RASHTRASANT TUKDOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF ENGINEERING (B.TECH) DEGREE
COURSE SEMESTER V (C.B.C.S)
BRANCH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Subject : Computer Communication Networks   **Subject Code:BTAI&ML501T**

Load (Th+Tu)	Credits (Th+Tu)	College Assessment Marks	University Evaluation	Total Marks
[36+0] hrs	3+0	30	70	100

Aim: To understand the concepts of Computer Networks and associated protocols.

Prerequisite(S): Computer Architecture and Organization

Course Objectives:
- To study the basic taxonomy and terminology of computer networking and enumerate the layers of OSI model and TCP/IP model.
- To study the fundamentals and basics of Physical layer, and apply them in real time applications.
- To study data link layer concepts, design issues, and protocols.
- To gain core knowledge of Network layer routing protocols and IP addressing
- To study pro-to-process communication and Congestion control mechanism.
- To study about domain name application layer and network management.

Course Outcomes:
At the end of course students are able to,

CO1	Describe the functions of each layer in OSI model along with each layer of OSI and TCP/IP Model
CO2	Explain physical layer functionality and its working along with transmission media with real time applications.
CO3	Describe the functions of data link layer and explain the protocols used in data link
CO4	Classify the routing protocols and analyze how to map IP addresses.

CO5	Identify the issues related to the transport layer. congestion control. Describe Quality of Service, DNS, Application layer protocols & Network security issues.

Syllabus:

UNIT I: Introduction to Computer networks and Physical Layer

Introduction to Networks, Components, Types of connections, Topologies ,Protocols and standards, ISO/OSI model and TCP/IP model, Transmission media, Coaxial cable, Fibre optics, Modems RS232 interfacing, sequencing, Uses of Computer network.

UNIT II: Data Link Layer

Error-Detection and correction, Parity, LRC, CRC, Hamming code, Flow Control and error control, Sliding window protocol, Stop and wait, Go back-N,ARQ-Selective repeat ARQ,HDLC-,LAN Medium access sublayer Channel allocation in LAN's and MAN's Network using CSMA,CDMA/CD.

UNIT III: Network Layer

Internetworks - Circuit Switching, Datagram Switching& Virtual circuit switching, IP addressing methods, Network Layer Design issues, IP addressing,IPv4,IPv6.Routing algorithms, shortest path routing, Flooding, Flow based routing, Distance vector routing, Link state routing.

UNIT IV: Transport Layer

Transport Layer-Process to process delivery, Connection oriented & Connectionless Transport, UDP, TCP, Congestion control.

UNIT V: Application Layer

Application Layer Protocols: DNS, SMTP, SNMP, FTP, HTTP & WWW Security: Cryptography, user authentication, security protocol in internet, Firewalls, IEEE 802.11 & Cellular telephony
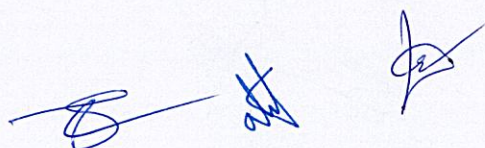
TEXT BOOKS:

- B. A. Forouzan - "Data Communication and Networking(3rd Ed.)" - TMH
- A.S. Tanenbaum- "Computer Network (4th Ed.)" -Pearson Education/PHI
- W. Stallings - "Data and Computer Communications(8th Ed.)" - PHI/Pearson Education

REFERENCE BOOKS:

- Kurose and Rose -"Computer Networking - A top down approach featuring the internet" - Pearson Education
- Introduction to Data Communications and Networking by Wayne Tomasi-Pearson Edition

- Comer - "Internetworking with TCP/IP, vol. 1,2,3(4th Ed.)" - Pearson Education/PHI.

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COURSE SEMESTER V (C.B.C.S)
BRANCH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Subject : Data Analytics and Machine Learning   Subject Code:BTAI&ML502T

Load (Th+Tu)	Credits (Th+Tu)	College Assessment Marks	University Evaluation	Total Marks
[36+0] hrs	3+1	30	70	100

Aim: To understand the use of data analysis in various fields of Computers and understanding and applying machine learning techniques on a set of data.

