Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal

New Scheme Based On AICTE Flexible Curricula

Robotics and Artificial Intelligence, IV semester

RA 401- Introduction to Probability and Statistics

Course Objective:

The objective of this course is to familiarize the students with statistical techniques. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

Syllabus

Unit 1: Concept of Probability: Random variable (Discrete and Continuous) Probability mass function, Probability distribution function, probability density function, Expectations, exponential and Gamma density.

Unit 2: Bivariate Distributions: Bivariate distributions and their properties, distribution of sums and quotients, Baye's rule, conditional probability.

Unit 3: Basic Statistics Measures of Central tendency: Moments, skewness and Kurtosis Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

Unit 4: Applied Statistics Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Unit 5: Small samples Test for single mean, difference of means and correlation coefficients, test for ratio of variances, Chi-square test for goodness of fit and independence of attributes.

Suggested Text/Reference Books:

1.Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).

3. Krishna K.D., Fundamentals of Probability & Statistics, Dhanpat Rai & Co.Delhi

4. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

5. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.

6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

8. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

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Robotics and Artificial Intelligence, IV semester

RA 402- Robotics Engineering

Course Objectives:

1. To understand the importance of robotics in scientific and industrial domains.
2. To introduce mathematical aspects of robotics such as spatial transformations, kinematics, dynamics, trajectory generation, actuators and control.
3. To learn about different types of end effectors and drive systems
4. To understand the criteria to select sensors, basic knowledge of piezoelectric sensors and Image processing
5. To learn about safety and economics of robots.

Module 1 Introduction: Need and importance, basic concepts, structure and classification of industrial robots, Geometric classification and control classification, Robot Elements , terminology of robot motion, motion characteristics, resolution, accuracy, repeatability, robot applications.

Module 2 End Effectors and Drive systems: Drive systems for robots, salient features and comparison, different types of end effectors, design, applications.

Module 3 Sensors: Sensor evaluation and selection, Piezoelectric sensors , linear position and displacement sensing, revolvers, encoders, velocity measurement, proximity, tactile, compliance and range sensing. Image Processing and object recognition.

Module 4 Robot Programming: Teaching of robots, manual, walk through, teach pendant, off line programming , Language based programming, task level programming, Robot programming synthesis, robot programming for foundry, press work and heat treatment, welding, machine tools, material handling, warehousing assembly, etc., automatic storage and retrieval system.

Module 5 Safety and Economy of Robots: Work cycle time analysis, economics and effectiveness of robots, safety systems and devices, concepts of testing methods and acceptance rule for industrial robots. Robot integration with CAD/CAM/CIM, Collision free motion planning.

REFERENCES:

1. Mittal RK, Nagrath IJ; Robotics and Control; TMH
2. Groover M.P,Weiss M, Nagel,OdreyNG; Industrial Robotics-The Appl□; TMH
3. Groover M.P; CAM and Automation; PHI Learning
4. Spong Mark and Vidyasagar; Robot Modelling and control; Wiley India
5. Yoshikava ; Foundations of Robotics- analysis and Control; PHI Learning;
6. Murphy ; Introduction to AI Robotics; PHI Learning
7. FU KS, Gonzalez RC, Lee CSG; Robotics □Control, sensing□; TMH
8. Shimon, K; Handbook of Industrial Robots; John Wiley & Sons,.
9. Ghosal Ashitava; Robotics Fundamental concepts and analysis; Oxford
10. Saha S; Introduction to Robotics; TMH 11. Yu Kozyhev; Industrial Robots Handbook; MIR Pub.

List of Suggested Experiments:

1. To study components of real Robot and its DH Parameters.
2. Study of Forward Kinematics and validation using a software (Robo Analyzer or any other free software tools)
3. Study of inverse kinematics of any real Robot and validation using any software
4. Study of positioning and orientation of Robot arm
5. Image processing for color/shape detection
6. Control experiment using available hardware/software
7. Integration of assorted sensors (IR, Potentiometer, strain gauges etc.)microcontroller and Robot operating System in a Robotic System
8. Project work

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Robotics and Artificial Intelligence, IV semester

RA 403- Microcontroller and its Applications

Syllabus:

Unit 1: Fundamentals of Microprocessors

Fundamentals of Microprocessor architecture, 8-bit Microprocessor and Microcontroller architecture, comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers, definition of embedded system and its characteristics, role of microcontrollers in embedded Systems, overview of the 8051 family, introduction to ARM7, Intel I (i3, i5, i7) series processors.

