**RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR**

**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**

**SEMESTER: V (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: **Robot Dynamics** Subject Code: **BTechRAI-501T**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **3T Hrs/week** | **03** | **30** | **70** | **100** |

**Aim:** To understand the basic principles of robotic cell assembly and its applications in industry.

**Prerequisite(s):** Student should have basic knowledge of Robot kinematics and Sensors.

**Course Objectives:**

| | |
|---|---|
| **1** | To provide a comprehensive understanding of the principles and theories of robot dynamics. |
| **2** | To develop proficiency in analyzing the motion and forces acting on robotic systems. |
| **3** | To gain knowledge of mathematical models and algorithms used in robot dynamics. |
| **4** | To enhance problem-solving skills and critical thinking abilities in the field of robot dynamics. |

**Course Outcomes:**

**At the end of this course students will be able to:**

| | |
|---|---|
| **CO1** | Understand and explain the fundamental concepts and principles of robot dynamics. |
| **CO2** | Analyze and predict the motion of robot manipulators and mobile robots. |
| **CO3** | Derive and solve the equations of motion for robotic systems. |
| **CO4** | Apply mathematical models and algorithms to simulate and control robot dynamics. |
| **CO5** | Identify and address the challenges and limitations associated with robot dynamics. |

**Syllabus**

**UNIT-I** **[6 Hours]**

Static & Dynamic balancing in rotating mechanisms and reciprocating mechanism by vector diagram of various robotic parts.

**UNIT-II** **[7 Hours]**

Structure and Function of complete Robotics Work cell and its different components. Introduction to Cycle time and its importance. Methods to incorporate programming pendent. Understanding PLC and robot communication and HMI. Understanding the conveyor system and its communication with PLC.

**UNIT-III** **[8 Hours]**

Advanced material handling systems assisted by Industrial Robotics, automated guided vehicle systems, automated storage and retrieval systems (ASRS), bar code technology, radio frequency identification technology, Robot applications in various industries.

**UNIT-IV** **[8 Hours]**

Advanced Arc welding Industrial Robot, robotic peripheral equipment, servicing the robotic welding torch and wire feeding system, understanding of the robot and its control panel, safety knowledge, evaluations of weld cross-sections, inspection process and familiarity with tools

**UNIT-V** **[7 Hours]**

Advanced assembly robot- automatic assembly applications, Introduction to automation and flexible manufacturing System, Introduction to micro and nano robotics.

**Text Books:**


1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, "Industrial Robotics", Tata Mc Graw Hill, 2010.
2. Mittal R K, Nagrath I J, "Robotics and control", Tata McGraw Hill, 2010.


**Reference Books:**


1. Theory Saced B. Niku, "An Introduction to Robotics: Analysis, systems and applications", Pearson Education, 2009. 4.
2. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., "Robotics control, sensing, vision and intelligence", McGraw Hill Book co, 1987.
3. Mikell P. Groover, "Automation, Production systems and Computer Integrated Manufcturing", Prentice Hall India Pvt. Ltd., 2011 6. Richard D Klafter, and Michacl Negin, "Robotics Engineering", Prentice Hall, 2009.

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**SEMESTER: V (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: **Robot Dynamics** Subject Code: **BTechRAI-501P**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **2 Hrs/Week (Practical)** | **1** | **25** | **25** | **50** |

**Prerequisite(s):** Knowledge of Mechanisms.

**Course Objectives:**

| | |
|---|---|
| **1** | To have understanding about how to analyze the motions of mechanisms, design mechanisms to give desired motions. |
| **2** | To apply robot dynamics principles to design and control robotic systems. |

**Course Outcomes:**

**At the end of this course Student are able to:**

| | |
|---|---|
| **CO1** | To derive and solve the equations of motion for robotic systems. |
| **CO2** | To apply mathematical models and algorithms to simulate and control robot dynamics. |
| **CO3** | To design robotic systems considering dynamic constraints and requirements. |

**List of Practicals**

1. Robotic application spot welding, ABB or FANUC or KUKA
2. Robotic application Assembly ABB or FANUC or KUKA
3. Robotic application spray Painting ABB or FANUC or KUKA
4. Robotic application arc welding ABB or FANUC or KUKA
5. Robotic application material handling ABB or FANUC or KUKA
6. Robotic application Machine Tending, ABB or FANUC or KUKA
7. Robotic application using gripper as end effector
8. Robotic application using tool as end effector

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**SEMESTER: V (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: **Machine Learning** Subject Code: **BTechRAI-502T**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **3T + 1TU Hrs/week** | **04** | **30** | **70** | **100** |

**Aim:** To understand different machine learning algorithms

**Prerequisite(s):** Introductory courses on probability theory and linear algebra, Knowledge of basic programming languages such as Python and Matlab

**Course Objectives:**

| | |
|---|---|
| **1** | The objective of this course is to familiarize the students with different machine learning algorithms ranging basic linear classifier/regression modelling problems to non-linear classification problem using deep-neural network. |

**Course Outcomes:**

At the end of this course students will be able to:

| | |
|---|---|
| CO1 | Understand basics of Machine Learning Techniques. |
| CO2 | Understand different types of Regression Techniques. |
| CO3 | Be capable of applying classification techniques. |
| CO4 | Apply unsupervised machine learning techniques. |
| CO5 | Apply & evaluate the machine learning techniques to real world problems. |

**Syllabus**

**UNIT-I** **[08 Hours]**

Introduction to Machine Learning (ML); Feature engineering; Learning Paradigm, Generalization of hypothesis, VC Dimension, PAC learning, Applications of ML.

**UNIT- II** **[07 Hours]**

Data pre-processing: Dimensionally reduction, feature subset selection, Types of regression: Multiple linear regression, Polynomial regression model.

**UNIT- III** **[07 Hours]**

Logistic regression, K-nearest neighbour (KNN), Naive Bayes Decision trees, Support vector machine, Recommendation Systems: Content based and collaborative techniques.

**UNIT -IV** **[07 Hours]**

Clustering, K-means clustering, Apriori algorithm and association rule, anomaly detection algorithm, Hierarchial clustering, K-Medoids.

**UNIT – V** **[07 Hours]**

Introduction to Neural Networks: Modelling and applications to logic gates. Back-propagation learning algorithm: training and testing, Applications of Machine learning: Image recognition, speech recognition, Prediction recommendation: email spam and malware filtering, virtual personal assistant, online fraud detection.

**Textbooks:**


1. Machine Learning by Subramanian Chandramouli, Saikat Dutt, Amit Kumar Das
2. Introduction to Machine Learning by Dr. Nilesh Shelke, Dr. Narendra. V. Choudhary,
3. Dr. Gopal Sakarkar, Das Ganu Publications, ISBN-978-93-84336-63-9
4. Machine Learning by Tom Mitchell, Mc.Graw Publications


**Reference books:**


1. Python Machine Learning Dr Randal S. Olson
2. Christopher Bishop. Pattern Recognition and Machine Learning, SecondEdition
3. Ethem Alpaydin, Introduction to Machine Learning, Second Edition
4. T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2008

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**SEMESTER: V (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: **Machine Learning Lab** Subject Code: **BTechRAI-502P**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **2 Hrs/Week (Practical)** | **1** | **25** | **25** | **50** |

**Aim:** To familiarize the students with different machine learning algorithms ranging basic linear classifier/regression modelling problems to non-linear classification problem using deep-neural network.

