RCOEM

Shri Ramdeobaba College of
Engineering and Management, Nagpur

SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR – 440013

An Autonomous College affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur, Maharashtra (INDIA)

PROGRAMME SCHEME & SYLLABI
2022 – 2023

B. TECH. - COMPUTER SCIENCE & ENGINEERING
(ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

About the Department:

The Department of Computer Science & Engineering was established in 2002, is well-equipped with state-of-the-art infrastructure. The programme in Computer Science & Engineering with specialization in Artificial Intelligence & Machine Learning (AL & ML) was established in 2020. The state of art infrastructure includes latest configuration desktops. The programme is designed to enable students to build intelligent machines, software, or applications with a cutting-edge combination of Artificial Intelligence, Machine learning and Deep Learning technologies after equipping them with the basic fundamentals of Computer Science and Engineering.

The department hosts computers, laptops and lab with internet facility. The 24X7 network managed with Cyberoam UTM firewall, and CISCO router offers intranet and internet connectivity. The computer laboratories have high-end servers of IBM and WIPRO along with industry-standard software, viz., Oracle, NetSim, Wireshark, AIX, Robotics Platform, IOT Kit and MSDN. The department promotes high-end computing through Open Source technologies and hosts NVIDIA DGX DL Workstation.

The major focus of the programme is to create skilled engineers to innovate, design, think and provide intelligent solutions to problems in a variety of domains such as Education, healthcare, security, information forensics, Data virtualization, Agriculture, efficient transportation, smart cities and business applications, in various government and public sectors etc.

Departmental Vision:

To continually improve the education environment, in order to develop graduates with strong academic and technical background needed to achieve distinction in the discipline. The excellence is expected in various domains like workforce, higher studies or lifelong learning. To strengthen links between industry through partnership and collaborative development works.

Department Mission:

To develop strong foundation of theory and practices of computer science amongst the students to enable them to develop into knowledgeable, responsible professionals, lifelong learners and implement the latest computing technologies for the betterment of the society.

Program Education Objectives:

1. To be able to comprehend, understand and analyze Computer Science Engineering problems related to real life which can be better resolved by artificial intelligence and machine learning.
2. To impart exhaustive knowledge of Computer Science Engineering, AI and Machine Learning to cater the industrial needs and excel in innovation and management fields by prediction analysis.
3. To promote collaborative learning and spirit of team work through multidisciplinary AI based projects and diverse professional ethics.
4. To inculcate a conviction to believe in self, impart professional and ethical attitude and nurture to be an effective team member, infuse leadership qualities, and build proficiency in soft skills and the abilities to relate engineering with the social, political and technical issues as per the current scenario.

Programme Outcomes (POs):

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis ofthe information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need forsustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and normsof the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage inindependent and lifelong learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs):

1. The ability to understand, analyze and demonstrate the knowledge of human cognition, Artificial Intelligence and Machine Learning in terms of real world problems to meet the challenges of the future.
2. The ability to develop computational knowledge and project development skills using innovative tools and techniques to solve problems in the areas related to Artificial Intelligence, Machine learning, Deep Learning.

Teaching Scheme for B. Tech Computer Science and Engineering (AIML)

Semester - I

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	CHT152	Chemistry	3	1	0	4	40	60	100	03
2.	CHP152	Chemistry Lab	0	0	3	1.5	25	25	50	-
3.	MAT152	Differential Equation, Linear Algebra, Statistics & Probability	3	0	0	3	40	60	100	03
4.	CAT101	Programming for Problem Solving	4	0	0	4	40	60	100	03
5.	CAP101	Programming for Problem Solving Lab	0	0	2	1	25	25	50	-
6.	IDT151	Creativity, Innovation & Design Thinking	1	0	0	1	20	30	50	1.5
7.	CAT102	Computer Workshop	1	0	0	1	20	30	50	1.5
8.	CAP102	Computer Workshop Lab	0	0	2	1	25	25	50	-
9.	HUT151	English	2	0	0	2	40	60	100	03
10.	HUP151	English Lab	0	0	2	1	25	25	50	-
		TOTAL	**14**	**1**	**9**	**19.5**			**700**	

Semester - II

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	PHT154	Introduction to Quantum Computing	3	1	0	4	40	60	100	03
2.	PHP154	Introduction to Quantum Computing Lab	0	0	3	1.5	25	25	50	-
3.	MAT151	Calculus	3	1	0	4	40	60	100	03
4.	MAP151	Computational Mathematics Lab	0	0	2	1	25	25	50	-
5.	CAT103	Digital Electronics	3	0	0	3	40	60	100	03
6.	CAP103	Digital Electronics Lab	0	0	2	1	25	25	50	-
7.	CAT104	Object Oriented Programming	3	0	0	3	40	60	100	03
8.	CAP104	Object Oriented Programming Lab	0	0	2	1	25	25	50	-
9.	HUT152	Constitution of India	2	0	0	0	-	-	-	-
10.	PEP151	Yoga / Sports	0	0	2	0	-	-	-	-
		TOTAL	**14**	**2**	**11**	**18.5**			**600**	

Semester - III

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	CAT201	Data Structures	3	1	0	4	40	60	100	03
2.	CAP201	Data Structures Lab	0	0	2	1	25	25	50	-
3.	CAT202	Computer Architecture	3	0	0	3	40	60	100	03
4.	MAT271	Mathematics for Machine Learning	3	0	0	3	40	60	100	03
5.	CAT203	Operating System	3	0	0	3	40	60	100	03
6.	CAP203	Operating System Lab	0	0	2	1	25	25	50	-
7.	HUT253	Business Communication	3	0	0	3	40	60	100	03
8.	HUT257	Cyber Laws & Ethics in IT	2	0	0	2	40	60	100	03
9.	CAP204	Python Programming Lab	0	0	4	2	25	25	50	-
		TOTAL	**17**	**1**	**8**	**22**			**750**	

Semester - IV

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	CAT205	Computer Networks	3	1	0	4	40	60	100	03
2.	CAP205	Computer Networks Lab	0	0	2	1	25	25	50	-
3.	CAT206	Artificial Intelligence: Principles and Techniques	3	1	0	4	40	60	100	03
4.	CAP206	Artificial Intelligence Lab	0	0	2	1	25	25	50	-
5.	CAT207	Theory of Computation	3	1	0	4	40	60	100	03
6.	CAT208	Design and Analysis of Algorithms	3	1	0	4	40	60	100	03
7.		Open Elective-I / MOOC (Related to AI-ML)	3	0	0	3	40	60	100	03
8.	CAP209	Software Lab-1	0	0	2	1	25	25	50	-
9.	CHT252	Environment Sciences	2	0	0	0	-	-	-	-
		TOTAL	**17**	**4**	**6**	**22**			**650**	

	Recommended course from MOOC
1	Computer Graphics
2	Software Engineering

Semester - V

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	CAT301	Database Management Systems	3	0	0	3	40	60	100	03
2.	CAP301	Database Management Systems Lab	0	0	2	1	25	25	50	-
3.	CAT302	Machine Learning	3	0	0	3	40	60	100	03
4.	CAP302	Machine Learning Lab	0	0	2	1	25	25	50	-
5.	CAT303	Microcontroller Design	3	0	0	3	40	60	100	03
6.	CAP303	Microcontroller Design Lab	0	0	2	1	25	25	50	-
7.	CAT304	Compiler Design	3	0	0	3	40	60	100	03
8.	CAP304	Compiler Design Lab	0	0	2	1	25	25	50	-
9.		Open Elective-II / MOOC (Related to AI-ML)	3	0	0	3	40	60	100	03
10.	CAP305	Mini Project-1	0	0	4	2	25	25	50	-
11.	HUT353	Indian Traditional Knowledge	2	0	0	0	-	-	-	-
		TOTAL	17	0	12	21			750	

Semester - VI

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	CAT306	Deep Learning	3	0	0	3	40	60	100	03
2.	CAP306	Deep Learning Lab	0	0	2	1	25	25	50	-
3.	CAT307	Data mining and Warehousing	3	0	0	3	40	60	100	03
4.	CAP307	Data mining and Warehousing Lab	0	0	2	1	25	25	50	-
5.	CAT308	Natural Language Processing	3	0	0	3	40	60	100	03
6.	CAP308	Natural Language Processing Lab	0	0	2	1	25	25	50	-
7.	CAT309	Fundamentals of Digital Image and Video Processing	3	0	0	3	40	60	100	03
8.	CAP309	Fundamentals of Digital Image and Video Processing Lab	0	0	2	1	25	25	50	-
9.		Open Elective-III/MOOC	3	0	0	3	40	60	100	03
10.	CAP310	Mini Project-2	0	0	4	2	25	25	50	-
11.	CAP311	Comprehensive Viva	0	0	2	1	25	25	50	-
		TOTAL	15	0	14	22			800	

List of Open Electives

SN	Semester	Course Code	Course
1	IV	CAT299	Statistical Computing with R
2	V	CAT398	Machine Learning - Tools and techniques
3	VI	CAT399	Data Analytics
4	VII	CAT498	Software Engineering