Unit 2: The 8051 Architecture

Internal Block Diagram, CPU, ALU, address, data and control bus, working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, RAM- ROM organization, Memory Structures, Data and Program Memory, Timing diagrams and Machine Cycles.

Unit 3: Instruction Set

Addressing modes: Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, bit inherent addressing, bit direct addressing, 8051 Instruction set, Instruction timings, Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction, Interrupts.

Unit 4: Programming

Assembly language programs, C language programs, Assemblers and compilers, Programming and debugging tools. I/O and External Communication Interface: Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, timers, counters, memory devices, Synchronous and Asynchronous Communication, serial communication, RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.

Unit 5: Applications

LED, LCD and keyboard interfacing, Stepper motor interfacing, DC Motor interfacing, sensor interfacing, Analog-to-Digital Convertors, Digital-to-Analog Convertors, Sensors with Signal conditioning Interface.

Suggested Text Books

1. Kenneth J. Ayala, “The 8051 Microcontroller Architecture, Programming & Applications”, Penram International, 1991.
2. Raj Kamal, “Embedded Systems: Architecture, Programming and Design”, Tata McGraw-Hill Education, 2008.

Suggested Reference Books

1. M. A. Mazidi, J. G. Mazidi and R. D. McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Pearson Education, 2007.
2. K. J. Ayala, “8051 Microcontroller”, Delmar Cengage Learning, 2004.

Suggested list of Practical:

- Based on 8051 and PIC microcontroller mini-cards/kits by downloading the binary file in flash memory
- Assignment exploiting the various addressing modes for accessing internal as well as external memory and unconditional/conditional branch, loop control instructions.
- Stack and Stack arithmetic operations, Subroutines and parameter passing via register, stack.
- Timers and its applications, PWM generation.
- Serial Communication.
- Interfacing – Push buttons LEDs Key Matrix Seven segment display LCD ADC/DAC Stepper motor.

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Robotics and Artificial Intelligence, IV semester

RA 404-Introduction to Artificial Intelligence

Syllabus:

Unit 1. Fundamental of Artificial Intelligence

History, motivation and need of AI, Production systems, Characteristics of production systems , goals and contribution of AI to modern technology, search space, different search techniques: hill Climbing, Best first Search, heuristic search algorithm, A* and AO* search techniques etc.

Unit 2. Knowledge Representation

Problems in representing knowledge, knowledge representation using propositional and predicate logic, comparison of propositional and predicate logic, Resolution, refutation, deduction, theorem proving, inferencing, monotonic and non-monotonic reasoning.

Unit 3. Probabilistic reasoning

Baye's theorem, semantic networks, scripts, schemas, frames, conceptual dependency, forward and backward reasoning.

Unit 4. Game playing techniques

Minimax procedure, alpha-beta cut-offs etc, planning, Study of the block world problem in robotics, Introduction to understanding, natural language processing (NLP), Components of NLP, application of NLP to design expert systems.

Unit 5. Expert systems (ES) and its Characteristics

Requirements of ES, components and capability of expert systems, Inference Engine Forward & backward Chaining, Expert Systems Limitation, Expert System Development Environment, technology, Benefits of Expert Systems.

TEXT BOOKS

1. Russel,S., and Norvig,P., “Artificial Intelligence: A Modern Approach”, 4 th Edition, 2020, Pearson.

2. Elaine Rich, Kevin Knight,Shivashankar B. Nair, “Artificial Intelligence”, McGraw-Hill International.

3. Nils J. Nilsson, “Artificial Intelligence: A New Synthesis”, Morgan-Kauffman.

REFERENCE BOOKS

1. Janakiraman, K.Sarukesi, 'Foundations of Artificial Intelligence and Expert Systems', Macmillan Series in Computer Science.
2. W. Patterson, 'Introduction to Artificial Intelligence and Expert Systems', Prentice Hall of India.