**Course Objectives:**

| | |
|---|---|
| **1** | Getting familiarize with one of the most popular programming language in the field of deep-learning i.e., Python |
| **2** | Visualization of regression and classification problems with data. |
| **3** | To know Feature extraction and feature reduction |
| **4.** | To Understand of how machine mimics human brain with simple examples. |

**Course Outcomes:**

**At the end of this course students will be able to:**

| | |
|---|---|
| CO1 | Understand basics of Machine Learning Techniques. |
| CO2 | Understand different types of Regression Techniques. |
| CO3 | Be capable of applying classification techniques. |
| CO4 | Apply unsupervised machine learning techniques. |
| CO5 | Apply & evaluate the machine learning techniques to real world problems. |

**List of Practicals:**

1. Introduction to Python/Matlab and their various modules. Python libraries: Tensorflow, Anaconda
2. Implement Decision Tree learning
3. Implement Logistic Regression
4. Implement classification using Multilayer perceptron
5. Implement classification using SVM
6. Implementations of logic gates (AND/OR/NOR/XOR) using perceptron-based methods
7. Implement K-means Clustering to Find Natural Patterns in Data
8. Implement Hierarchical clustering
9. Implement K-mode clustering
10. Evaluating ML algorithm with balanced and unbalanced datasets

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**SEMESTER: V (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: **Robotic Drive System** Subject Code: **BTechRAI-503T**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **3T Hrs** | **3** | **30** | **70** | **100** |

**Aim:** To understand the fundamentals of Electrical transmission and distribution systems

**Prerequisite(s):** Basic Electrical Engineering.

**Course Objectives:**

| | |
|---|---|
| **1** | To study about basic electrical prime movers, electrical transmission and distribution systems and the transformers |
| **2** | To understand induction motors and power system. |

**Course Outcome**

At the end of this course students will be able to:

| | |
|---|---|
| **CO1** | Understand the principles of operations and characteristics of DC machines, |
| **CO2** | Have the knowledge of electrical transformers and induction motors. |
| **CO3** | Visualize the operation of synchronous motors stepper and servo motors |
| **CO4** | Understand power transmission and distribution. |

**Syllabus**

**UNIT-I DC Machines** **[08 Hrs.]**

Constructional details – EMF equation – methods of excitation – self and separately excited generators – characteristics of series, and shunt generators – principle of operation of D.C. Motor – back emf and torque equation – characteristics of series and shunt motors - starting of D.C. Motors – types of starters - speed control and braking of DC. motors.

**UNIT-II Transformers** **[08 Hrs.]**

Constructional Details – Principle Of Operation – EMF Equation – Transformation Ratio – Transformer on No Load – Parameters Referred To HV/LV Windings – Equivalent Circuit – Transformer on Load – Regulation - Testing – Load Test - 3- PHASE Transformers connections.

**UNIT-III Induction Motors** **[07Hrs.]**

Construction – types – principle of operation of three-phase induction motors – equivalent circuit – starting and speed control – single-phase induction motors (only qualitative analysis).

**UNIT-IV Synchronous and Special Machines** **[07 Hrs.]**

Construction of Synchronous machines-types – induced emf – brushless alternators – reluctance motor – stepper motor servo motor

**UNIT-V Introduction to Power System** **[06 Hrs.]**

Structure of electric power systems – generation, transmission, sub-transmission and distribution systems - EHVAC and EHVDC transmission systems – substation layout. (Concepts only)

**TEXT BOOKS:**


1. Murugesh Kumar K., "Electric Machines Vo I", Vikas Publishing House Pvt Ltd, 2010.
2. Murugesh Kumar K., "Electric Machines Vol II", Vikas Publishing House Pvt Ltd, 2010
3. Mehta V.K. and Rohit Mehta, "Principles of Power System", S.Chand and Company Ltd, 2003


**REFERENCE BOOKS:**


1. Fitzgerald A.E., Charles Kingsley, Stephen.D.Umans, "Electric Machinery", Tata McGraw Hill publishing Company Ltd, 2003.
2. Gupta J.B., "Theory and Performance of Electrical Machines", S.K.Kataria and Sons, 2002
3. Kothari D.P. and Nagrath I.J., "Electric Machines", Tata McGraw Hill Publishing Company Ltd, 2002.
4. Bhimbhra P.S. , "Electrical Machinery", Khanna Publishers, 2003.

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**SEMESTER: V (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: **Design and Analysis of Algorithms** Subject Code: **BTechRAI-504T**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **3T Hrs** | **3** | **30** | **70** | **100** |

**Aim:** To understand the fundamentals of algorithmic problem solving.

**Prerequisite(s):** Data Structures, C programming, Mathematics

**Course Objectives:**

| | |
|---|---|
| **1** | Students should learn techniques for effective problem solving in computing. |
| **2** | Students should analyze different paradigms of problem solving to solve a given problem in efficient way. |

**Course Outcomes:**

At the end of this course students are able to:

| | |
|---|---|
| **CO1** | Understand mathematical formulation, complexity analysis and methodologies to solve the recurrence relations for algorithms. |
| **CO2** | Design Greedy and Divide and Conquer algorithms and their usage in real life examples. |
| **CO3** | Design Dynamic programming and Backtracking Paradigms to solve the real life problems. |
| **CO4** | Assess the limitations of algorithmic power and reframe methodologies to cope with them. |
| **CO5** | Understand NP class problems and formulate solutions using standard approaches. |

**Syllabus**

**UNIT I** **[7 Hours]**

Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem

Types – Fundamentals of the Analysis of Algorithm Efficiency – Analysis Framework – Asymptotic Notations and its properties – Mathematical analysis for Recursive and Non recursive algorithms.

**UNIT II** **[6 Hours]**

Divide and Conquer- basic strategy, Binary Search, Quick sort, Merge sort, Strassen's matrix multiplication, Maximum sub-array problem, Closest pair of points problem, Convex hull problem.

**UNIT III** **[8 Hours]**

Dynamic Programming and Greedy method – basic strategy, Bellmen ford algorithm, all pairs shortest path, multistage graphs, optimal binary search trees, traveling salesman problem, String Editing, Longest Common Subsequence problem and its variations.

Fractional knapsack problem, Minimum cost spanning trees, Huffman Coding , activity selection problem ,Find maximum sum possible equal to sum of three stacks, K Centers Problem.

**UNIT IV** **[8 Hours]**

Basic Traversal and Search Techniques, breadth first search and depth first search, connected components. Backtracking basic strategy, 8-Queen's problem, graph coloring, Hamiltonian cycles, sum of subset problem, Introduction to Approximation algorithm.

**UNIT V** **[7 Hours]**

NP-hard and NP-complete problems, basic concepts, non-deterministic algorithms, NP-hard and NP complete, decision and optimization problems, polynomial reduction, graph based problems on NP Principle, vertex cover problem, clique cover problem

**Text Books**


1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.
2. Thomas H. Cormen et.al; "Introduction to Algorithms"; 3 Edition; Prentice Hall, 2009.
3. Horowitz, Sahani and Rajasekaram; "Computer Algorithms", Silicon Press, 2008.
4. Brassard and Bratley; "Fundamentals of Algorithms", 1 Edition; Prentice Hall, 1995. 4. Richard Johnsonbaugh, "Algorithms", Pearson Publication, 2003.


**Reference Books**


1. Parag Himanshu Dave, Balchandra Dave, "Design and Analysis of Algorithms" Pearson Education, O'relly publication
2. Richard Johnsonbaugh, "Algorithms", Pearson Publication, 2003.