Semester - VII

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	CAT401	Data Analytics and Visualization	3	0	0	3	40	60	100	03
2.	CAP401	Data Analytics and Visualization Lab	0	0	2	1	25	25	50	-
3.	IDT453	Bio-Informatics	2	0	0	2	20	30	50	1.5
4.		Open Elective IV/MOOC	3	0	0	3	40	60	100	03
5.	CAT402	Program Elective-I	3	0	0	3	40	60	100	03
6.	CAP402	Program Elective-I Lab	0	0	2	1	25	25	50	-
7.	CAT403	Program Elective-II	3	0	0	3	40	60	100	03
8.	CAP403	Program Elective-II Lab	0	0	2	1	25	25	50	-
9.	CAP404	Project phase I	0	0	12	6	50	50	100	-
		TOTAL	14	0	18	23			700	

Semester - VIII

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	CAT405	Program Elective-III	3	0	0	3	40	60	100	03
2.	CAT406	Program Elective-IV	3	0	0	3	40	60	100	03
3.	CAP407	Project Phase II	0	0	12	6	50	50	100	-
OR										
1	CAP408	Industry Internship (One semester)	-	-	-	12	150	150	300	-
		TOTAL	**6**	**0**		**12**			**300**	

Program Electives [PE]:

VII [PE-I]	CAT402-1	Distributed Systems
	CAT402-2	Introduction to IOT
	CAT402-3	Computer Vision
	CAT402-4	Information Retrieval
	CAT402-5	Managerial Economics

VII [PE-II]	CAT403-1	Information Security
	CAT403-2	Embedded Systems
	CAT403-3	Biomedical Image Processing
	CAT403-4	Social Network analysis

VIII [PE-III]	CAT405-1	Introduction to GAN [Generative Adversarial Networks]
	CAT405-2	Cyber Security Intelligence
	CAT405-3	Soft Computing Techniques
	CAT405-4	Time-Series Analysis
	CAT405-5	Cognitive systems
	CAT405-6	Web Technologies

VIII [PE-IV]	CAT406-1	Cloud Computing
	CAT406-2	Robotics
	CAT406-3	Reinforcement learning
	CAT406-4	Human Computer Interaction
	CAT406-5	Big Data Analytics using Hadoop
	CAT406-6	Game Theory

Syllabus for Semester I, B. E. Computer Science & Engineering(AIML)

Course Code : CHT152 **Course : Chemistry**

L: 3 Hrs, T: 1 Hr, P: 0Hr, Per Week **Total Credits: 4**

Course Outcomes

After the successful completion of the course, students shall be able to

- Predict the properties and interactions of chemical substances by understanding their composition at the atomic level. [CO for Unit – 1]
- Conversant in applying unique properties of nano-materials to solve challenges in our life. [CO for Unit – 2]
- Explain the differences in the mechanical behavior of engineering materials based upon bond type, structure, composition, and processing. [CO for Unit – 3]
- Study chemical kinetics using concepts of computational chemistry. [CO for Unit – 4]
- Discuss how spectroscopic methods are used for qualitative and quantitative analyses. [CO for Unit – 5]
- Analyse impurities present in the water and suggest the methodology for its removal. [CO for Unit – 6]

Syllabus:

Unit 1: Solid State Chemistry (7 Hours)

Bondings in atoms: Primary bonding: ionic, covalent, metallic. Secondary bonding: dipole-dipole, induced dipole-induced dipole, London dispersion/van der Waals, hydrogen. Shapes of molecules: hybridization, LCAO-MO, VSEPR theory.

Electronic material: Band theory: metals, insulators, and semiconductors. Band gaps, doping. Silicon wafer production.

Unit 2: Nano-material-I(7 Hours)

Basics of Nanochemistry: Defination of Nano, Scientific revolution-Atomic Structure and atomic size, emergence and challengs of nanoscience and nanotechnology, carbon age-new form of carbon (CNT to Graphene), One dimensional, Two dimensional and Three dimensional nanostructured materials, mechanical-physical-chemical properties.

Application of Nanomaterial: Molecular electronics and nanoelectronics, Nanotechnology for waste reduction and improved energy efficiency, Carbon Nanotubes for energy storage, Hydrogen Storage in Carbon Nanotubes, nanotechnology based water treatment strategies.

Unit 3: Advanced Materials: (7 hours)

Composite materials: Introduction, Classification: Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber-Reinforced Composites and Applications.

Reinforcements: Fibres- Glass, Kevlar, Carbon, Silicon Carbide, And Born Carbide Fibres.

Industrial Polymer: Thermoplastics, Thermosetting Plastics, Polymers used in electronic industries, Piezo and pyroelectric polymers, Polymers in optical media data storage devices.

Unit 4: Computational Chemistry [6 Hours]

Rate of the reaction, Order and Molecularity of the reaction, Rate expression for Zero Order, First Order and Second Order Reactions, Effect of the temperature, Use of Mathematica for determining rate of the reaction, etc.

Unit 5: Material Characterization using different Spectroscopic Techniques [7 Hours]

Fundamentals of spectroscopy, Infrared Spectroscopy, Electronic Spectrocopy, Nuclear Magnetic Resonance Spectroscopy.

Fundamentals of X-Ray Diffractions (XRD), X-Ray Fluorescence (XRF) spectroscopy.

Unit 6: Water Technology [8 Hours]

Impurities in natural water, hardness and alkalinity, Disadvantages of hardness i. e. sludge and scale formation, softening of water using lime-soda, zeolite and ion-exchange method, advantages and limitations of these water softening processes, Desalination of water using Reverse Osmosis.

Text Books:

1. J. Michael Hollas, Modern Spectroscopy, Fourth Edition, John Wiley and Sons, 2004.
2. William Kemp, Organic Spectroscopy, Third Edition, Palgrave Publication, 1991.
3. Bradley D. Fahlman, Materials Chemistry, Third Edition, Springer Nature, 2018.
4. Brian W. Pfennig, Principles of Inorganic Chemistry, John Wiley and Sons, 2015.
5. Steven S. Zumdahl, Donald J. DeCoste, Chemical Principles,Eighth Edition, Cengage Learning, 2017.
6. Catherine E. Housecroft and Edwin C. Constable, Chemistry: An Introduction to Organic, Inorganic and Physical Chemistry, Third Edition, Pearson Education Limited, 2006.
7. Michael J. Moran and Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, Fifth Edition, John Wiley and Sons, 2006.
8. Donald L. Pavia, Gary M. Lampman, George S. Kriz, and James R. Vyvyan, Introduction to Spectroscopy, Fifth Edition, Cengage Learning, 2009.
9. C. N. R. Rao, A. Muller and A. K. Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications, Wiley-VCH, 2004.
10. P. C. Jain and Monica Jain, Engineering Chemistry, Dhanpat Rai Publication.
11. S. S. Dara, A Textbook ofEngineering Chemistry, S. Chand Publications.
12. J. D. Lee, Concise Inorganic Chemistry, Fourth Edition, Chapman and Hall Publications

Course Code: CHP152 **Course: Chemistry Lab**

L: 0 Hrs, T: 0 Hr, P: 3 Hr, Per Week **Total Credits: 1.5**

Course Outcomes:

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering.

The students will learn to:

- Estimate the amount of different impurities in water/waste water samples.
- Estimate rate constants of reactions and order of the reaction from concentration of reactants/products as a function of time and to validate adsorption isotherms.
- Measure molecular/system properties such as surface tension, viscosity of aqueous or other industrially important liquids/mixtures etc.
- Synthesize a polymer or drug molecule or nano-material.
- Use principle of spectroscopic techniques for structural determination.

List of Experiments: [Any Eight from the List]

1. Preparation of different Solutions: Molar solution, Normal solution and percent solution and Determination of concentration.
2. To find out types of alkalinity and estimation of their extent in the water sample.
3. Estimation of temporary, permanent and total hardness present in the water sample using complexometric titration method.
4. Spectroscopic/Colorimetric determine of wavelength of maximum absorption of chemical/biological compound in solution and determination of concentration using Lambert-Beer's Law.
5. Determination of rate of the reaction of hydrolysis of ethyl acetate at room temperature and analysis of experimental data using Computational Software.
6. To study chemical kinetics of peroxydisulphate and iodide ions reactions and to find out order of the reaction and analysis of experimental data using Computational Software.
7. Synthesis of Nano-material/Polymer and its study.
8. Determination of relative and kinematic viscosities of aqueous solutions of Poly-ethylene glycol (Polymeric Liquid) using Redwood Viscometer (type I or II) at different temperatures.
9. To study effect of bondings of water molecules with electrolyte (NaCl/KCl) and non-electrolyte solute (Soap) in the solution through Surface Tension Determination.
10. Study of ion-exchange column for removal of hardness in the water sample.
11. Demonstrations of organic spectral techniques: IR, NMR.
12. Demonstration of in-organic spectral techniques: XRD, XRF.

