB

Course Code: AIE4311 **Credit Units: 01**

Course Contents:

List of Experiments:

1. Study of Biological Neural Network
2. Study of Artificial Neural Network
3. Write a program of Perceptron Training Algorithm.
4. Write a program to implement Hebb's Rule
5. Write a program to implement of Delta Rule.
6. Write a program to implement back propagation learning algorithm.
7. Study of fuzzy inference system
8. To study fuzzy logic controller using fuzzy logic toolbox
9. Write a program to implement SDPTA
10. Write a program to implement RDPTA
11. To Study various defuzziification techniques
12. Write a program to implement of fuzzy set operation
13. Study of genetic algorithm
14. Study of Genetic programming and solve a real life problem

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

Text & References:

- Limin Fu. "Neural Networks in Computer Intelligence" McGraw Hill, 1995.
- Freeman J. A., and Skapura D. Mu. "Neural Networks Algorithms applications and Programming Techniques", Addison Wesley New York, 1991.
- S, Rajasekaran& G.A. VijayalakshmiPai, Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & Applications, PHI Publication.
- S.N. Sivanandam& S.N. Deepa, Principles of Soft Computing, Wiley Publications
- Rich E and Knight K, Artificial Intelligence, TMH, New Delhi.

Syllabus - Fourth Semester

PROJECT-DISSERTATION-II

Course Code: AIE4437 **Credit Units: 15**

GUIDELINES FOR DISSERTATION

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critiqued by the faculty guide and corrected by the student at each stage.

The File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

In general, the File should be comprehensive and include

A short account of the activities that were undertaken as part of the project;

A statement about the extent to which the project has achieved its stated goals.

A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;

Any activities planned but not yet completed as part of the DISSERTION, or as a future initiative directly resulting from the project;

Any problems that have arisen that may be useful to document for future reference.

- Report Layout

The report should contain the following components:

- **Title or Cover Page**

The title page should contain the following information: Project Title; Student's Name; Course; Year; Supervisor's Name.

- **Acknowledgements** (optional)

Acknowledgment to any advisory or financial assistance received in the course of work may be given.

- **Abstract**

A good"Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project

- **Table of Contents**

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- **Introduction**

Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.

- **Materials and Methods**

This section should aim at experimental designs, materials used. Methodology should be mentioned in details including modifications if any.

- **Results and Discussion**

Present results, discuss and compare these with those from other workers, etc. In writing these section, emphasis should be given on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in

contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.

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- **Conclusion**

A conclusion should be the final section in which the outcome of the work is mentioned briefly.

- **Future prospects**

- **Appendices**

The Appendix contains material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.

- **References / Bibliography**

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For book

Kowalski,M.(1976) Transduction of effectiveness in *Rhizobium meliloti*. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), **7**: 63-67

ASSESSMENT OF THE DISSERTATION FILE

Essentially, marking will be based on the following criteria: the quality of the report, the technical merit of the project and the project execution.
Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project.
Project execution is concerned with assessing how much work has been put in.
The File should fulfill the following ***assessment objectives:***

Range of Research Methods used to obtain information

Execution of Research

Data Analysis
Analyse Quantitative/ Qualitative information
Control Quality

Draw Conclusions

Examination Scheme:

Dissertation	50
Viva Voce	50
Total	**100**

ata, leading to production of a structured report.

Selecting the Dissertation Topic
It is usual to give you some discretion in the choice of topic for the dissertation and the approach to be adopted. You will need to ensure that your dissertation is related to your field of specialization.

Deciding this is often the most difficult part of the dissertation process, and perhaps, you have been thinking of a topic for some time.

It is important to distinguish here between 'dissertation topic' and 'dissertation title'. The topic is the specific area that you wish to investigate. The title may not be decided until the dissertation has been written so as to reflect its content properly.

Few restrictions are placed on the choice of the topic. Normally we would expect it to be:
- relevant to business, defined broadly;
- related to one or more of the subjects or areas of study within the core program and specialisation stream;
- clearly focused so as to facilitate an in-depth approach, subject to the availability of adequate sources of information and to your own knowledge;
- of value and interest to you and your personal and professional development.