Prerequisite(S): Statistics, Calculus, Linear Algebra and Probability & Programming Knowledge.

Course Objectives:
- To understand the basic concepts of Data Science
- Demonstrate an understanding of statistics and classification concepts that are vital for Data Science
- Demonstrate the implementation of Data Science experiments through python or R language
- To enable the Students with basic knowledge on Machine Learning Techniques.
- To develop skills of applying Machine Learning Techniques for solving real world problems.

Course Outcomes:
At the end of course students are able to,

CO1	Understand the significance of exploratory data analysis in Data Science
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:
Exploratory Data Analysis
Elements of Structured Data, Rectangular Data, Estimates of Location, Estimates of Variability, Exploring the Data Distribution, Exploring Binary and Categorical Data, Correlation, Exploring Two or More Variables.

UNIT II: Supervised Learning : Regression
Data pre-processing : Dimensionally reduction , feature subset selection Types of regression : Multiple linear regression , Polynomial regression model.

UNIT III: Supervised Learning Classification
Logistic regression, K-nearest neighbor(KNN) , NATIVE Bayes Decision trees, Support vector machine. Recommendation System : Content based and collaborative techniques.

UNIT IV: Unsupervised Learning Introduction
Clustering, K-means clustering, Apriori algorithm and associations rule, anomaly detection algorithm, Hierarchical clustering , L-Medoids.

UNIT V: Trends and Application in Machine learning
Ensemble learning, Bagging, randomization, Boosting, Applications of Machine Learning : Image recognition, speech recognition, Prediction recommendation: email spam and malware filtering,virtual personal assistant, online fraud detection.

TEXT BOOKS:
- Peter Bruce, Andrew Bruce and Peter Gedeck, Practical Statistics for Data Scientists, 2nd Edition, O'Reilly.
- Learning by Subramanian Chandramouli , Saikat Dutt Amit Kumar Das

REFERENCE BOOKS:
- Python Machine Learning Dr Randal S. Olson
- Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2ND Edition, O'Reilly, 2015. ISBN-978-1-491-93936-9.
- R for dummies –Andrie de vries and JorisMeys, A John Wiley Sons, Ltd. Publication.
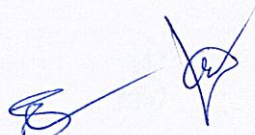
Subject : Data Analytics and Machine Learning   **Subject Code:BTAI&ML502P**

Load (Th+Tu)	Credits (Th+Tu)	College Assessment Marks	University Evaluation	Total Marks
2 Hrs (Per Practical)	1	25	25	50

Practical List:- Practicals Based on above Syllabus

RASHTRASANT TUKDOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
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COURSE SEMESTER V (C.B.C.S)
BRANCH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Subject : Design and Analysis of Algorithms   **Subject Code:BTAI&ML502P**

Load Th	Credits Th	College Assessment Marks		Total Marks
3	3.00	30	70	100

Prerequisite(s): Data Structure

Course Objectives:

1	To understand different Asymptotic notations
2	To have an appreciation of different mathematical principles of algorithm analysis
3	To understand and apply various algorithm design strategies
4	To understand various complexity classes like P,NP complete and NP hard

Course Outcomes:

At the end of this course students are able to:

CO1	Compare different types of Aymptotic notations and find time complexity in terms of asymptotic notations
CO2	Implement Divide and conquer strategy
CO3	Implement Dynamic programming strategy
CO4	Implement Backtracking strategy
CO5	Identify differentiate between Various types of Complexity classes

Syllabus:
UNIT I:

Mathematical Foundations, summation of arithmetic and geometric series,n,n2, bounding summations using integration , analysing control structures, worst case and average case analysis, Asymptotic notations, sorting algorithm such as Insertion sort ,recursive function and

recurrence relations, solution of recurrence relations using technique of characteristics equation, Amortised analysis.