Text Books/Reference Books:

(1) S. S. Dara, **A Textbook on Experiments and Calculations in Engineering Chemistry**, S. Chand Publications.

(2) J. B. Yadav, **Advanced Practical Physical Chemistry**, Krishna's Prakashan Media (P) Limited.

(3) A. J. Elias, **Collection of Interesting General Chemistry Experiments**, Universities Press Publications.

(4) V. K. Ahluwalia, S. Dhingra and A. Gulati, **College Practical Chemistry**, Universities Press Publications.

(5) Ashutosh Kar ,**Advanced Practical Medicinal Chemistry**, New Age International Publisher.

Course Code: MAT152 **Course: Differential Equation, Linear Algebra, Statistics & Probability**

L: 3 Hrs, T: 1 Hr, P: 0 Hr, Per Week **Total Credits: 3**

Course Objective

The objective of this course is to familiarize the prospective engineers with techniques in ordinary differential equation, statistics, probability and Matrices. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Course Outcomes

On successful completion of the course, the students will learn:

1. The effective mathematical tools for the solutions of ordinary differential equations that model physical processes.
2. The essential tool of matrices incomprehensive manner.
3. The ideas of probability and various discrete and continuous probability distributions and the basic ideas of statistics including measures of central tendency, correlation and regression.

Syllabus

Module 1: First order ordinary differential equations (7 hours)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for e, equations solvable for y, equations solvable for x and Clairaut's type.

Module 2: Ordinary differential equations of higher orders (8 hours)

Second order linear differential equations with constant and variable coefficients, method of variation of parameters, Cauchy-Euler equation.

Module 3: Basic Statistics: (7 hours)

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves, correlation and regression–Rank correlation, multiple regression and correlation.

Module 4: Basic Probability: (8 hours)

Probability spaces, conditional probability, independence; Discrete random variables, Binomial distribution, Poisson distribution, Normal distribution. Relation between binomial, Poisson and Normal distributions.

Module 5: Matrices (10 hours)

Algebra of matrices, Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Eigenvalues and eigenvectors; Diagonalization of matrices;. Cayley Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms

Topics for Self Learning Application of Differential Equations.

Textbooks/References

1. ErwinKreyszig,AdvancedEngineeringMathematics,9thEdition,JohnWiley&Sons,2006.
2. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems,9thEdition,WileyIndia,2009.
3. S.L.Ross,DifferentialEquations,3rdEd.,WileyIndia,1984.
4. E.A.Codington,AnIntroductiontoOrdinaryDifferentialEquations,PrenticeHallIndia,1995.
5. E.L.Ince,OrdinaryDifferentialEquations,DoverPublications,1958.
6. B.S.Grewal,HigherEngineeringMathematics,KhannaPublishers,35thEdition,2000.
7. TheoryandProblemsofprobabilityandstatistics:2nded:J.R.Spiegal,Schaumseries
8. AtextbookofAppliedMathematicsVolumeI&II,byP.N.WartikarandJ.N.Wartikar,Pune VidhyarthiGrihaPrakashan,Pune-411030(India).
9. S.Ross,AFirstCourseinProbability,6thEd.,PearsonEducationIndia,2002

Syllabus for Semester I, B. TECH. CSE (AIML)

Course Code:	**CAT101**	**Course: Programming for Problem Solving**
L: 4 Hrs, T: 0 Hr, P: 0 Hr, Per Week		**Total Credits: 4**

Course Outcomes :

On successful completion of course student will learn:

1. To formulate simple algorithms for arithmetic and logical problems, translate the algorithms to programs (in C language), test and execute the programs and correct syntax and logical errors.
2. To implement conditional branching, iteration and recursion, to decompose a problem into functions and synthesize a complete program using divide and conquer approach.
3. To use arrays, pointers, structures and I/O operations for the formulation of algorithms and programs.
4. To apply programming to solve matrix addition, multiplication problems and searching & sorting problems.

UNIT-I: Introduction to Programming

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) Idea of Algorithm : Steps to solve logical and numerical problems. Representation of Algorithm: Flowchart / Pseudocode with examples. Arithmetic expressions and precedence

UNIT-II: C Programming Language

Introduction to C language: Keywords, Constant, Variable, Data types, Operators, Types of Statements,

Preprocessor Directives, Decision Control Statement-if, if-else, Nested if-else statement, Switch case, Loops and Writing and evaluation of conditionals and consequent branching.

UNIT-III: Arrays and Basic Algorithms

Arrays: 1-D, 2-D, Character arrays and Strings. Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

UNIT-IV: Functions and Recursion

User defined and Library Functions, Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference. Recursion: As a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT-V: Pointers and Structures

Structures, Defining structures, Array of Structures, Introduction to pointers, Defining pointers, Pointer

arithmetic, pointer operators, Use of Pointers in self-referential structures, notion of linked list (no implementation)

UNIT-VI: File handling

Streams in C, Types of Files, File Input/ Output Operations: Modes of file opening, Reading and writing the file, Closing the files, using fflush().

Text Books:

1. Programming in ANSI C : E. Balguruswami McGraw Hill
2. Mastering C: K. R. Venugopal and S. R. Prasad, Tata McGraw Hill

Reference Books:

1. Programming with C: Byron Gottfried, Schaums Outline Series.
2. Let Us C: Yashwant Kanetkar, BPB Publication

Syllabus for Semester I, B. TECH. CSE (AIML)

Course Code: CAP101	**Course: Programming for Problem Solving Lab**
L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week	**Total Credits: 1**

Course Outcomes:

On successful completion of course student will be able to:

1. Understand the fundamentals of C programming and choose the loops and decision making statements to solve and execute the given problem.
2. Implement different Operations on arrays also design functions to solve the given problem using C programming.
3. Understand pointers, structures, unions and apply them to develop programs.
4. Implement file Operations in C programming for a given application.

Syllabus for Semester I, B. TECH. CSE (AIML)

Course Code: IDT151	**Course: Creativity, Innovation & Design Thinking**
L: 1 Hrs, T: 0 Hr, P: 0 Hr, Per Week	**Total Credits: 1**

Course Outcomes

1. Be familiar with processes and methods of creative problem solving
2. Enhance their creative and innovative thinking skills
3. Practice thinking creatively and innovative design and development

Detailed Topics

UNIT I. Introduction: Making a case for creativity, Creative thinking as a skill, Valuing diversity in thinking: Thinking preferences, Creativity styles, Creativity in problem solving

UNIT 2. Pattern Breaking: Thinking differently , Lateral thinking, Mind stimulation: games, brain-twisters and puzzles, Idea-collection processes, Brainstorming/Brainwriting, The SCAMPER methods, Metaphoric thinking, Outrageous thinking , Mapping thoughts, Other (new approaches)

UNIT 3. Using Math and Science, Systematic logical thinking, Using math concepts, Eight-Dimensional (8D) Approach to Ideation: Uniqueness, Dimensionality, Directionality, Consolidation, Segmentation, Modification, Similarity, Experimentation

UNIT4. Systematic Inventive Thinking: Systematic inventive thinking: The TRIZ methodology, Decision and Evaluation: Focused thinking framework, Six thinking hats , Ethical considerations

UNIT 5. Design for Innovation: Introduction to design for interaction, nine lessons for innovation, difference in creativity and innovation, Building blocks for innovation

UNIT 6.Intellectual Property: Introduction to intellectual property: Patents, Copyrights©, Trademarks ®, Trade Secret, Unfair Competition.

Reference Books and Text Book :

1. Creative Problem Solving for Managers - Tony Proctor - Routledge Taylor & Francis Group
2. 101 Activities for Teaching creativity and Problem Solving - By Arthur B Vangundy - Pfeiffer
3. H. S. Fogler and S.E. LeBlanc, Strategies for Creative Problem Solving, Prentice Hall
4. E. Lumsdaine and M. Lumsdaine, Creative Problem Solving, McGraw Hill,
5. J. Goldenberg and D. Mazursky, Creativity in product innovation. Cambridge University Press, 2002.