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Robotics and Artificial Intelligence, IV semester

RA-405 : Object Oriented Programming & Methodology

Syllabus

Unit 1: Introduction to Object Oriented Thinking &Object Oriented Programming: Comparison with Procedural Programming, features of Object oriented paradigm– Merits and demerits of OO methodology; Object model; Elements of OOPS, IO processing, Data Type, Type Conversion, Control Statement, Loops, Arrays.

Unit 2: Encapsulation and Data Abstraction- Concept of Objects: State, Behavior& Identity of an object; Classes: identifying classes and candidates for Classes Attributes and Services, Access modifiers, Static members of a Class, Instances, Message passing, and Construction and destruction of Objects.

Unit 3: Relationships – Inheritance: purpose and its types, 'is a' relationship; Association, Aggregation. Concept of interfaces and Abstract classes.

Unit 4: Polymorphism: Introduction, Method Overriding & Overloading, static and run time Polymorphism. Virtual Function, friend function, Static function, friend class.

Unit 5: Strings, Exceptional handling, Introduction of Multi-threading and Data collections. Case study like: ATM, Library management system.

Text Books

1. Timothy Budd, "An Introduction to Object-Oriented Programming", AddisonWesley Publication, 3rd Edition.
2. Cay S. Horstmann and Gary Cornell, "Core Java: Volume I, Fundamentals", Prentice Hall publication.

Reference Books

1. G. Booch, "Object Oriented Analysis& Design", Addison Wesley.
2. James Martin, "Principles of Object Oriented Analysis and Design", Prentice Hall/PTR.
3. Peter Coad and Edward Yourdon, "Object Oriented Design", Prentice Hall/PTR.
4. Herbert Schildt, "Java 2: The Complete Reference", McGraw-Hill Osborne Media.

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Robotics and Artificial Intelligence, IV semester

RA - 406- Computer Workshop

Syllabus:

Unit 1: Introduction to python language, Basic syntax, Literal Constants, Numbers,Variable and Basic data types,String, Escape Sequences, Operators and Expressions,Evaluation Order, Indentation, Input, Output, Functions, Comments.

Unit 2: Data Structure**:** List, Tuples, Dictionary, DataFrame and Sets, constructing,indexing, slicing and content manipulation.

Unit 3: Control Flow:Conditional Statements - If, If-else, Nested If-else. IterativeStatement - For, While, Nested Loops. Control statements - Break, Continue, Pass.

Unit 4: Object oriented programming:Class and Object, Attributes, Methods, Scopesand Namespaces, Inheritance, Overloading, Overriding, Data hiding**,**Exception:Exception Handling, Except clause, Try finally clause, User Defined Exceptions.

Unit 5: Modules and Packages**:** Standard Libraries: File I/0, Sys, logging, Regularexpression, Date and Time, Network programming, multi-processing and multithreading.

References

- Timothy A. Budd: Exploring python, McGraw-Hill Education.
- R.NageshwarRao ,"Python Programming" ,Wiley India
- Think Python: Allen B. Downey, O'Reilly Media, Inc.

List of Experiments:

1. To write a Python program to find GCD of two numbers.
2. To write a Python Program to find the square root of a number by Newton's Method.
3. To write a Python program to find the exponentiation of a number.
4. To write a Python Program to find the maximum from a list of numbers.
5. To write a Python Program to perform Linear Search
6. To write a Python Program to perform binary search.
7. To write a Python Program to perform selection sort.
8. To write a Python Program to perform insertion sort.
9. To write a Python Program to perform Merge sort.
10. To write a Python program to find first n prime numbers.
11. To write a Python program to multiply matrices.
12. To write a Python program for command line arguments.
13. To write a Python program to find the most frequent words in a text read from a file.
14. To write a Python program to simulate elliptical orbits in Pygame.
15. To write a Python program to bouncing ball in Pygame.