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**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**

**SEMESTER: V (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject : **Design and Analysis of Algorithms Lab** Subject Code : **BTechRAI-504P**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **2 Hrs/Week (Practical)** | **1** | 25 | 25 | 50 |

**Aim:** To introduce basic mathematical techniques for algorithm analysis and design.

**Prerequisite(s):** Computer Programming Language knowledge

**Course Objectives:**

| | |
|---|---|
| 1 | Analyze the performance of algorithms. |
| 2 | Demonstrate a familiarity with major algorithms and data structures.. |
| 3 | Apply important algorithmic design paradigms and methods of analysis. |

**Course Outcomes:**

**At the end of this course students will be able to:**

| | |
|---|---|
| **CO1** | Analyze greedy paradigm and implement greedy algorithms. |
| **CO2** | Analyze divide-and-conquer paradigm and synthesize divide-and-conquer algorithms. |
| **CO3** | Implement algorithms using Dynamic Approach and analyze it to determine its computational complexity. |
| **CO4** | Apply backtracking paradigm to realize real world problems. |

**Practical List: (Programs Based on following topics)**

1. Programming of linear and linked data structures – Arrays, Stacks, Queues, Linked List
2. Implementations of various searching/sorting algorithms- Quick sort, Merge sort, Heaps Priority queues, Heap sort, linear time sorting; Linear Serach, Binary search trees etc.
3. Implementations of divide and conquer approaches on several algorithms.
4. of several Dynamic Programming (DP) based algorithms
5. Implementation of various trees algorithms: Traversals, insertions, deletion, Search Trees
6. Implementation of various graph algorithms: Traversals, insertions, deletion, Search Trees, Minimum spinning tress etc.
7. Implementation of Various Greedy algorithms

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**SEMESTER: V (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: **Field and Service Robotics(Elective – I)**Subject Code: **BTechRAI-505.1T**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **3T Hrs** | **3** | **30** | **70** | **100** |

**Aim:** To study the various parts of robots and fields of robotics

**Prerequisite(s):** Principles of robotics

**Course Objectives:**

| | |
|---|---|
| **1** | To study the various parts of robots and fields of robotics |
| **2** | To study the control of robots for some specific applications |

**Course Outcomes:**

At the end of this course students are able to:

| | |
|---|---|
| **CO1** | Understand the various parts of robots and fields of robotic |
| **CO2** | Understand the various kinematics and inverse kinematics of robots |
| **CO3** | Analyze about the localization, planning and navigation |
| **CO4** | To understand the control of robots for some specific applications. |
| **CO5** | Access the designing about the humanoid robots, |

**Syllabus**

**UNIT-I INTRODUCTION** **[08 Hrs.]**

History of service robotics – Present status and future trends – Need for service robots applications examples and Specifications of service and field Robots. Non conventional Industrial robots.

**UNIT-II LOCALIZATION** **[07 Hrs. ]**

Introduction-Challenges of Localization- Map Representation- Probabilistic Map based LocalizationMonte carlo localization- Landmark based navigation-Globally unique localization- Positioning beacon systems- Route based localization.

**UNIT-III PLANNING AND NAVIGATION** **[07Hrs.]**

Introduction-Path planning overview- Road map path planning- Cell decomposition path planningPotential field path planning-Obstacle avoidance - Case studies: tiered robot architectures.

**UNIT-IV FIELD ROBOTS** **[06 Hrs.]**

Ariel robots- Collision avoidance-Robots for agriculture, mining, exploration, underwater, civilian and military applications, nuclear applications, Space applications.

**UNIT-V HUMANOIDS:** **[08 Hrs.]**

Wheeled and legged, Legged locomotion and balance, Arm movement, Gaze and auditory orientation control, Facial expression, Hands and manipulation, Sound and speech generation, Motion capture/Learning from demonstration, Human activity recognition using vision, touch, sound, Vision, Tactile Sensing, Models of emotion and motivation. Performance, Interaction, Safety and robustness, Applications, Case studies.

**TEXT BOOKS:**


1. Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, „Introduction to Autonomous Mobile Robots", Bradford Company Scituate, USA, 2004
2. Riadh Siaer, „The future of Humanoid Robots- Research and applications", Intech Publications, 2012.


**REFERENCE BOOKS:**


1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.
2. Kelly, Alonzo; Iagnemma, Karl; Howard, Andrew, "Field and Service Robotics ", Springer, 2011

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**SEMESTER: V (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: **Theory of Computation (Elective I)** Subject Code: **BTechRAI-505.2T**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **3T Hrs** | **3** | **30** | **70** | **100** |

**Aim:** To study the basic concepts in the theory of computation

**Prerequisite(s):** Knowledge of discrete mathematics, data structure and Algorithm

**Course Objectives:**

| | |
|---|---|
| **1** | To provide students an understanding of basic concepts in the theory of computation. |
| **2** | To teach formal languages and various models of computation. |
| **3** | To exhibit fundamental concepts related with computability theory. |

**Course Outcomes:**

At the end of this course students will be able to:

| | |
|---|---|
| **CO1** | Describe the formal relationships among machines, languages and grammars.. |
| **CO2** | Design and Optimize finite automata for given regular language |
| **CO3** | Design Push Down Automata, Turing Machine for given languages. |
| **CO4** | Demonstrate use of computability, decidability, recursive function theory through Problem solving. |

**Syllabus**

**UNIT I** **[07 Hrs]**

Basics of Sets and Relation, Countability and Diagonalisation, Principle of mathematical induction,Pigeon- hole principle. Fundamentals of formal languages and grammars, Chomsky hierarchy of languages.

**UNIT II** **[07 Hrs]**

Finite automata: Deterministic finite automata (DFA), Nondeterministic finite automata (NFA) and equivalence with DFA, Minimization of finite automata, NFA with Epsilon Transitions, Finite Automatawithoutput.

**UNIT III** **[08 Hrs]**

Regular expressions and Regular languages, Regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, Context-free grammars (CFG) and language(CFL), parse trees, ambiguity in CFG, Reduction of CFGs, Chomsky and Greibach normal forms.

**UNIT IV** **[06 Hrs]**

Push Down Automata: Deterministic pushdown automata and Non-Deterministic pushdown automata, Acceptance by two methods: Empty stack and Final State, Equivalence of PDA with CFG ,closure properties of CFLs.

**UNIT V** **[08 Hrs]**

Turing machines: The basic model for Turing machines (TM), Turing recognizable recursively enumerable) and Turing-decidable (recursive) languages, variants of Turing machines, Undecidability: Church-Turing thesis, Universal Turing machine, Undecidable problems about languages ,Recursive Function Theory.

**Text Books**

John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.

**Reference Books**


1. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson EducationAsia.
2. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.
3. Michael Sipser, Introduction to the Theory of Computation, PWSPublishing.
4. John Martin, Introduction to Languages and The Theoryof Computation, Tata McGraw Hill

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**SEMESTER: V (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: **Wireless Communication Technologies (Elective I)** Subject Code: **BTechRAI-505.3T**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **3T Hrs** | **3** | **30** | **70** | **100** |

**Aim:** To study the basic concepts of wireless communications

**Prerequisite(s):** Digital Communication Systems , Networking and Protocols

**Course Objective:**

| | |
|---|---|
| 1 | To understand the basic concepts in cellular communication |
| 2 | To understand the characteristics of wireless channels. |
| 3 | To know the Impact of digital modulation techniques in fading |
| 4 | To get exposed to diversity techniques in wireless communication. |
| 5 | To acquire knowledge in multicarrier systems |

**Course Outcome:**

At the end of this course students will be able to:

| | |
|---|---|
| CO1 | To be able to design solutions for cellular communication |
| CO2 | To be able to compute the capacity of wireless channels |
| CO3 | To be able to analyze the performance of the digital modulation techniques in fading channels. |
| CO4 | To apply various diversity techniques in wireless communication. |
| CO5 | To design multicarrier systems in wireless communication |

**Syllabus:**

**Unit 1: Functional Grammar:**

Common errors, Transformation of Sentences- Change the Voice, Change the Narration, Simple, Compound Complex sentences, Use of Phrases, Idioms & Proverbs.

**Unit II. English for Competitive Exams & Interview Techniques:**

Word building, English words /phrases derived from other languages, Prefixes and Suffixes, Synonyms/Antonyms, Technical Jargons, Verbal Analogies, Give one word for, Types & Techniques of Interview.