Course Assignments for internal continuous assessment of 20 Marks (NO T1 and T2)

- Brain teasers (aka Puzzle Busters, to be solved individually)
- Cartoon captions (small teams)
- TRIZ, a systematic ideation method, reading (individual)
- Book readings and discussions (small teams)

• Small teams presentations on innovation: (1) innovative individual, (2) innovative company, (3) innovative movie / game, (4) sustainable innovation, (5) innovation in business, (6) innovation in art, (7) innovation in architecture, (8) innovative nation, (9) innovation in science, and (10) innovation in engineering.
• Large groups hands-on projects
• Eight-dimensional (8D) ideation method examples
• Large teams videos

Syllabus for Semester I, B. TECH. CSE (AIML)

Course Code: CAT102 **Course: Computer Workshop**

L: 1 Hrs, T: 0 Hr, P: 0 Hr, Per Week **Total Credits: 1**

Course Objectives

1. Understand the fundamentals of writing Python code
2. Learn core Python coding concepts such as data types, variables and flow control structures
3. Discover how to work with lists and sequence data, dictionaries & write functions
4. Use Python to read and write files

Introduction to Python: Installation and working with Python, Variables, Basic Operators
Python Data Types: int , float, complex, User Input, Arithmetic Expressions ,Using Strings and Operations on Strings, Use of list and list slicing, Use of Tuples
Flow Control: Conditional blocks: if, else, elif, For Loops in Python: Loops with range, Strings, List and Dictionaries, While Loop
Python Functions: Defining a function, using a function
Python String, List and Dictionary manipulations
Files: Reading and Writing Files in Python, File Operations

Course Outcomes
On successful completion of the course, students will be able to:

1. Learn basic fundamentals of writing a python code
2. Understand Lists, Dictionaries in Python.'
3. Create Functions in Python
4. Handle Strings and Files in Python

Text Books
1. Python Programming Using Problem Solving Approach: Reema Thareja, Oxford University Press; First edition

Syllabus for Semester I, B. TECH. CSE (AIML)

Course Code: CAP102	**Course: Computer Workshop Lab**
L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week	**Total Credits: 1**

Course Objectives

Throughout the course, students will be expected to learn Python Language basics to do the following:

1. Understand basic concepts of python code writing
2. Understand the basics of control flow operations, Use of Lists, Dictionaries
3. Develop program using functions
4. Develop programs for file handling

Syllabus

Programs based on:
1. Python Data Types
2. Flow Control
3. Functions
4. String
5. File handling

Course Outcomes

On successful completion of the course, students will be able to:
1. Write basic python code
2. Implement flow control in python
3. Implement functions in Python
4. Write python code for file handling

Syllabus for Semester I, B. TECH. CSE (AIML)

Course Code: HUT151 **Course: English**

L: 2 Hrs, T: 0 Hr, P: 0 Hr, Per Week **Total Credits: 2**

Course Objectives

The main objective of the subject is to enhance the employability skills of engineering students as well as communication skills at work place. The sub-objectives are:

1. To develop vocabulary of students.
2. To orient students in basic writing skills.
3. To orient students in functional grammar.
4. To orient students in the process of effective writing.
5. To provide practice and improve students' oral communication skills.

Course Outcomes

1. Students will have good word power.
2. Students will acquire basic writing skills.
3. Students will understand functional grammar and its usage.
4. Students will organize and express their thoughts effectively through written communication.
5. Students will learn oral communication skills in order to handle themselves effectively in an interview and group discussion

SYLLABUS

1. Vocabulary Building

1.1. The concept of Word Formation
1.2. Root words from foreign languages and their use in English
1.3. Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives
1.4. Synonyms, Antonyms and standard abbreviations

2. Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

3. Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Redundancies
3.6 Cliches

4. Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying

4.4 Providing examples or evidence

5. Writing Practices
5.1 Comprehension
5.2 Precis Writing
5.3 Essay Writing
5.4 Letter Writing
5.5 Email Writing

6. Oral Communication
(This unit involves interactive practice sessions in Language Lab)
• Listening Comprehension
• Pronunciation, Intonation, Stress and Rhythm
• Common Everyday Situations : Conversations and Dialogues
• Communication at Workplace
• Interviews
• Formal Presentations

Books
1. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
2. Practical English Usage. Michael Swan. OUP. 1995.
3. Remedial English Grammar. F.T. Wood. Macmillan.2007
4. On Writing Well. William Zinsser. Harper Resource Book. 2001
5. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Syllabus for Semester I, B. TECH. CSE (AIML)

Course Code: HUP151 **Course: English Lab**

L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week **Total Credits: 1**

Course objective :

1. To enhance competency of communication in English among learners.

Course outcomes:

1. Students learn presentation and public speaking skills
2. Students learn to practice effective strategies for Personal Interview and Group Discussions
3. Students learn and effectively apply language skills – listening, speaking, reading and writing

List of Practical (2 hours each for each batch) based on unit 6 (oral communication).

1. Common Everyday Situations: Conversations and Dialogues
2. Pronunciation, Intonation , Stress, and Rhythm
3. Formal Presentations: Orientation
4. Formal Presentations : Practice Session
5. Interviews: Orientation
6. Interviews: Practice Session
7. Communication at Workplace: Group Discussion- Orientation
8. Communication at Workplace: Practice Session

Syllabus for Semester II, B. E. Computer Science & Engineering (AIML)

Course Code : PHT154 **Course : Introduction to Quantum Computing**

L: 3 Hrs, T: 1 Hr, P: 0Hr, Per Week **Total Credits : 4**

Course Objectives

1. To introduce the fundamentals of quantum computing to students
2. The problem solving approach using finite dimensional mathematics

Course Outcomes:

After successful completion of the course, the students will learn,

1. Basics of complex vector spaces
2. Quantum mechanics as applied in Quantum computing
3. Architecture and algorithms
4. Fundamentals of Quantum computations

Module 1: Complex Vector Spaces

Algebra and Geometry of Complex numbers, Real and Complex Vector Spaces, definitions, properties, basis and dimensions, Generalization to n-dimensional space

Module 2: Linear Algebra

Inner products, Hilbert Spaces, Eigenvalues and Eigenvectors, Hermitian and Unitary Matrices, Tensor Product, Applications of linear algebra in computer graphics, Geometric transforms, positioning the virtual camera

Module 3: Basic Quantum Theory

Introduction to Quantum mechanics, Schrodinger's time dependent equation, Wave nature of Particles, expectation values, variance, standard deviation, probability density, Stationary states, Infinite square well, Uncertainty principle

Module 4: Classical and Quantum Systems

Deterministic and Probabilistic Systems, Quantum Systems, Observations, Quantum measurement principles, Stochastic matrices, Probabilistic double slit experiment with photons, Entangled states, Quantum clocks

Module 5: Architecture

Bits and Qubits, Classical Gates, Reversible Gates, Quantum Gates, Toffoli and Fradkin Gates, BlochSphere, Deusch Gate, No-cloning theorem, Applications in Cryptography and Quantum teleportation

Module 6: Quantum algorithms

Deutsch's algorithm, The Deutsch-Jozsa algorithm, Simon's periodicity algorithm, Grover's search algorithm, Shor's factoring algorithm, Quantum Fourier Transform

Text Book

1. Quantum computing for computer scientists, Noson S. Yanofsky, Mirco A. Mannucci,

CambridgeUniversityPress2008

2. Introduction to Quantum Mechanics, 2nd Edition, David J. Griffiths, Prentice Hall New Jersey1995

Reference Books

1. Quantum computing explained, David McMahon, Wiley-interscience, John Wiley & Sons, Inc. Publication2008
2. Quantum computation and quantum information, Michael A. Nielsen and Isaac L. Chuang, CambridgeUniversityPress2010

Syllabus for Semester II, B. E. Computer Science & Engineering (AIML)

Course Code : PHP154 **Course: Introduction to Quantum Computing Lab**

L: 0 Hrs, T: 0 Hr, P: 3 Hr, Per Week **Total Credits : 1.5**

Course Outcomes

The physics laboratory will consist of experiments and programming exercises illustrating the principles of physics relevant to the study of computer science and engineering. During the training in the Physics Lab, the students will be able,

1. To develop skills for experimental verification of physics laws
2. To analyze the results using the mathematical tools
3. To learn the computational techniques
4. To write the project reports

The laboratory will consist of general physics experiments and computational physics practicals.

General Physics:

1. Measuring scales and error estimation
2. Verification of Ohm's law and linear least square fitting method
3. Verification of Newton's law of cooling
4. Simple harmonic motion
5. Magnetic flux measurement using the graphical method of integration
6. Measurement, analysis and fitting of non-linear IV characteristics of PN junction diode

Computational Physics

1. Linear least square fit method for data analysis
2. Plotting of Plank's function and verification of Stefan's law
3. Finding inverse, norm and inner products, rank of a matrix
4. Introduction to quantum computing packages (GitHub repository)
5. Implementation of Deutsch-Josza algorithm using Cirq library

Project

Project on the applications of linear algebra, quantum mechanics or quantum computing to solve science and engineering problems.

Reference Books

1. Lab manual prepared by Physics Department, RCOEM, Nagpur

Syllabus for Semester II, B. E. Computer Science & Engineering (AIML)

Course Code : MAT151 Course : Calculus

L: 3 Hrs, T: 1 Hr, P: 0Hr, Per Week **Total Credits : 4**

Course Objective

The objective of this course is to familiarize the prospective engineers with techniques in Calculus and multivariate analysis. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes

On successful completion of the course, the students will learn:

The fallouts of Mean Valve Theorems that is fundamental to application of analysis to Engineering problems, to deal with functions of several variables that are essential in most branches of engineering.

Basics of improper integrals, Beta and Gamma functions, Curve Tracing, tool of power series and Fourier series for learning advanced Engineering Mathematics.

Multivariable Integral Calculus and Vector Calculus and their applications to Engineering problems.