UNIT II:

Divide and conquer basic strategy: Binary search, quick sort, merge sort, heap sort, Greedy method: Basic strategy, Fractional Knapsack problem, application to job sequencing with deadlines problems, minimum cost spanning trees, single source shortest path.

UNIT III:

Dynamic Programming: Basic strategy, multistage graphs, all pairs shortest path, single source shortest path, travelling salesman problem, Longest common sequence,0/1 Knapsack problem.

UNIT IV:

Basic Traversal and Search Techniques: Breadth first search, Depth first search, Backtracking: Basic strategy, N-Queen's problem, graph coloring, Hamiltonian cycles.

UNIT V

NP-hard, NP-complete Problems: Basic concepts, Non-deterministic algorithms, NP-hard and NP-complete, Cook's theorem, decision and optimization problems, Polynomial reduction.

Textbooks:

1. Computer Algorithms By Horowitz, Sahani, Rajsekharam, Galgotia Publications Pvt.
2. Introduction to Algorithms by Thomas H. Cormen et. al. Prentice Hall of India.
3. Fundamentals of Algorithm, Brassard Bratley, Prentice Hall of India.

Reference books:

- The Design and Analysis of Algorithms By Alfred V. Aho, John E. Hopcraft, Jeffrey D. Ullman, Pearson Publication

Subject : Design and Analysis of Algorithms   **Subject Code:BTAI&ML503P**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 hrs/Week (Practical)	1	25	25	50

Practical List:- Practicals Based on above Syllabus

RASHTRASANT TUKDOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF ENGINEERING (B.TECH) DEGREE
COURSE SEMESTER V (C.B.C.S)

BRANCH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Subject : Internet of Things and Cloud Computing   **Subject Code: BTAI&ML504T**

Load (Th+Tu)	Credits (Th+Tu)	College Assessment Marks	University Evaluation	Total Marks
[36+0] hrs	3	30	70	100

Aim: To study the network of physical objects—"things"—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. This is combined with the study of cloud computing i.e the delivery of computing services—including servers, storage, databases, networking, software, analytics, and intelligence—over the Internet ("the cloud") to offer faster innovation, flexible resources, and economies of scale.

Prerequisite(s): Computer Networks

Course Objectives:
- To study fundamental concepts of IoT
- To understand roles of sensors in IoT
- To Learn different protocols used for IoT design
- To Understand the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges;
- To Understand the basic ideas and principles in cloud computing architecture; cloud computing services and cloud software deployment considerations

Course Outcomes:
At the end of course students are able to,

CO1	**Understand** the various concepts, terminologies and architecture of IoT systems.
CO2	**Use** sensors and actuators for design of IoT.

CO3	**Understand** and apply various protocols for design of IoT systems
CO4	**Summarize** the concept and characteristics of cloud computing, compare the cloud computing with grid and cluster computing. (BL 1,2, 3,5)
CO5	**Describe** the role of computer network in cloud computing and the concept of virtualization with its advantages and pitfalls, classify the services of cloud computing. (BL 1,3,4)

Syllabus:

Unit I:

IoT Web Technology The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardisation, Recommendations on Research Topics.

Unit II:

IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

Unit III:

Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security.

Unit IV:

Introduction to Cloud Computing: Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers, Properties, Characteristics & Disadvantages of Cloud Computing, Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing. Legal issues when using cloud models, challenges in cloud computing, Overview of Mobile Cloud.

Unit V:

Cloud Computing Architecture: Cloud computing stack, Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works,

Role of Networks in Cloud computing, protocols used, Role of Web services, Service Models (XaaS), Infrastructure as a Service (IaaS), Platform as a Service(PaaS), Software as a Service(SaaS), Virtualization Technology: Virtual machine technology, virtualization applications in enterprises, Pitfalls of virtualization, Infrastructure as a Service (Iaas)using OpenStack/OwnCloud.