**Unit III. Formal Correspondence**

Business Letters, (Enquiry, Quotation, Order, Complaint), Job applications and Resume

Writing, e-mail etiquette, Writing Memorandum, Circulars, notices, Analytical comprehension

**Unit IV. Technical & Scientific Writing:**

Features of Technical Writing, Technical Report writing (Accident, Feasibility, Trouble,

Progress), Writing Scientific Projects, Writing Manuals, Writing Project Proposals, Writing Research papers.

**Text and Reference Books:**


1. Effective technical Communication by Barun K. Mitra, Oxford University Press.
2. Technical Communication-Principles and Practice by Meenakshi Raman & Sharma, Oxford University Press, 2011
3. Functional English for Technical Students by Dr. Pratibha Mahato and Dr. Dora Thompson, Himalaya Publishing House.
4. How to Prepare a Research Proposal: Guidelines for Funding and Dissertations in the Social and Behavioral Sciences by Krathwohl & R David.
5. Technical Writing- Process and Product by Sharon J. Gerson & Steven M. Gerson, 3rd edition, Pearson Education Asia, 2000
6. Developing Communication skills by Krishna Mohan & Meera Banerjee

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**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**

**SEMESTER: VI (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: **Deep Learning** Subject Code: **BTechRAI-601T**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **3T Hrs/week** | **03** | **30** | **70** | **100** |

**Prerequisite(s): Artificial Intelligence Course Objectives:**

| | |
|---|---|
| 1. | To understand the mathematical, statistical and computational challenges of building stable representations for high-dimensional data, such as images, text and data. |
| 2. | To apply Deep Learning Techniques to various engineering and social applications. |

**Course Outcomes:**

**At the end of this course students will be able to:**

| | |
|---|---|
| 1. | Understand the fundamentals of Deep Learning. |
| 2. | Gain knowledge of the different modalities of Deep Learning currently used. |
| 3. | Gain knowledge about state-of the art models and other important works in recent years. |
| 4. | Learn the skills to develop Deep Learning based AI systems. (use of multiple packages etc.) |
| 5. | Develop applications of deep learning for Data Science. |

| | |
|---|---|
| **UNIT I CELLULAR CONCEPTS**<br>Frequency Reuse – Channel Assignment Strategies – Hand off Strategies – Interference and system capacity- Co-Channel Interference- Adjacent Channel Interference – Trunking and Grade of service – Improving coverage & capacity in cellular systems-Cell Splitting- Sectoring- Repeaters for Range Extension-Microcell Zone Concept. | **[08 Hours]** |
| **UNIT II THE WIRELESS CHANNEL**<br>Overview of wireless systems – Physical modeling for wireless channels – Time and Frequency coherence – Statistical channel models – Capacity of wireless Channel- Capacity of Flat Fading Channel – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver –Capacity comparisons – Capacity of Frequency Selective Fading channels. | **[07 Hours]** |
| **UNIT III PERFORMANCE OF DIGITAL MODULATION OVER WIRELESS CHANNELS**<br>Performance of flat fading and frequency selective fading – Impact on digital modulation techniques — Outage Probability– Average Probability of Error — Combined Outage and Average Error Probability – Doppler Spread – Inter symbol Interference | **[07 Hours]** |
| **UNIT IV DIVERSITY TECHNIQUES**<br>Realization of Independent Fading Paths – Receiver Diversity – Selection Combing – Threshold Combing – Maximal-Ratio Combing – Equal - Gain Combing – Capacity with Receiver diversity – Transmitter Diversity – Channel known at Transmitter – Channel unknown at Transmitter – The Alamouti Scheme– Transmit & Receive Diversity- MIMO Systems. | **[07 Hours]** |
| **UNIT V MULTICARRIER MODULATION**<br>Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Sub channels – Mitigation of Subcarrier Fading – Discrete Implementation of Multicarrier Modulation – Peak to average Power Ratio- Frequency and Timing offset. | **[07 Hours]** |
| **Text Books:**<br>Theodore.S. Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, India, 2009.<br>Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.<br>David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Wiley Series in Telecommunications, Cambridge University Press, 2005. | |
| **References:**<br>Keith Q. T. Zhang, "Wireless Communications: Principles, Theory and Methodology" John Wiley & Sons, 1st Edition, 2016.<br>Ramjee Prasad, "OFDM for Wireless Communication Systems", Artech House,2004. | |

**RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR**

**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**

**SEMESTER: V (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: **Drone and Automation system (Elective I)** Subject Code: **BTechRAI-505.4T**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **3T Hrs** | **3** | **30** | **70** | **100** |

**Prerequisite(s):**

**Course Objective:**

| | |
|---|---|
| 1 | To understand the features of UAV, design elements, electronics involved in UAV and navigation |

**Course Outcome:**

At the end of this course students will be able to:

| | |
|---|---|
| CO1 | To understand the various types and characteristics of UAV with various materials, sensors and balancing techniques used along with application. |

**Syllabus**

**UNIT-I** **[07 HRS]**

Introduction to drones and their applications: - Definition of drones, history of drones, India and drones, tinkering and drones. Key features of drone regulations:- Structural classification of drones: - fixed wing structure, lighter than air systems, rotary wings aircraft, and applications of drones.

**Unit-II** **[07 HRS]**

Components of drones:-classifications of drone structures and their suitability, applications and uses of drone frame materials, classifications and applicability of propeller motors, drone propeller materials, design parameters for propellers, composition and structuring of electronic speed controller, flight control board, characteristics of FCB and their structure

**UNIT III** **[06 hrs]**

INTRODUCTION TO UAV ELECTRONICS- Introduction of Battery, Description of Li-Po Battery, Charging / Discharging of Battery. Back up, Ratings, Shelf Life, Maintenance and safety of Battery. Selection criteria of Battery for Drone application, Motors, Sensors, Radio Control System, Connections and Interfaces of Devices in Drone

**UNIT IV** **[08hrs]**

Introduction and scope of metrology in drone technology:- basic concepts of metrology, classifications of measurements, need of measurements in drone technology, types of measuring instruments, their accuracy and precision parameters. Special purpose drone sensors:-need and application of distance sensors, brief introduction to light-pulse distance sensing (laser), radio detection and ranging, sonarpulse distance sensing (ultrasonic), time of flight (TOF) sensors, thermal and chemical sensors.

**UNIT V** **[08hrs]**

Drone Mechanics:-concepts of engineering mechanics, definition of mechanics, statics, dynamics, applications of engineering mechanics in practical fields. Free body diagrams types of loads, Principles and concept of moments and its applications, Methods for finding resultant of a force system, equilibrium of coplanar force systems. Center of gravity:-concepts, definition of centroid of plane figures and centre of gravity of symmetrical solid bodies, determination of centroid of plane and composite lamina using first principle, centroid of areas with removed portions .CG of solid bodies like cone, cylinder, hemisphere and sphere, bodies with removed portions. Force analysis in drones: - force analysis in drones, forces and force systems during drone operations, aerodynamics of drones-dynamics of aerial systems, forces of flight, principle axes and rotation of aerial systems. Stability and control of drones:-stability and control of drones, force balancing of rotating masses.

**TEXT BOOKS:**

Syed Omar FarukTowaha, Building Smart Drones with ESP8266 and Arduino: Build exciting drones by leveraging the capabilities of Arduino and ESP8266, Packt Publishing, 2018.