Syllabus

Module - I : Differential Calculus: (12hours)

Taylor's and Maclaurin's series expansions; radius of curvature (Cartesian form), evolutes and involutes, Limit and continuity of functions of several variables and their partial derivatives, Eulers Theorem, chain rule, total derivative, Jacobians, Maxima, minima and saddle points; Method of Lagrange multipliers.

Module - II : Integral Calculus: (6 hours)

Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Tracing of curves (Cartesian form)

Module III Calculus: (6 hours)

Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Tracing
of curves (Cartesian form)

Module - IV : Sequences and series: (7 hours)

Convergence of sequence and series, tests for convergence, power series, Fourier series: Half range sine and cosine series, Parseval's theorem.

Module - V : Multiple Integrals (10 hours)

Multiple Integration: Double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: area, mass and volume by double integration, Center of mass and Gravity (basic concepts).

Module - VI : Vector Calculus (10 hours)

Vector Differentiation, Directional derivatives, total derivative, Gradient, Curl and Divergence. Vector integration , Theorems of Green, Gauss and Stokes and their applications.

Topics for self-learning

Rolle's theorem, Mean value theorems, Indeterminate forms , Maxima and minima for function of one variable, Geometrical interpretation of Partial Differentiation(Tangent plane and Normal line) , Applications of definite integrals to evaluate perimeter, area, surface areas and volumes of revolutions.

Textbooks/References

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
6. P. N. Wartikar and J. N. Wartikar, A text book of Applied Mathematics Volume I & II, Pune Vidhyarthi Griha Prakashan, Pune-411030 (India).

Syllabus for Semester II, B. E. Computer Science & Engineering (AIML)

Course Code : MAP151 Course: Computational Mathematics Lab

L: 0 Hrs, T: 0 Hr, P: 2Hr, Per Week Total Credits : 1

Course Outcomes

The Computational Mathematics Lab course will consist of experiments demonstrating the principlesof mathematics relevant to the study of science and engineering. Students will show that they havelearnt laboratory skills that will enable them to properly acquire and analyze the data in the lab and drawvalid conclusions.

At the end of the Course the students will learn to:

1. Develop skills to impart practical knowledge in real time.
2. Understand principle, concept, working and application of areas in mathematics and comparethe resultsobtainedwiththeoreticalcalculations.
3. Understand basics of mathematics, and report the results obtained through proper programming.

The Lab turns will be utilized for performing the experiments based on the following list

1. Calculus
2. Ordinary Differential Equations
3. Statistics
4. Linear Algebra

Suggested References

1. Computational Mathematics Lab Manual written by the Teaching Faculty of Mathematics Department, RCOEM.
2. Aminimumof8experimentstobeperformedbasedontheabovelist.

Syllabus for Semester II, B. E. Computer Science & Engineering AIML)

Course Code : CAT103 Course : Digital Electronics

L: 3 Hrs, T: 0 Hr, P: 0Hr, Per Week Total Credits : 3

Course Outcomes

After successful completion of this course, the student will be able to,

1. Understanding of various optimization techniques used to minimize and design digital circuits.
2. Analyze and design various combinational logic circuits.
3. Analyze and design various sequential circuits.
4. Design different microprocessor based components of computer system using combinational and sequential circuits.

Course Contents

UNIT-I

Basics of Digital Electronics

Motivation for digital systems: Logic and Boolean algebra, Number Systems. Logic Gates & Truth Tables, Demorgan's law, Minimization of combinational circuits using Karnaugh maps up to five variable. Map manipulation-essential prime implicants, non-essential prime implicants.

UNIT-II

Combinational Circuit Design

Design procedure: Multiplexers, Demultiplexer, Encoders, Decoders, Code Converters, Adders, Subtractor (Half, Full), BCD Adder / Subtractor, ripple and carry look-ahead addition.

UNIT-III

Sequential circuit Design-I

Storage elements, Flip-flops and latches: D, T, J/K, S/R flip-flops. Master Slave Conversion of one of type of F/F to another Sequential circuit. Analysis –Input equations, state table, and analysis with J-K Flip flops. Sequential circuit Design, Design procedure, designing with D & J-K Flip flop.

UNIT-IV

Sequential circuit Design-II

Counters, asynchronous and synchronous design using state and excitation tables. Registers & Shift registers.

UNIT-V

Programmable logic Design

Memory & Programmable logic Devices: RAM, Array of RAM IC's, Read only Memory, PLA, PAL, Flash Memories.

UNIT-VI

Fundamental of Microprocessor

Introduction to µp 8085, Addressing modes, Instruction set, Programming of µp 8085.

TextBooks

1. Morris Mano; Digital Logic Design; Fourth edition, McGraw Hill
2. R.P.Jain; Modern Digital Electronic; Fourth edition; Tata McGraw-Hill.
3. V.J.Vibhute; 8-Bit Microprocessor & Microcontrollers; fifth edition.

Reference books

1. A. Anand Kumar; Fundamental of Digital Electronics; Second Edition, PHI
2. A.P.Godse; Digital circuit & design; Technical Publications; 2009.
3. Ramesh Gaonkar; 8 bit Microprocessor; CBS Publishers; 2011.

Syllabus for Semester II, B. E. Computer Science & Engineering (AIML)

Course Code : CAP103 Course : Digital Electronics Lab

L: 0 Hrs, T: 0 Hr, P: 2Hr, Per Week Total Credits : 1

Course Outcome

On Successful completion of course, students will be able to:

1. Use logic gates for designing digital circuits
2. Implement combinational circuits using VHDL
3. Implement sequential circuits using VHDL
4. Apply the knowledge gained for their project work based on the hardware digital circuits

Practicals based on above theory syllabus

Syllabus for Semester II, B. E. Computer Science & Engineering (AIML)

Course Code : CAT104 Course : Object Oriented Programming

L: 3Hrs, T: 0 Hr, P: 0Hr, Per Week Total Credits : 3

Course Objectives

1. To make students understand Fundamental features of an object oriented language like Java: object classes and interfaces, exceptions and libraries of object collections
2. Introduce students with fundamental concepts like exception handling, generics, multithreading and streams.

Course Outcomes

On successful completion of the course, students will be able to demonstrate

1. Understand the principles of object-oriented programming; create classes, instantiate objects and invoke methods.
2. Understand concept of generics and implement collection classes. Use exception handling mechanism.
3. Efficiently work with streams, use multithreading for solving classic synchronization problems. Perform java database connectivity and execute basic SQL commands.
4. Understand characteristics and need of Design Pattern in Software Design Process.

SYLLABUS

UNIT I

Features of Object Oriented Programming languages, Abstraction, Encapsulation, Inheritance, polymorphism and late binding. Concept of a class, Access control of members of a class, instantiating a class, constructor and method overloading.

UNIT II

Concept of inheritance, methods of derivation, use of super keyword and final keyword in inheritance, run time polymorphism, abstract classes and methods, Interface, implementation of interface, creating packages, importing packages, static and non-static members, Lambda Expressions Introduction, Block, Passing Lambda expression as Argument.

UNIT III

Exceptions, types of exception, use of try catch block, handling multiple exceptions, using finally, throw and throws clause, user defined exceptions, Introduction to streams, byte streams, character streams, file handling in Java, Serialization.

UNIT IV

Generics, generic class with two type parameter, bounded generics. Collection classes: Arraylist, Linked List, Hashset, Treeset.

UNIT V

Multithreading: Java Thread models, creating thread using runnable interface and extending Thread, thread

priorities, Thread Synchronization, InterThread communications.

UNIT VI

Introduction to Design Patterns, Need of Design Pattern, Classification of Design Patterns, and Role of Design Pattern in Software design, Creational Patterns, Structural Design Patterns and Behavioral Patterns.

Text Books

1. Herbert Schildt; JAVA, the Complete Reference; Ninth Edition, Tata McGraw- Hill Publishing Company Limited.
2. Design Patterns by Erich Gamma, Pearson Education.

Reference Books

1. Cay S. Horstmann and Gary Cornell; Core JAVA Volume-II Advanced Features; Eighth Edition; Prentice Hall, Sun Microsystems Press 2008.
2. Herbert Schildt and Dale Skrien; Java Fundamentals A Comprehensive Introduction; Tata McGraw-Hill Education Private Ltd 2013.

Syllabus for Semester II, B. E. Computer Science & Engineering (AIML)

Course Code : CAP104 Course : Object Oriented Programming Lab

L: 0Hrs, T: 0 Hr, P: 2Hr, Per Week Total Credits : 1

Course Objectives

1. To develop ability of students to implement basic concepts and techniques of object oriented programming paradigm like encapsulation, inheritance, polymorphism, exception handling.
2. Develop solution to problems using collection classes, generics, streams, multithreading.

Course Outcomes

On completion of the course the student will be able to

1. Design solution to problems using concepts of object oriented programming like classes, objects, inheritance with proper exception handling.
2. Use collection classes, generic classes to design programs and perform database connectivity.
3. Implement programs based on streams and multithreading.