TEXT BOOKS:

- Dr. Ovidiu Vermesan, Dr. Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers, 2013, ISBN: 978-87-92982-96-4 (E-Book), ISBN: 978-87-92982-73-5
- Dr. Parikshit Mahalle, Poonam Railkar, Identity Management for Internet of Thing, River Publishers, 2015, ISBN: 978-87-93102-91-0 (EBook), ISBN:978-87-93102-90-3
- Google Compute Engine, Mark Cohen and K. Hurley, O'Reilly, 2014.
- Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Wiley, 2011
- Cloud Computing, A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2014.

REFERENCE BOOKS:

- Cuno Pfister, Getting Started with the Internet of Things, O'Reilly Media, 2011, ISBN: 978-1- 4493- 9357-1
- Cloud Computing using Windows Azure, B. M. Harwani, SPD Publication.

Subject : Internet of Things and Cloud Computing   **Subject Code:BTAI&ML504P**

Load (Th+Tu)	Credits (Th+Tu)	College Assessment Marks	University Evaluation	Total Marks
2Hrs(Per Practical)	1	25	25	50

Practical List:- Practicals Based on above Syllabus

RASHTRASANT TUKDOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
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COURSE SEMESTER V (C.B.C.S)
BRANCH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Subject : Effective Technical Communication   **Subject Code: BTAI&ML506T**

Load (Th+Tu)	Credits (Th+Tu)	College Assessment Marks	University Evaluation	Total Marks
[36+0] hrs	2	15	35	50

Aim: To develop a confidence and communication skills among students in order to face the interviews confidently.

Prerequisite(S): Communication Skills

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 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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COURSE SEMESTER V (C.B.C.S)
BRANCH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

(ELECTIVE-I)

Subject : Social Media and Web Analytics   **Subject Code: BTAI&ML505T**

Load (Th+Tu)	Credits (Th+Tu)	College Assessment Marks	University Evaluation	Total Marks
[36+0] hrs	3	30	70	100

Aim: To understand the importance and potential of social media on product marketing.
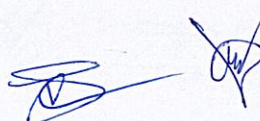
Prerequisite(S): NIL

Course Objectives:·
- Be able to understand social media, web and social media analytics, and their potential impact To impart knowledge on the direct and inverse kinematics.
- Be able to understand usability, user experience, and customer experience
- Be able to understand the relationship between the experiences and ROI

Course Outcomes:
At the end of course students are able to,

CO1	Understand the role of web analytics within the digital marketing landscape
CO2	Identify, define and interpret commonly used web metrics and KPIs
CO3	Understand analytical methods to transform social media data into marketing insights
CO4	Understand the process of informed decision making using case based method

CO5	Understand how to effectively use insights to support website design decisions, campaign optimization, search analytics, etc

Syllabus:

Unit I:

Introduction :

Introduction to the course, The concept of Purchasing funnel in Marketing in Offline and Online world, Technical concepts about web medium, Definition and History of Web Analytics, Overview in different mediums of Web analytics, Data collection methods in Web Analytics

Unit II:

Introduction: Google Analytics, Google Analytics, Outcome data analysis and Web survey analysis, Metrics used in Web analysis, Pyramid Model of Web Analytics

Unit III:

Introduction: Fundamentals of Social Networks, Fundamentals of Social Networks, KPIs in Web Analytics, Website Goals

Unit IV:

Introduction:Website Optimization, Email analytics, Facebook analytics, Sentimental analysis on Social media data , Web analytics cases
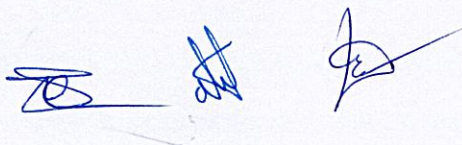
Unit V:

Introduction: Topic modelling on Twitter data, Attribution modeling , Group work and hands on practice Usability study planning and testing; and data analysis using software tools (Google· Analytics, Google Sites, R and Deducer)

TEXT BOOKS:
- Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity by Avinash Kaushik

REFERENCE BOOKS:
- Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media, Matthew Ganis, Avinash Kohirkar
- Social Media Metrics: How to Measure and Optimize Your Marketing Investment, Jim Sterne
- Social Media ROI: Managing and Measuring Social Media Efforts in Your Organization (Que Biz-Tech), Oliver Blanchard 4. Social Media Analytics, Marshall Sponder