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**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**

**SEMESTER: V (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: **Effective Technical Communication** Subject Code: **BTechRAI-506T**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **2 Hrs/Week** | **2** | 15 | 35 | 50 |

**Course Objective:**

| | |
|---|---|
| 1. | At the end of the semester, students will have enough confidence to face competitive examinations (IELTES/ TOEFL/CAT/ MAT/ XAT/ SNAP/ GMAT/GATE etc.) to pursue masters degree. They will also acquire language skills required to write their Reviews/Projects/Reports. They will be able to organize their thoughts in English and hence face job interviews more confidently. |

**Course Outcome: By the end of the course, students will be able to**

| | |
|---|---|
| CO1 | Acquire knowledge of structure of language. |
| CO2 | Be able to face competitive exams and the interview process and can become employable |
| CO3 | Develop business writing skills |
| CO4 | Become familiar with technology enabled communication and can develop technical and scientific writing skills. |

**Syllabus:**

| | |
|---|---|
| **UNIT I:**<br>Issues and challenges in machine learning, difference between machine learning and deep learning, understanding biological neuron and artificial neuron, types of activation functions, architecture of neural network, learning process in ANN. | **[06 Hours]** |
| **Unit II:**<br>McCulloch Pitts Neuron, thresholding logic, perceptron, perceptron learning algorithm, multilayer perceptron (MLPs), representation power of MLPs, sigmoid neurons, gradient descent. | **[07 Hours]** |
| **Unit III:**<br>Feedforward Neural Networks, Back propagation Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMS Prop, Adam, Weighted initialization in neural network, Eigen values and Eigen vectors. | **[08 Hours]** |
| **UNIT IV**<br>Basic concept of Computer Vision: Image formation, image representation, linear filtering, Image in frequency domain, Image sampling, image processing and feature extraction, correlation, convolution, edge detection: canny edge detector | **[07 Hours]** |
| **UNIT V**<br>Convolutional Neural Networks: Popular CNN architecture, LeNet, Alex Net, ZF-Net, VGGNet, Google Net object detection. Introduction to Recurrent Neural Network (RNN), advantages, disadvantages and its application. | **[08 Hours]** |

**Text books:**

1. Deep Learning by Amit Kumar Das first edition 2021 Pearson education.
2. Deep Learning, an MIT press book, Ian goodfellow and yoshua Bengio and aaron cournville http://www.deeplearningbook.org
3. Daniel Jurafsky, James H. Martin "Speech and language processing: An introduction to natuarral language processimg, computatonal linguistics and spech recognition, 2/e, prentice hall,2008

**Reference books:**

1. Multiple view geometry in computer vision by Richard HEartley and Andrew Zisserman.
2. Deep learning by Ian Goodfellow and Yoshua bengio and Aaron Courville http ://www. deeplearningbook.org/ computer vision, a modern approach by Fosyth and Ponce.

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**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**

**SEMESTER: VI (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: **Deep Learning Lab** Subject Code: **BTechRAI-601P**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **2 Hrs/Week (Practical)** | **1** | 25 | 25 | 50 |

**Prerequisite(s):** Advanced Python and Basic understanding of machine learning concepts.

**Course Objectives:**

| | |
|---|---|
| 1. | To understand dataset and pre-processing to build neural network models |
| 2. | To identify the problems, choose relevant deep learning algorithms and analyze the results for respective applications. |

**Course Outcomes:**

At the end of this course students are able to:

| | |
|---|---|
| CO1 | Understand the fundamentals of Deep Learning. |
| CO2 | Gain knowledge of the different modalities of Deep Learning currently used. |
| CO3 | Choose appropriate data preprocessing techniques to build neural network models. |
| CO4 | Build neural network models using deep learning algorithms-CNN and RNN to solve real world problems. |

**Name of Experiments / Case Studies**

1. To study various type of activation functions.
2. To perform and implement perceptron model.
3. To perform and implement Multilayer Perceptron.
4. To perform and implement Feedforward Neural Network for diabetic datasets.
5. To perform and implement Back propagation Neural Network.
6. To perform and implement Convolution Neural Network for Diabetic datasets.
7. To write a program in Python to generate edge features for any same image:
8. To perform and implement RNN.
9. To build a model for any image classification e.x. Covid-19 or CT Scan Image classification.
10. Implementation and analysis by any Deep Neural network algorithm for Character recognition.

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**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**

**SEMESTER: VI (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: **Automation System Design** Subject Code: **BTechRAI-602T**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **3T Hrs/week** | **03** | **30** | **70** | **100** |

**Prerequisite(s):**

**Course Objectives:**

| | |
|---|---|
| 1. | This course is designed to know about the basic concepts in industrial automation |
| 2. | To know about transfer lines and automated assembly, be exposed to pneumatic, electric, hydraulic and electronic systems in automation of mechanical operations |

**Course Outcomes:**

At the end of this course students will be able to:

| | |
|---|---|
| 1. | To apply knowledge of industrial automation by transfer lines and automated assembly lines. |
| 2. | To design an automated system |
| 3. | To understand automated controls using pneumatic and hydraulic systems |
| 4. | To understand the electronic control systems in metal machining and other manufacturing processes |
| 5. | To understand advancement in hydraulics and pneumatics systems. |

**Syllabus:**

**UNIT-I FUNDAMENTAL CONCEPTS OF INDUSTRIAL AUTOMATION [07 Hrs.]**

Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation.

**UNIT-II TRANSFER LINES AND AUTOMATED ASSEMBLY [08 Hrs.]**

General terminology and analysis, analysis of transfer lines without storage, partial automation. Automated flow lines with storage buffers. Automated assembly-design for automated assembly, types of automated assembly systems, part feeding devices, analysis of multi-station assembly machines. AS/RS, RFID system, AGVs, modular fixturing. Flow line balancing.

**UNIT-III DESIGN OF MECHATRONIC SYSTEMS [06 Hrs.]**

Stages in design, traditional and mechatronic design, possible design solutions. Case studies-pick and place robot, engine management system.

**UNIT-IV PROGRAMMABLE AUTOMATION [08 Hrs.]**

Special design features of CNC systems and features for lathes and machining centers. Drive system for CNC machine tools. Introduction to CIM; condition monitoring of manufacturing systems.:

**UNIT-V DESIGN FOR HIGH SPEED AUTOMATIC ASSEMBLY [07 Hrs.]**

Introduction, Design of parts for high speed feeding and orienting, high speed automatic insertion. Analysis of an assembly. General rules for product design for automation.

**TEXT BOOKS:**


1. Mikell P Groover, "Automation Production Systems and Computer- Integrated Manufacturing Pearson Education, New Delhi, 2001.
2. Bolton W, "Mechatronics", Pearson Education, 1999.


**REFERENCE BOOKS:**


1. Mikell P Groover, "Industrial Robots – Technology Programmes and Applications" , McGraw Hill , New York, USA. 2000.
2. Steve F Krar, "Computer Numerical Control Simplified", Industrial Press, 2001.
3. Boothroyd, Peter Dewhurst and Winston A. Knight, "Product Design for manufacture and Assembly", CRC Press, 2011

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**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**

**SEMESTER: VI (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: **Automation System Design Lab** Subject Code: **BTechRAI-602P**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **2 Hrs/Week (Practical)** | 1 | 25 | 25 | 50 |

**Prerequisite(s):**

**Course Objectives:**

| | |
|---|---|
| 1. | This course is designed to know about the basic concepts in industrial automation |
| 2. | To know about transfer lines and automated assembly, be exposed to pneumatic, electric, hydraulic and electronic systems in automation of mechanical operations |

**Course Outcomes:**

At the end of this course students will be able to:

| | |
|---|---|
| CO1 | To apply knowledge of industrial automation by transfer lines and automated assembly lines. |
| CO2 | To design an automated system |
| CO3 | To understand automated controls using pneumatic and hydraulic systems |
| CO4 | To understand the electronic control systems in metal machining and other manufacturing processes |

**LIST OF PRACTICALS:**

1. Co-ordinated motion of multiple pneumatic actuators in a desired sequence using Cascade method
2. Integration of fringe condition modules in multiple actuator pneumatic systems
3. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using hard – wire programmed control systems
4. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using PLC.
5. Interfacing of an LVDT with a PC for monitoring the displacement of machine slide and raising an alarm if the displacement exceeds specified limit.
6. Inspection using Machine vision System
7. Control of speed, direction and number of revolutions of a stepper motor using PC.
8. Development of an obstacle avoidance robot using servo motors, ultrasonic and touch sensors.