SYLLABUS

Experiments based on above Syllabus.

Syllabus for Semester II, B. E. Computer Science & Engineering (AIML)

Course Code : HUT152 Course : Constitution of India

L: 2 Hrs, T: 0 Hr, P: 0Hr, Per Week Total Credits : 0

Course outcome

1. Students will understand the role of constitution in democratic India
2. Students will be responsible students by knowing their fundamental rights and duties
3. Students will develop better understanding of democratic functions of the government of India
4. Students will form better understanding of system of governance for effective participation

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the Fundamental Rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Union Executive: structure, functions
10. Judiciary: Structure, role with special reference to PIL, writ petitions, strengthening of democracy & social Justice
11. Amendment of the Constitutional Powers and Procedure
12. Emergency Provisions: National Emergency, President Rule, Financial Emergency
13. Local Self Government – Constitutional Scheme in India
14. Provisions of civil services: Characteristics, functions, merits and demerits
15. Democratic principles in industry

Book

(1) Durga Das Basu "An Introduction to Constitution of India" 22nd Edition, LexisNexis

Syllabus for Semester II, B. E. Computer Science & Engineering (AIML)

Course Code : PEP151 Course : Yoga / Sports

L: 0Hrs, T: 0 Hr, P: 2Hr, Per Week Total Credits : 0

Course outcome

On successful completion of the course, students will be able to:_

1. Understand fundamental skills and basic rules of games offered by the Physical Education DepartmentofRCOEM.
2. Obtained health related physical fitness.
3. Develop body-mind co-ordination through games and yoga.
4. Changed sedentary life styles towards active living.

Brief Objectives of Sports/Yoga Practical Classes

It has long been proven that a healthy body leads to a healthy mind. With a strong belief in this,Physical Education Department at RCOEM will conduct Sports/Yoga Classes with the objective of maintaining health, fitness and wellness of students as well as create awareness about need for good health and physical fitness. The objective would also be to make the all-round development with team spirit, social values as well as to identify and develop leadership qualities in students through various sports activities. Sports activities would also be conducted with the objective to provide better interaction and recreation to the students which is an important neutralizer for stress. Additionally, theobjective would be to evaluate the health related fitness of students so as to recommend and conduct specific Yoga and Sports activities. The emphasis is on participation, with healthy competition.

Programme Outline

Sports

1. Introduction to sports, offered by the department.
2. Health and safety issues related to sports; knowledge, recognition and ability to deal with injuriesand illnessassociatedwithsports.
3. Practicing the fundamental skills and bringing awareness of basic rules and regulations.
4. Conduction of small recreational games and activities.

Yoga : Includes various sitting, standing and lying Asanas, Suryanamaskars and Pranayamas.

Physical Efficiency Tests : This includes 6 health related physical fitness tests.

Syllabus for Semester III, B. E. Computer Science & Engineering (Artificial Intelligence and Machine Learning)

Course Code : CAT201 Course : Data Structure

L: 3Hrs, T: 1Hr, P: 0Hr, Per Week Total Credits : 04

Course Objectives

1. To impart to students the basic concepts of data structures and algorithms.
2. To familiarize students on different searching and sorting techniques.
3. To prepare students to use linear (stacks, queues, linked lists) and non-linear (trees, graphs) data structures.
4. To enable students to devise algorithms for solving real-world problems.

SYLLABUS

UNIT I Data Structures and Algorithms Basics

Introduction : basic terminologies, elementary data organizations, data structure operations; abstract data types (ADT) and their characteristics. Algorithms: definition, characteristics, analysis of an algorithm, asymptotic notations, time and space tradeoffs. Array ADT: definition, operations and representations – row-major and column-major.

UNIT II Stacks and Queues

Stack ADT: allowable operations, algorithms and their complexity analysis, applications of stacks –expression conversion and evaluation (algorithmic analysis), multiple stacks.

Queue ADT: allowable operations, algorithms and their complexity analysis for simple queue and circular queue, introduction to double-ended queues and priority queues.

UNIT III Linked Lists

Singly Linked Lists: representation in memory, algorithms of several operations: traversing, searching, insertion, deletion, reversal, ordering, etc. Doubly and Circular Linked Lists: operations and algorithmic analysis. Linked representation of stacks and queues, header node linked lists.

UNIT IV Sorting and Searching

Sorting: different approaches to sorting, properties of different sorting algorithms (insertion, Shell, quick, merge, heap, counting), performance analysis and comparison.

Searching: necessity of a robust search mechanism, searching linear lists (linear search, binary search) and complexity analysis of search methods.

UNIT V Trees

Trees: basic tree terminologies, binary tree and operations, binary search tree [BST] and operations with time analysis of algorithms, threaded binary trees. Self-balancing Search Trees: tree rotations, AVL tree and operations, B+-tree: definitions, characteristics, and operations (introductory).

UNIT VI Graphs and Hashing

Graphs: basic terminologies, representation of graphs, traversals (DFS, BFS) with complexity analysis, path finding (Dijkstra's SSSP, Floyd's APSP), and spanning tree (Prim's method) algorithms.

Hashing: hash functions and hash tables, closed and open hashing, randomization methods (division method, mid-square method, folding), collision resolution techniques.

Course Outcomes

On completion of the course the student will be able to

1. Recognize different ADTs and their operations and specify their complexities.
2. Design and realize linear data structures (stacks, queues, linked lists) and analyze their computation complexity.
3. Devise different sorting (comparison based, divide-and-conquer, distributive, and tree- based) and searching (linear, binary) methods and analyze their time and space requirements.
4. Design traversal and path finding algorithms for Trees and Graphs.

Text Books

1. Ellis Horowitz, Sartaj Sahni & Susan Anderson-Freed, Fundamentals of Data Structures in C, Second Edition, Universities Press, 2008.
2. Mark Allen Weiss; Data Structures and Algorithm Analysis in C; Second Edition; Pearson Education; 2002.
3. G.A.V. Pai; Data Structures and Algorithms: Concepts, Techniques and Application; First Edition; McGraw Hill; 2008.

Reference Books

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein; Introduction to Algorithms; Third Edition; PHI Learning; 2009.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran; Fundamentals of Computer Algorithms; Second Edition; Universities Press; 2008.
3. A. K. Sharma; Data Structures using C, Second Edition, Pearson Education, 2013.

Syllabus for Semester III, B. E. Computer Science & Engineering (AIML)

Course Code : CAP201 Course : Data Structure Lab

L: 0Hrs, T: 0Hr, P: 2Hr, Per Week Total Credits : 01

Course Objectives

1. To enable students to employ different searching and sorting methods.
2. To prepare students to identify and apply linear (stacks, queues, linked lists) and non- Linear (trees,graphs)datastructuresinsolvingproblems.
3. To encourage students to design and execute tree-based algorithms for solving real- world problems.

SYLLABUS

Experiments based on CAT201 Syllabus in C | C++.

Course Outcomes

On completion of the course the student will be able to

1. Design and realize different linear data structures.
2. Identify and apply specific methods of searching and sorting to solve a problem.
3. Implement and analyze operations on binary search trees and AVL trees.
4. Implement graph traversal algorithms, find shortest paths and analyze them.

Reference Books

1. K R. Venugopal and Sudeep. R Prasad; Mastering C; Second Edition; McGraw Hill; 2015.
2. Ellis Horowitz, Sartaj Sahni & Susan Anderson-Freed, Fundamentals of Data Structures in C,Second Edition, Universities Press, 2008.
3. Mark Allen Weiss; Data Structures and Algorithm Analysis in C; Second Edition; Pearson Education; 2002.

Syllabus for Semester III, B. E. Computer Science & Engineering

(Artificial Intelligence and Machine Learning)

Course Code : CAT202 Course : Computer Architecture

L: 3Hrs, T: 0Hr, P: 0Hr, Per Week Total Credits : 03

Course Objectives

1. To familiarize student with computer architecture and organization.
2. Prepare student to perform mathematical operation and execute complete instruction in computer.
3. Prepare students to analyse performance of various memories.
4. To familiarize student with input/output operation and interrupt handling mechanism.

SYLLABUS

UNIT I : Basic Structure Of Computers: Functional units of computer. Instructions set architecture ofa CPU-Instruction sequencing, Addressing modes, and instruction set classification, subroutine & parameter passing, expanding opcode, RISC and CISC.

UNIT II : Basic Processing Unit: Bus architecture, Execution of a Complete Instruction, sequencing of control signals, Hardwired control, Micro-programmed Control.

UNIT III : Data Representation : signed number representations and their operations, Computer arithmetic – integer addition and subtraction, design of Fast Adders, Multiplication- shift and add,booth's Algorithm, bit-pair recoding, Integer Division- restoring and non-restoring division. Floating point numbers-representation, arithmetic, guard bits and rounding.