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COURSE SEMESTER V (C.B.C.S)
BRANCH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

(ELECTIVE-I)

Subject : Distributed Computing   **Subject Code:BTAI&ML505T**

Load (Th+Tu)	Credits (Th+Tu)	College Assessment Marks	University Evaluation	Total Marks
[36+0] hrs	3	30	70	100

Aim: To understand the concept of system where processing and data storage is distributed across multiple devices or systems,

Prerequisite(S): Digital Circuits & Microprocessor concepts and applications, Assembly language concepts, Basics of Operating System

Course Objectives:·
- To discuss about real-time and quality of service system principles
- To discuss real-time operating systems and the resource management and quality of service issues that arises.
- To construct sample applications on representative platforms .Platforms range from handheld and Mobile computers to media and real-time server systems

Course Outcomes:
> After completing the course, students will able to:

CO1	Explain the characteristics of a distributed system along with its and design challenges
CO2	Illustrate the mechanism of IPC between distributed objects
CO3	Describe the distributed file service architecture and the important characteristics of SUN NFS

CO4	Discuss the time and global states
CO5	Discuss concurrency control algorithms applied in distributed transactions

Syllabus:

Unit I:

Characterization of Distributed Systems: Introduction, Examples of DS, Resource sharing and the Web, Challenges System Models: Architectural Models, Fundamental Models

Unit II:

Inter Process Communication: Introduction, API for Internet Protocols, External Data Representation and Marshalling, Client – Server Communication, Group Communication Distributed Objects and RMI:

Introduction, Communication between Distributed Objects, RPC, Events and Notifications

Unit III:

Introduction, The OS layer, Protection, Processes and Threads, Communication and Invocation , Operating system architecture

Distributed File Systems: Introduction, File Service architecture, Sun Network File System

Unit IV:

Time and Global States: Introduction, Clocks, events and process status, Synchronizing physical clocks, Logical time and logical clocks, Global states
Coordination and Agreement: Introduction, Distributed mutual exclusion, Elections

Unit V:

Distributed Transactions: Introduction, Flat and nested distributed transactions, Atomic commit protocols, Concurrency control in distributed transactions, distributed deadlocks

TEXT BOOKS:

- George Coulouris, Jean Dollimore and Tim Kindberg: Distributed Systems – Concepts and Design, 5thEdition, Pearson Publications, 2009

REFERENCE BOOKS:

Andrew S Tanenbaum: Distributed Operating Systems, 3rd edition, Pearson publication, 2007

Ajay D. Kshemkalyani and MukeshSinghal, Distributed Computing: Principles, Algorithms and Systems, Cambridge University Press, 2008

SunitaMahajan, Seema Shan, " Distributed Computing", Oxford University Press,2015

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COURSE SEMESTER V (C.B.C.S)
BRANCH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

(ELECTIVE-I)

Subject : Arm Processors and its Essentials   **Subject Code:BTAI&ML505T**

Load (Th+Tu)	Credits (Th+Tu)	College Assessment Marks	University Evaluation	Total Marks
[36+0] hrs	3	30	70	100

Aim: ARM Architecture is widely used in smartphones, normal phones, and also in laptops. To understand the working of elctronic devices. Study of Arm Processor is important.

Prerequisite(S): Digital Circuits & Microprocessor concepts and applications, Assembly language concepts, Embedded System, Basics of all electronics components

Course Objective:

1	To teach the architecture of 8 bit RISC processor
2	To teach the architecture and programming of 16 bit RISC processor
3	To teach the implementation of DSP in ARM processor
4	To discuss on memory management in RISC processor
5	To teach the application development with ARM processor

Course Outcome:

CO1	To be able to understand architecture , addressing modes of AVR Microcontroller
CO2	To be able to programme 8 bit RISC processor
CO3	To be able to design applications using ARM processor

CO4	To be able to understand memory protection Management.
CO5	To apply various diversity techniques to design with ARM controllers