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**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**

**SEMESTER: VI (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: **Internet of Things and its Application** Subject Code: **BTechRAI-603T**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **3T Hrs/week** | **03** | **30** | **70** | **100** |

**Prerequisite(s):**

**Course Objectives:**

| | |
|---|---|
| 1 | To understand the concepts of Internet of Things to build IoT application |

**Course Outcomes:**

At the end of this course students will be able to:

| | |
|---|---|
| CO1 | Understand the concepts of Internet of Things. |
| CO2 | Understand the concept of AI for IoT. |
| CO3 | Analyze IoT protocols for sensor network. |
| CO4 | Analyze IoT application using Arduino and Raspberry Programming |
| CO5 | Design IoT Application in different domain and analyze its performance. |

| | |
|---|---|
| **UNITI:**<br>**Introduction to IoT:**<br>Defining IoT, the characteristics of IoT, Physical Design of IoT, Logical Design of IoT, Functional blocks of IoT and Communication Models and APIs sensing actuation, IoT tools | **[07 Hours]** |
| **UNIT II:**<br>**Aritificial Intelligence for IoT:**<br>Machine to machine communication, IoT reference model, verticals, big data and IoT, introduction to tensorflow and keras | **[07Hours]** |
| **UNIT III:**<br>**Aspects of Communication using IoT protocols:**<br>WSN protocol, SCADA and RFID, 6low, COAP protocol, Sensor deployment and Node discovery, Data aggregation and dissemination | **[07Hours]** |
| **UNIT IV:**<br>Interoprattibility in IoT, introduction to Arduino programming: Part I, Part II, intergration of sensors and actuators with Arduino, introduction to Raspberrypi, implementation of IoT with Raspberrypi, introduction to SDN for IoT. | **[08Hours]** |
| **UNIT V:**<br>**Domain specific IoT applications:**<br>AI for industrial IoT, AI for smart cities IoT, Home automation, Surveillance applications, Other IoT applications, Sensor based application through embedded system. | **[07Hours]** |

**Textbooks:**


1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach" Waltenegus Dargie,
2. Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice".
3. Amita Kapoor,"Hands on Artificial Intelligence for IoT".
4. Beginning C for Arduino, 2nd Edition, Jack Purdum.
5. Programming Auduino: Gettting started with sketch, Simon Monk, 2nd Edition.


**Reference books:**


1. Introduction to IoT, by Sudip Misra 1st Edition 2020. Cambridge University press.
2. IoT Architecture, Implementation and Security, 1st Edition Mayur Ramgir, Pearson Publication.

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**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**

**SEMESTER: VI (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: **Internet of Things and its Application Lab** Subject Code: **BTechRAI-603P**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **2 Hrs/Week (Practical)** | **1** | 25 | 25 | 50 |

**Prerequisite(s):**

| Sr. No. | Practical List |
|---|---|
| 1 | To study Arduino Uno IoT Kit with ATMega 328 Microcontroller |
| 2 | Design a sketch for running of LEDs |
| 3 | Design a sketch to monitor state of switch by establishing serial communication between Arduino and computer |
| 4 | Design a sketch to read analog value of potentiometer by establishing serial communication between arduino and computer. |
| 5 | Design a sketch for blinking LEDs without using delay. |
| 6 | Design a sketch to develop switch based binary LED counter. Also observe output on serial monitor. |
| 7 | Design a sketch to create a simple digital clock using LCD display. |
| 8 | Design a sketch to make use of EEPROM to control devices (LED). |
| 9 | To log data of temperature sensor over internet and analysis it. |
| 10 | Advance Practical: Study and setup of ESP -32 board |
| 11 | Interfacing Raspberry Pi with RFID. |
| 12 | Controlling Raspberry Pi with WhatsApp |
| 13 | Setting up Wireless Access Point using Raspberry Pi |
| 14 | Fingerprint Sensor interfacing with Raspberry Pi |
| 15 | Raspberry Pi GPS Module Interfacing |
| 16 | IoT based Web Controlled Home Automation using Raspberry Pi |
| 17 | Visitor Monitoring with Raspberry Pi and Pi Camera |

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**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**

**SEMESTER: VI (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

**Subject: : Compiler Design (Elective II)** Subject Code: **BTechRAI-604.1T**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **3T Hrs/week** | **03** | **30** | **70** | **100** |

**Prerequisite(s):** Basic course on Theory of Computation

**Course Objectives:**

| | |
|---|---|
| 1 | To design the front end of the compiler, scanner, parser, intermediate code generator, object code generator, and the parallel compilation strategies. |
| 2 | To gain the ability to implement a parser without using any other compiler-generation tools. |

**Course Outcomes:**

At the end of this course students will be able to:

| | |
|---|---|
| CO1 | Demonstrate the different phases of compiler using various programming language. |
| CO2 | Construct a lexical analyzer using Deterministic Finite Automata and Non-Deterministic Finite Automata. |
| CO3 | Implement the parser for a given Context Free Grammar using various parsing method |
| CO4 | Implement the Intermediate code generation techniques and runtime environment. |
| CO5 | Analyze the code generation techniques. |

**Syllabus**

**UNIT I INTRODUCTION TO COMPILERS [07 Hours]**

Translators - Compilation and Interpretation - Language processors - The Phases of Compiler - Errors Encountered in Different Phases - The Grouping of Phases - Compiler Construction Tools - Programming Language basics.

**UNIT II LEXICAL ANALYSIS [07 Hours]**

Need and Role of Lexical Analyzer - Lexical Errors - Expressing Tokens by Regular Expressions - Converting Regular Expression to DFA - Minimization of DFA - Language for Specifying Lexical Analyzers – LEX - Design of Lexical Analyzer for a sample Language.

**UNIT III SYNTAX ANALYSIS [08 Hours]**

Need and Role of the Parser - Context Free Grammars - Top Down Parsing - General Strategies - Recursive Descent Parser - Predictive Parser - LL(1) Parser - Shift Reduce Parser - LR Parser - LR (0)Item Construction of SLR Parsing Table - Introduction to LALR Parser - Error Handling and Recovery in Syntax Analyzer – YACC - Design of a syntax Analyzer for a Sample Language .

**UNIT IV SYNTAX DIRECTED TRANSLATION & RUN TIME ENVIRONMENT [08 Hours]**

Syntax directed Definitions - Construction of Syntax Tree - Bottom-up Evaluation of SAttribute Definitions - Design of predictive translator - Type Systems - Specification of a simple type checker - Equivalence of Type Expressions - Type Conversions. RUN-TIME ENVIRONMENT: Source Language Issues - Storage Organization - Storage Allocation - Parameter Passing - Symbol Tables - Dynamic Storage Allocation - Storage Allocation in FORTAN.

**UNIT V CODE OPTIMIZATION AND CODE GENERATION [06 Hours]**

Principal Sources of Optimization – DAG - Optimization of Basic Blocks - Global Data Flow Analysis - Efficient Data Flow Algorithms - Issues in Design of a Code Generator - A Simple Code Generator Algorithm.

**TEXT BOOK:**

1. Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, "Compilers – Principles, Techniques and Tools", 2nd Edition, Pearson Education, 2007.