UNIT IV : Concept of hierarchical memory, Memory System Design: Semiconductor RAM memories, Static and Dynamic Memories, ROM, higher order memory design, multi-module memories, Memory interleaving, Cache memory, Cache size vs. block size, mapping functions, replacement algorithms, Cache read/write policy, Virtual Memory. Secondary storage – Magnetic disk, Optical disk.

UNIT V : Input/output Organization: I/O mapped I/O and memories mapped I/O, interrupt and interrupt handling mechanisms, vectored interrupts, synchronous vs. asynchronous data transfer, Bus Arbitration, Direct Memory Access,

UNIT VI : Pipelining: Basic concepts of pipelining, throughput and speedup, Introduction of Parallel Computing: SISD, MISD, SIMD, MIMD

Course Outcomes:
On Successful completion of course, students will be able to:

1. Describe basic components of a computer, including CPU, memories, and input/output, and their organization.
2. Execute complete instruction and design control unit.

3. Perform mathematical operations on arithmetic and floating point numbers.
4. Analyse cost performance trade off in designing memory hierarchy and instruction sets.

Text Books

1. V.C.Hamacher, Z.G.Vranesic and S.G.Zaky; Computer Organisation; 5th edition; Tata McGrawHill, 2002.
2. W. Stallings; Computer Organization & Architecture; PHI publication; 2001.
3. J. P. Hayes; Computer Architecture & Organization; 3rd edition; McGraw-Hill; 1998.
4. Reference Books
5. M Mano; Computer System and Architecture; PHI publication; 1993.
6. A.S.Tanenbaum; Structured Computer Organization; Prentice Hall of India Ltd.ProgrammeScheme & Syllabi for B.E. (Computer Science & Engineering)

Syllabus for Semester III, B. E. Computer Science & Engineering

(Artificial Intelligence and Machine Learning)

Course Code : MAT271 Course : Mathematics for Machine Learning L: 3Hrs, T: 0Hr, P: 0Hr, Per Week Total Credits : 03

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in linear algebra and optimization. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes

On successful completion of the course, the students will learn:

Computational techniques and algebraic skills essential for the study of systems of linear equations, matrix algebra, vector spaces, eigen values and eigenvectors, orthogonality and diagonalization.

Visualization, spatial reasoning, as well as geometric properties and strategies to model, solve problems, and view solutions, especially in R^2 and R^3, as well as conceptually extend these results to higher dimensions.

Understand the optimization formulations and methods to vital in designing algorithms to extract essential knowledge from huge volumes of data.

Syllabus :

Module - 1 (9 - Lectures) Vector Space; Subspaces; Linear Dependence and Independence; Basis; Dimension; Linear transformation; Range Space and Rank; Null Space and Nullity; Rank nullity theorem, Matrix Representation of a linear transformation; Linear Operators on and their representation as square matrices; Invertible linear operators.

Module - 2 (9-Lectures) : Eigenvalues and Eigenvectors of a linear operator; Inner Product Spaces, Norm; Orthonormal Sets, Gram Schmidt orthogonalisation process; projections, positive definite matrices, and Singular Value Decomposition.

Module - 3 (9 - Lectures) : Dimentionality Reduction with PCA : Properties and application of SVD, Least square approximation, principal component analysis ,Linear discriminant analysis ,Low rank approximation.

Module -4 (9 - Lectures) : Continuous Optimizations : Optimization using gradient descent, Constrained optimization, Convex optimization, Linear programming , Quadratic programming .

Text Books

1. Hoffman and Kunze : Linear Algebra, Prentice Hall of India, New Delhi
2. Gilbert Strang : Linear Algebra And Its Applications (Paperback) , Nelson Engineering (2007)
3. Mark Peter Deisenroth,A.Aldo Faisal,Chen Soon Ong :Mathematics for Machine Learning.Cambridge University Press.

4. Stephen Boyd and Lieven Vandenberghe: Convex optimization .Cambridge University Press.

Reference Books

1. Seymour Lipschutz et al: Linear Algebra, 3rded: Schaum outlinevseries.
2. V. Krishnamoorthy et al : An introduction to linear algebra , Affiliated East West Press, New Delhi
3. P.G. Bhattacharya, S.K. Jain and S.R.
4. Nagpaul : First course in Linear Algebra, Wiley Eastern Ltd., New Delhi
5. K.B.Datta : Matrix and Linear Algebra, Prentice Hall of India, New Delhi

Syllabus for Semester III, B. E. Computer Science & Engineering

(Artificial Intelligence and Machine Learning)

Course Code : CAT203 Course : Operating System

L: 3Hrs, T: 0Hr, P: 0Hr, Per Week Total Credits : 03

Course Objectives

1. The course focuses on developing a fundamental knowledge of operating systems.
2. The course targets at the detail understanding of the basic tasks such as scheduling, memory management and File systems
3. It also covers the complex concepts of inter process communication and deadlocks.

SYLLABUS:

UNIT I:
Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine, Case study on LINUX and Windows Operating System.

UNIT II:
Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. Threads: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads. Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SRTF, Priority, RR, Case study on Process Management in LINUX Operating System.

UNIT III:
Inter-process Communication : Critical Section, Race Conditions, Mutual Exclusion, Peterson's solution, Hardware Solution, Semaphores, Monitors, Message Passing, Classical IPC Problems: Producer-Consumer Problem, Reader-Writer Problem, Dinning Philosopher Problem etc.

UNIT IV:
Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

UNIT V:
Memory Management: Basic concept, Logical and Physical address mapping, Memory allocation: Contiguous Memory allocation – Fixed and variable partition, Internal and External fragmentation and Compaction, Paging: Principle of operation – Page allocation, Hardware support for paging, Protection and sharing, Advantages & Disadvantages of paging. Virtual Memory: Basics of Virtual Memory, Hardware and control structures, Locality of reference, Page fault, Working Set, Dirty page/ Dirty bit, Demand paging; Page Replacement, algorithms: First in First Out (FIFO), Least Recently used (LRU), and Optimal.

UNIT VI:

File Management : Concept of File, Access methods, File types, File operations, Directory structure, File System structure, Allocation methods, Free-space management.
Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK, Disk reliability, Disk formatting, Boot block, Bad blocks, case study on File Systems in LINUX operating System.

Course Outcomes:
On successful completion of the course, students will be able to:

1. Describe and Classify differing structures for operating systems.
2. Understand the role of various components (process, page, file systems etc) of operating system.
3. Analyze and apply resource (CPU, Memory, Disk) management policies.
4. Determine challenges in inter process communication and design solution for it.

Text Books

1. Operating System Concepts, 8th Edition by A. Silberschatz, P.Galvin, G. Gagne, Wiley India.
2. Modern Operating Systems, 2nd Edition by Andrew Tanenbaum, PHI.

Reference Books:

1. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.
2. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly

Syllabus for Semester III, B. E. Computer Science & Engineering

(Artificial Intelligence and Machine Learning)

Course Code : CAP203 Course : Operating System Lab

L: 0Hrs, T: 0Hr, P: 2Hr, Per Week Total Credits : 01

Course Objectives

1. The course provides practical exposure to design and implementation of concepts in operating systems such as system calls, CPU scheduling, process/thread management.
2. It focuses on implementation of resource management methodologies such as concurrency management, memory management, and File management.

SYLLABUS

Experiments based on CAT203 Syllabus.

Course Outcomes

On successful completion of the course, students will be able to:

1. Demonstrate LINUX system calls and implement system commands.
2. Implement processes and process schedulers.
3. Design and implement solution to handle synchronization and deadlock.
4. Implement Memory management and File management solutions.

Syllabus for Semester III, B. E. Computer Science & Engineering

(Artificial Intelligence and Machine Learning)

Course Code : HUT253 Course : Business Communication

L: 3Hrs, T: 0Hr, P: 0Hr, Per Week Total Credits : 03

SYLLABUS

UNIT I Fundamentals of Business Communication
Definition of communication and business communication, Objectives of Business Communication, Audience recognition, Barriers of Communication, Product Promotion, Usage of Social Media, Negotiation Skills, Persuasive Communication, PAC concept.

UNIT II Technical Writing
Process of Technical Writing, Types of Technical Writing. Letters: Job application, Job Description and CV, enquiry, complaint, order, follow-up, cover/transmittal letters, and e-mails. Writing to Persuade: Proposals and Sales Letters. Other Forms of Technical Writing: Notices, Circulars, Memos, Organizational announcements, Minutes of Meeting.

UNIT III Grammar for Writing
Functional Grammar: Punctuations, Mechanics, Active/ Passive, Transformation of Sentences, Subject-Verb Agreement, Articles, Prepositions.

UNIT IV Business Reports
Basic formats and types (Annual, Progress, Project (Project Charter, Project Timeline), Market Search, Sales, Feasibility/Recommendation), Case Study evaluation.

UNIT V Preparation of Documents
Visual Appeal: Document Design, Graphics, Tables, User Manuals, Brochures, Fliers.

UNIT VI Effective Oral Communication
Non-Verbal Communication, Public speaking, Presentation, Group Discussion.