Syllabus:

UNTI I AVR MICROCONTROLLER ARCHITECTURE

Architecture – memory organization – addressing modes – I/O Memory – EEPROM – I/O Ports SRAM – Timer –UART – Interrupt Structure- Serial Communication with PC – ADC/DAC Interfacing

UNIT II ARM ARCHITECTURE AND PROGRAMMING

Arcon RISC Machine – Architectural Inheritance – Core & Architectures, The ARM Programmer's model -Registers – Pipeline - Interrupts – ARM organization - ARM processor family – Co-processors. Instruction set – Thumb instruction set – Instruction cycle timings

UNIT III ARM APPLICATION DEVELOPMENT

Introduction to DSP on ARM –FIR Filter – IIR Filter – Discrete Fourier transform – Exception Handling – Interrupts – Interrupt handling schemes- Firmware and bootloader – Example: Standalone - Embedded Operating Systems – Fundamental Components - Example Simplelittle Operating System

UNIT IV MEMORY PROTECTION AND MANAGEMENT

Protected Regions-Initializing MPU, Cache and Write Buffer-MPU to MMU-Virtual MemoryPage Tables-TLB-Domain and Memory Access Permission-Fast Context Switch Extension.

UNIT V DESIGN WITH ARM MICROCONTROLLERS

Assembler Rules and Directives- Simple ASM/C programs- Hamming Code- Division-Negation- Simple Loops –Look up table- Block copy- subroutines.

TEXTBOOKS

1. Steve Furber, 'ARM system on chip architecture', Addision Wesley
2. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield 'ARM System Developer's Guide Designing and Optimizing System Software', Elsevier 2007.
3. Trevor Martin, 'The Insider's Guide To The Philips ARM7-Based Microcontrollers, An Engineer's Introduction To The LPC2100 Series' Hitex (UK) Ltd.,

REFERENCES:

1. Dananjay V. Gadre 'Programming and Customizing the AVR microcontroller', McGraw Hill 2001 5. William Hohl, ' ARM Assebly Language' Fundamentals and Techniques.
2. ARM Architecture Reference Manual 6. LPC213x User Manual

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COURSE SEMESTER V (C.B.C.S)
BRANCH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

(ELECTIVE-I)

Subject : ROBOTICS   **Subject Code:BTAI&ML505T**

Load (Th+Tu)	Credits (Th+Tu)	College Assessment Marks	University Evaluation	Total Marks
[36+0] hrs	3	30	70	100

Aim: To understand the concept of designing, building, and engineering robots

Prerequisite(S): Assembly language concepts, Basics of Operating System, Embedded System

Course Objectives:

- To introduce the functional elements of Robotics
- To impart knowledge on the direct and inverse kinematics
- To educate on various path planning techniques
- To introduce the manipulator differential motion and control
- To introduce the dynamics and control of manipulators

Course Outcomes:

After completing the course, students will able to:

CO1	Ability to understand basic concept of robotics
CO2	To analyze Instrumentation systems and their applications to various
CO3	To know about the differential motion add statics in robotics
CO4	To know about the various path planning techniques
CO5	To know about the dynamics and control in robotics industries.

Syllabus:

Unit I:

BASIC CONCEPTS: Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and control issues- Various manipulators – Sensors - work cell - Programming languages.

Unit II:

DIRECT AND INVERSE KINEMATICS: Mathematical representation of Robots - Position and orientation – Homogeneous transformation- Various joints- Representation using the Denavit Hattenberg parameters -Degrees of freedom-Direct kinematics-Inverse kinematics- SCARA robots- Solvability – Solution methods-Closed form solution

Unit III:

MANIPULATOR DIFFERENTIAL MOTION AND STATICS: Linear and angular velocities- Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and armsingularity - Static analysis - Force and moment Balance.

Unit IV:

PATH PLANNING: Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning.

Unit V:

DYNAMICS AND CONTROL: Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model – Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator

TEXT BOOKS:

- R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.
- JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education,
- M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.

REFERENCE BOOKS:

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