**REFERENCES:**

1. Randy Allen, Ken Kennedy, "Optimizing Compilers for Modern Architectures: A Dependence-based Approach", Morgan Kaufmann Publishers, 2002.
2. Steven S. Muchnick, "Advanced Compiler Design and Implementation, "Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2003.
3. Keith D Cooper and Linda Torczon, "Engineering a Compiler", Morgan Kaufmann Publishers Elsevier Science, 2004. 5. Charles N. Fischer, Richard. J. LeBlanc, "Crafting a Compiler with C", Pearson Education, 2008.

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**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**

**SEMESTER: VI (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

**Subject: : Block chain & cyber security (Elective II)** Subject Code: **BTechRAI-604.2T**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **3T Hrs/week** | **03** | **30** | **70** | **100** |

**Prerequisite(s): Network Security Course Objectives:**

| | |
|---|---|
| 1 | To learn fundamentals of Cyber Security. |
| 2 | Obtain knowledge about technologies of Blockchain. |
| 3 | To learn different models and their application. |

**Course Outcomes:**

At the end of this course students will be able to:

| | |
|---|---|
| CO1 | To understand fundamentals of Cyber Security and Blockchain Technology |
| CO2 | To learn models of Blockchain. |
| CO3 | Analyze and demonstrate Ethereum. |
| CO4 | Analyze and demostrate Hyperledger fabric. |

| | |
|---|---|
| **UNIT I:**<br>Introduction to Cyber Security:Private and Public Key Cryptography, RSA algorithm, Hash Functions SHA-256, SHA-512 algorithms, and Digital signatures, Message Authentication HMAC, MD5 | **[07 Hours]** |
| **Unit II:**<br>Digital Cash, Bitcoin Blockchain -Wallet -Why Nakamoto came up with Block chaincryptocurrency-Merkley Tree, transaction veriability, Double spending, Bitcoin challenges and solutions. | [07Hours] |
| **Unit III:**<br>Models f-GARAY, RLA model, proof of work, proof of state, Consensus.<br>Algorithm in Blockchain Byzantine General Problems. | [08Hours] |
| **UNIT IV:**<br>Smart Contract Tools and Hands-on -Ethereum Virtual Machine (EVM), wallets, introduction to solidity, attacks on smart contracts. | **[07Hours]** |
| **UNIT V**<br>Introduction to HyperLedger fabric, mechanism in permissioned<br>Blockchain, application of Blockchain in Cyber Security, limitation of Blockchain as a technology. | **[07Hours]** |

**Textbooks:**


1. S.Shukla, M.Dhawan, S.Sharma, S.Venkateshan Blockchain technology: cryptocurrency and applications, Oxford University Press 2019.
2. Arvind Narayanan, Joseph Bonneau, Edverd Felten, Andrew Miller and Steaven GoldFeder, Bitcoin and Cryptocurrency technologies: A comprehensive introduction, Priceton University Press 2016.

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**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**

**SEMESTER: VI (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

**Subject: : Robotics and Intelligent Systems (Elective II)** Subject Code: **BTechRAI-604.3T**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **3T Hrs/week** | **03** | **30** | **70** | **100** |

**Prerequisite:** Artificial Intelligence

**Course Objective:**

| | |
|---|---|
| **1** | Study the concepts of Artificial Intelligence. |
| **2** | Learn the methods of solving problems using Artificial Intelligence. |
| **3** | Introduce the concepts of Expert Systems and Machine learning. |

**Course Outcome:**

At the end the course the Student will be able to:

| | |
|---|---|
| **CO1** | Identify problems that are amenable to solution by AI methods. |
| **CO2** | Identify appropriate AI methods to solve a given problem. |
| **CO3** | Formalize a given problem in the language/framework of different AI methods. |
| **CO4** | Summarize the learning methods adopted in AI |
| **CO5** | Design and perform an empirical evaluation of different algorithms on a problem formalization. & Illustrate the applications of AI in Robotic Applications. |

| | |
|---|---|
| **Unit 1: Introduction**<br>History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. | [07 Hours] |
| **Unit 2: Problem Solving**<br>Solving problems by searching –Informed search and exploration– Constraint satisfaction problems– Adversarial search, knowledge and reasoning– knowledge representation – first order logic | [07 Hours] |
| **Unit 3: Planning**<br>Planning with forward and backward State space search – Partial order planning – Planning graphs– Planning with propositional logic – Planning and acting in real world. | [07 Hours] |
| **Unit 4: Reasoning**<br>Uncertainty – Probabilistic reasoning–Filtering and prediction–Hidden Markov models–Kalman filters– Dynamic Bayesian Networks, Speech recognition, making decisions. Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, and perception. | [08 Hours] |
| **Unit 5: AI In Robotics** (7 hrs) Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics. | [07 Hours] |

**Text Books:**


1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A modern approach", Pearson Education, India, 2016.
2. Negnevitsky, M, "Artificial Intelligence: A guide to Intelligent Systems",. Harlow: Addison Wesley, 2002.


**Reference Books:**


1. David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 1992.
2. Robin Murphy, Robin R. Murphy, Ronald C. Arkin, "Introduction to AI Robotics", MIT Press, 2000. 3. Francis.X.Govers, "Artificial Intelligence for Robotics", Packt Publishing, 2018.
4. Huimin Lu, Xing Lu, "Artificial Intelligence and Robotics", Springer, 2017.
5. Michael Brady, Gerhardt, Davidson, "Robotics and Artificial Intelligence", Springer, 2012.

**RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR**

**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**

**SEMESTER: VI (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

**Subject: : Robotic Process Automation (Elective II)** Subject Code: **BTechRAI-604.4T**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **3T Hrs/week** | **03** | **30** | **70** | **100** |

**Prerequisite:** Process Assessment and standardization

**Course Objective:**

| | |
|---|---|
| **1** | To Learn RPA, where it can be applied and how it's implemented. |
| **2** | Describe the different types of variables, Control Flow and data manipulation techniques. |
| **3** | Identify and understand Image, Text and Data Tables Automation. |

**Course Outcome:**

At the end the course the student will be able to:

| | |
|---|---|
| **CO1** | Understand the RPA and the ability to differentiate it from other types of automation & Models the sequences and the nesting of activities. |
| **CO2** | Understand to store and manipulate data in a more persistent way using such files as CSV and Excel. |
| **CO3** | Model the workflow of different scrapping methodologies, Understand Image, Text and Data Tables Automation. |
| **CO4** | Understand to handle the exceptions and will troubleshoot towards the solution |
| **CO5** | Experiment with workflow in a manner to get the optimized output from a Bot. |

**UNIT-I** **[08 HRS]**

**INTRODUCTION TO ROBOTIC PROCESS AUTOMATION:** Scope and techniques of automation, Robotic process automation - Benefits of RPA, Components of RPA, RPA platforms, RPA BASICS: History of Automation - Programming Constructs in RPA - What Processes can be Automated - Types of Bots - Standardization of processes - RPA Development methodologies - Difference from SDLC - Robotic control flow architecture–

**UNIT II** **[08 hrs]**

**RPA TOOL INTRODUCTION AND BASICS: Introduction to RPA Tool –**

The User Interface - Variables - Managing Variables - Naming Best Practices - The Variables Panel - Generic Value Variables - Text Variables - True or False Variables - Number Variables - Array Variables - Date and Time Variables - Control Flow - Control Flow Introduction - If Else Statements - Loops - Advanced Control Flow - Sequences - Flowcharts - About Control Flow - Text Manipulation - Data Manipulation - Gathering and Assembling Data

**UNIT III ADVANCED AUTOMATION CONCEPTS & TECHNIQUES:** **[7 hrs]**

Recording Introduction - Basic and Desktop Recording - Web Recording - Input/Output Methods - Screen Scraping - Data Scraping - Scraping advanced techniques - Selectors - Defining and Assessing Selectors - Customization - Debugging - Dynamic Selectors - Introduction to Image & Text Automation

**UNIT IV** **[7hrs]**

**HANDLING USER EVENTS & ASSISTANT BOTS, EXCEPTION HANDLING**

Assistant bots - Monitoring system event triggers - Hotkey trigger - Mouse trigger - System trigger - Monitoring image and element triggers - An example of monitoring email - Example of monitoring a copying event and blocking it - Launching an assistant bot on a keyboard event.