Planning the Dissertation
This will entail following:
- Selecting a topic for investigation.
- Establishing the precise focus of your study by deciding on the aims and objectives of the dissertation, or formulating questions to be investigated. Consider very carefully what is worth investigating and its feasibility.
- Drawing up initial dissertation outlines considering the aims and objectives of the dissertation. Workout various stages of dissertation
- Devising a timetable to ensure that all stages of dissertation are completed in time. The timetable should include writing of the dissertation and regular meetings with your dissertation guide.

The Dissertation plan or outline
It is recommended that you should have a dissertation plan to guide you right from the outset. Essentially, the dissertation plan is an outline of what you intend to do, chapter wise and therefore should reflect the aims and objectives of your dissertation.

There are several reasons for having a dissertation plan
- It provides a focus to your thoughts.
- It provides your faculty-guide with an opportunity, at an early stage of your work, to make constructive comments and help guide the direction of your research.
- The writing of a plan is the first formal stage of the writing process, and therefore helps build up your confidence.
- In many ways, the plan encourages you to come to terms with the reading, thinking and writing in a systematic and integrated way, with plenty of time left for changes.
- Finally, the dissertation plan generally provides a revision point in the development of your dissertation report in order to allow appropriate changes in the scope and even direction of your work as it progresses.

Keeping records
This includes the following:

- Making a note of everything you read; including those discarded.
- Ensuring that when recording sources, author's name and initials, date of publication, title, place of publication and publisher are included. (You may consider starting a card index or database from the outset). Making an accurate note of all quotations at the time you read them.
- Make clear what is a direct a direct quotation and what is your paraphrase.

Dissertation format
All students must follow the following rules in submitting their dissertation.

- Front page should provide title, author, Name of degree/diploma and the date of submission.
- Second page should be the table of contents giving page references for each chapter and section.
- The next page should be the table of appendices, graphs and tables giving titles and page references.
- Next to follow should be a synopsis or abstract of the dissertation (approximately 500 words)
- Next is the 'acknowledgements'.
- Chapter I should be a general introduction, giving the background to the dissertation, the objectives of the dissertation, the rationale for the dissertation, the plan, methodological issues and problems. The limitations of the dissertation should also be hinted in this chapter.
- Other chapters will constitute the body of the dissertation. The number of chapters and their sequence will usually vary depending on, among others, on a critical review of the previous relevant work relating to your major findings, a discussion of their implications, and conclusions, possibly with a suggestion of the direction of future research on the area.
- After this concluding chapter, you should give a list of all the references you have used. These should be cross - references with your text. For articles from journals, the following details are required e.g.

  Draper P and Pandyal K. 1991, The Investment Trust Discount Revisited, Journal of Business Finance and Accounting, Vol18, No6, Nov, pp 791-832.

  For books, the following details are required:
  Levi, M. 1996, International Financial Management, Prentice Hall, New York, 3rd Ed, 1996

- Finally, you should give any appendices. These should only include relevant statistical data or material that cannot be fitted into the above categories.

The Layout Guidelines for the Dissertation

- A4 size Paper
  - Font: Arial (10 points) or Times New Roman (12 points)
  - Line spacing: 1.5
  - Top and bottom margins: 1 inch/ 2.5 cm; left and right margins: 1.25 inches/ 3 cm

Guidelines for the assessment of the Dissertation

While evaluating the dissertation, faculty guide will consider the following aspects:

11. Has the student made a clear statement of the objective or objective(s).
12. If there is more than one objective, do these constitute parts of a whole?
13. Has the student developed an appropriate analytical framework for addressing the problem at hand.
14. Is this based on up-to-date developments in the topic area?
15. Has the student collected information / data suitable to the frameworks?
16. Are the techniques employed by the student to analyse the data / information appropriate and relevant?
17. Has the student succeeded in drawing conclusion form the analysis?
18. Do the conclusions relate well to the objectives of the project?
19. Has the student been regular in his work?
20. Layout of the written report.

Assessment Scheme:

Continuous Evaluation:		40%
(Based on Abstract, Regularity, Adherence to initial plan, Records etc.)		
Final Evaluation: Based on,		60%
Contents & Layout of the Report,	20	
Conceptual Framework,	05	
Objectives & Methodology and	05	
Implications & Conclusions	10	
Viva & Presentation	20	