EXCEPTION HANDLING: Debugging and Exception Handling - Debugging Tools - Strategies for solving issues - Catching errors..

**UNIT V DEPLOYING AND MAINTAINING THE BOT:** **[6hrs]**

Creation of Server - Using Server to control the bots - Creating a provision Robot from the Server - Connecting a Robot to Server - Deploy the Robot to Server - Publishing and managing updates - Managing packages - Uploading packages - Deleting packages

**TEXT BOOKS:**


1. Alok Mani Tripathi, "Learning Robotic Process Automation", Packt Publishing, 2018.


**REFERENCES:**


1. Frank Casale , Rebecca Dilla, Heidi Jaynes , Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation,1st Edition 2015.

2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant", Independently Published, 1st Edition 2018.

3. Srikanth Merianda, "Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation", Consulting Opportunity Holdings LLC, 1st Edition 2018.

4. Lim Mei Ying, "Robotic Process Automation with Blue Prism Quick Start Guide: Create software robots and automate business processes", Packt Publishing, 1st Edition 2018..

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**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**

**SEMESTER: VI (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: **Current Trend in Image Processing & Pattern recognition(Open Elective)** Subject Code:**BTechRAI-605-1T**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **3T Hrs/week** | **03** | **30** | **70** | **100** |

**Prerequisite:**

**Course Objective:**

| | |
|---|---|
| **1** | To deliver the fundamental concepts of image processing and pattern recognition. |
| **2** | To understand various image processing steps and their applications in real time |
| **3** | To assist the students to incorporate pattern recognition in image processing and its importance in real time applications |

**Course Outcome:**

At the end the course the student will be able to:

| | |
|---|---|
| **CO1** | Describe the basic concepts of image processing with mathematical interpretation. |
| **CO2** | Apply the knowledge of different image enhancement, and image registration techniques. |
| **CO3** | Demonstrate the various image segmentation and morphological operations for partition of objects. |
| **CO4** | Describe the fundamental concepts of various feature extraction techniques and recognize the image scene from image feature. |
| **CO5** | Analyze and implement image processing techniques for various real-time applications such as industry, medicine and defense. |

**Syllabus :**

**UNIT I** **[07 Hrs]**

Introduction: Image processing systems and its applications. Basic image file formats Image formation: Geometric and photometric models; Digitization - sampling, quantization; Image definition and its representation, neighbourhood metrics.

**UNIT II** **[07 Hrs]**

Image Enhancement 6 hours Enhancement, contrast stretching, histogram specification, local contrast enhancement; Smoothing, linear and order statistic filtering, sharpening, spatial convolution

**UNIT III** **[06 Hrs]**

Image Registration: Mono-modal/multimodal image registration; Global/local registration; Transform and similarity measures for registration; Intensity/pixel interpolation.

**UNIT IV** **[08 Hrs]**

Image Segmentation: Pixel classification; Grey level thresholding, global/local thresholding; Optimum thresholding - Bayes analysis, Derivative based edge detection operators, edge detection/linking, Canny edge detector; Region growing, split/merge techniques

**UNIT V** **[08 Hrs]**

Image/Object features extraction - gray level co-occurrence matrix; Moments; Connected component analysis; Convex hull; Distance transform, medial axis transform, skeletonization/thinning, shape properties

**Text Book(s)**

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, 4th Edition, Pearson, 2018.

2. William K. Pratt, Digital Image Processing, 4th Edition, John Wiley, 2007.

**Reference Books**

1. Maria Petrou and Panagiota Bosdogianni, "Image Processing: The Fundamentals", 2nd edition, John Wiley, 2010

2. Kenneth R. Castleman, "Digital Image Processing", 2nd Edition, Pearson, 2010

**RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR**

**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**

**SEMESTER: VI (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

**Subject: Mobile Robotics (Open Elective)** **Subject** Code: **BTechRAI-605-2T**

| Load | Credits | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| **3T Hrs/week** | **03** | **30** | **70** | **100** |

**Prerequisite:** Robot Kinematics

**Course Objective:**

| | |
|---|---|
| **1** | To learn the math and computational methods necessary to model and solve kinematic problems involving robot manipulators and mobile robots |
| **2** | To explore the computational challenges inherent in fundamental mobile robotic tasks (e.g. localization, mapping, motion planning |

**Course Outcome:**

At the end the course the student will be able to:

| | |
|---|---|
| **CO1** | Understand and explain the fundamental concepts and principles of robot dynamics. |
| **CO2** | Analyze and predict the motion of robot manipulators and mobile robots. |
| **CO3** | Derive and solve the equations of motion for robotic systems. |
| **CO4** | Apply mathematical models and algorithms to simulate and control robot dynamics. |
| **CO5** | Identify and address the challenges and limitations associated with robot dynamics. |

**Syllabus:**

**UNIT I** **[ 06 Hrs]**

Robot locomotion: Types of locomotion, hopping robots, legged robots, wheeled robots, stability, maneuverability, controllability

**UNIT II** **[ 07 Hrs]**

Mobile robot kinematics and dynamics: Forward and inverse kinematics, holonomic and nonholonomic constraints, kinematic models of simple car and legged robots, dynamics simulation of mobile robots

**UNIT III** **[ 08 Hrs]**

Perception: Proprioceptive/Exteroceptive and passive/active sensors, performance measures of sensors, sensors formobile robots like global positioning system (GPS), Doppler effect-based sensors, vision based sensors, uncertainty in sensing, filtering

**UNIT IV** **[ 08 Hrs]**

Localization: Odometric position estimation, belief representation, probabilistic mapping, Markov localization, Bayesian localization, Kalman localization, positioning beacon systems

**UNIT V-** **[ 07 Hrs]**

Introduction to planning and navigation: path planning algorithms based on A-star, Dijkstra, Voronoi diagrams, probabilistic roadmaps (PRM), rapidly exploring random trees (RRT), Markov Decision Processes (MDP), stochastic dynamic programming (SDP)

**Text Books:**


1. R. Siegwart, I. R. Nourbakhsh, —Introduction to Autonomous Mobile Robots‖, The MIT Press, 2011.
2. Peter Corke, Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Springer Tracts in Advanced Robotics, 2011.
3. S. M. LaValle, —Planning Algorithms‖, Cambridge University Press, 2006. (Available online http://planning.cs.uiuc.edu/)


**Reference Books :**


1. Thrun, S., Burgard,W., and Fox, D., Probabilistic Robotics. MIT Press, Cambridge, MA, 2005.
2. Melgar, E. R., Diez, C. C., Arduino and Kinect Projects: Design, Build, Blow Their Minds, 2012.
3. H. Choset, K. M. Lynch, S. Hutchinson, G. Kantor, W. Burgard, L. E. Kavraki, and S. Thrun, Principles of Robot Motion: Theory, Algorithms and Implementations, PHI Ltd., 2005.

**RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR**

**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**

**SEMESTER: VI (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: Organizational Behavior Subject Code: **BTechRAI-606T**

| Load Th | Credits Th | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| 2 Hrs./Week | Audit | College assessment in grades O,A,B,C | | |

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**FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE**

**SEMESTER: VI (C.B.C.S.)**

**BRANCH: Robotics & Artificial Intelligence**

Subject: Mini Project/ Internship

Subject Code: **BTechRAI-607P**

| Load Th | Credits Th | College Assessment Marks | University Evaluation | Total Marks |
|---|---|---|---|---|
| 6 Hrs./Week | 6 | 25 | 25 | 50 |