Course Outcomes

1. Students will understand the fundamentals and objectives of business communication, and role of audience in effective communication.
2. Students will develop technical writing skills and produce effective workplace documents.
3. Students will learn the application of grammar in writing.
4. Students will develop skills to enhance visual appeal of documents.
5. Students will understand strategies for effective oral communication for professional needs.

Syllabus for Semester III, B. E. Computer Science & Engineering

(Artificial Intelligence and Machine Learning)

Course Code : HUT257 Course : Cyber Laws and Ethics in IT

L: 2Hrs, T: 0Hr, P: 0Hr, Per Week Total Credits : 02

Course Objectives

1. Describe laws governing cyberspace and analyze the role of Internet Governance in framing policies for Internet security
2. Identify intellectual property right issues in the cyberspace and design strategies to protect your intellectual property
3. Understand the importance of freedom of expression, defamation and hate speech in Cyber world.
4. Recognize the importance of digital divide, contingent workers and whistle blowing situations.

SYLLABUS

UNIT I

Cyber laws and rights in today's digital age; IT Act, Intellectual Property Issues connected with use and management of Digital Data, Emergence of Cyberspace, Cyber Jurisprudence.

UNIT II

Cyber Crimes against Individuals, Institution and State, Hacking, Digital Forgery, Cyber Stalking/Harassment, Cyber terrorism, Cyber Defamation, Different offences under IT Act, 2000,Cyber Torts.

UNIT III

Ethics in business world, Ethic s in IT, Ethics for IT professionals and IT users, IT professional malpractices, communications eavesdropping, computer break-ins, denial-of-service, destruction and modification of data, distortion and fabrication of information, Types of Exploits and Perpetrators.

UNIT IV

Intellectual Property: Copy rights, Patents, Trade Secret Laws, Key Intellectual property issues, Plagiarism, Competitive Intelligence, Cybersquatting, Information warfare policy and ethical Issues.

UNIT V

Privacy: The right of Privacy, Protection, Key Privacy and Anonymity issues, Identity Theft, Consumer Profiling, Defamation, Freedom of Expression, Anonymity, National, Security Letters, Defamation and Hate Speech.

UNIT VI

Ethics of IT Organization: Contingent Workers H- IB Workers, Whistle- blowing, Protection for Whistle- Blowers, Handling Whistle- blowing situation, Digital divide.

Course Outcomes

On successful completion of the course, students will be able

1. To identify and analyze statutory, regulatory, constitutional, and organizational laws that affectsthe softwareprofessional.
2. To understand carious cyber laws with respect to legal dilemmas in the Information Technology field.
3. To interpret various intellectual property rights, Privacy, Protection issues in software developmentfield.
4. To understand role of ethics in IT organization.

Text Books

1. George Reynolds, "Ethic s in information Technology",5th edition, Cengage Learning
2. Hon C Graff, Cryptography and E-Commerce - A Wiley Tech Brief, Wiley Computer Publisher,2001.

Reference Books

1. Michael Cross, Norris L Johnson, Tony Piltzecker, Security, Shroff Publishers and Distributors Ltd.
2. Debora Johnson," Computer Ethic s",3/e Pearson Education.
3. Sara Baase, "A Gift of Fire: Social, Legal and Ethical Issues, for Computing and the Internet," PHI Publications.
4. Chris Reed & John Angel, Computer Law, OUP, New York, (2007).

Syllabus for Semester III, B. E. Computer Science & Engineering

(Artificial Intelligence and Machine Learning)

Course Code : CAP204 Course : Python Programming Lab

L: 0Hrs, T: 0Hr, P: 4Hr, Per Week Total Credits : 02

Course Objective

The course focuses on developing the python programming skills to do a variety of programming tasks where the students are encouraged to develop application using python. Apart from the basic constructs of python programming, data structures, object oriented programming, exception handling is covered. The course also targets the coverage of important modules and libraries available in python.

Syllabus

- Arithmetic, logical operations, Control statements, Functions, Class and OOM
- String, List, Array, Tuples, Dictionary, Set
- Collections, Files, Exception Handling
- Module, Packages, Library
- Plotting, Web scrapping, Multimedia services
- Matplotlib, Pandas, Request, Numpy
- Beautifil soup, Pyglet, Scrapy, PyGame
- Pywin32, PyGTK, Geopy

Course Outcome

On Successful completion of course student will be able to :

1. Identify, Recall syntax of various constructs in python programming
2. Understand the usage of various instructions, functions, modules, packages and libraries in python programming
3. Write, debug and execute python program to solve given problem
4. Select an appropriate instruction, function, module and libraries for writing an efficient and correct code in python
5. Design a small python based software to solve a numerical, multimedia, games, location, web based problems.

Reference Books

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.
2. Shroff "Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.
3. David M.Baezly "Python Essential Reference". Addison-Wesley Professional; Fourth Edition, 2009.
4. David M. Baezly "Python Cookbook" O'Reilly Media; Third edition, 2013.

Syllabus for Semester IV, B. E. Computer Science & Engineering

(Artificial Intelligence and Machine Learning)

Course Code : CAT205 Course : Computer Network

L: 3Hrs, T: 1Hr, P: 0Hr, Per Week Total Credits : 04

Course Objectives

1. To develop an understanding of modern network architectures from a design and performance perspective.
2. To introduce the student to the major concepts involved in network protocols.
3. To provide an opportunity to do network programming

SYLLABUS

UNIT - I

Data communication Components: Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN,Wireless LANs, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Timedivision and Wavedivision

UNIT - II

Data Link Layer : Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, SelectiveRepeatARQ.

UNIT - III

Medium Access Sub Layer : Switching, Random Access, Multiple access protocols - Pure ALOHA,Slotted ALOHA,CSMA/CD,CDMA/CA,IEEE 802 standard protocols.

UNIT - IV

Network Layer : Internet Protocol (IP) – Logical Addressing: IPV4, IPV6; Address mapping: ARP, RARP, BOOTPand DHCP–Delivery,Forwardingand UnicastRoutingprotocols.

UNIT - V

Transport Layer : Elements of Transport protocols: Addressing, Connection establishment,Connection release, Crash recovery, User Datagram Protocol (UDP), Transmission Control Protocol(TCP), TCP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

UNIT - VI

Application Layer : Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP),WWW, HTTP, SNMP, Bluetooth, Firewalls; AI in network infrastructure, Self-Healing Networks

Course Outcomes

On successful completion of the course, students will be able to:

1. Understandbasicsofcomputernetworksandreferencemodels

2. Identify the Design issues of each layer of OSI model
3. Implement the protocols of OSI model

Text Books

1. Computer Networks: 5th ed by Andrew. S. Tanenbaum. PHI Publication.
2. Data Communications and Networks: 3rd ed by Behrouz A. Forouzan. TataMcGraw Hill publication.

Reference Books

1. James F. Kurose and Keith W. Ross: Computer Networking: A Top-Down Approach Featuring the Internet, 3rd Edition.
2. William Stallings, "Data and Computer Communications", PHI 6th Edition

Syllabus for Semester IV, B. E. Computer Science & Engineering

(Artificial Intelligence and Machine Learning)

Course Code : CAP205 Course : Computer Network Lab

L: 0Hrs, T: 0Hr, P: 2Hr, Per Week Total Credits : 01

Course Objectives

1. To introduce use of different network simulation software.
2. To analyze performance of different protocols at various layers of a network architecture.
3 To demonstrate the implementation of various networking concepts.

Prerequisites: Basic knowledge of computer network, equipment

SYLLABUS

Experiments based on CAT205 Syllabus.

Course Outcomes

On successful completion of the course, students will be able to:

1. Simulate and then configure different types of networks.
2. Implement algorithms present in different layers of OSI model
3. Implement networking concepts like server, client and addressing mechanism.

Syllabus for Semester IV, B. E. Computer Science & Engineering

(Artificial Intelligence and Machine Learning)

Course Code : CAT206 Course : Artificial Intelligence Principles and Techniques

L: 3Hrs, T: 1Hr, P: 0Hr, Per Week Total Credits : 04

Course Objectives

1. To introduce artificial intelligence and challenges involved in designing intelligent systems.
2. To learn state space representation and problem solving by using various search techniques.
3. To cover basic knowledge representation methods using logic programming.
4. To understand uncertainty theory in designing AI systems.

Syllabus

UNIT - I

Introduction : Basics of problem solving, problem representation (toy problems and real world problems); Structure of agent, rational agent, Specifying task environment, Properties of task environment; measuring problem-solving performance

UNIT - II

Uninformed search techniques: Depth, Breadth, Uniform Cost, Depth Limited, Iterative deepening DFS, Bidirectional Search

UNIT - III

Informed search techniques: Heuristic Based Search, Greedy Best First Search, A* Search; Local Search algorithms: Hill-climbing, Simulated Annealing, Genetic Algorithms.

UNIT - IV

Adversarial Search: Two player Games, The min-max algorithm, Alpha-Beta pruning. Constraint Satisfaction Problems: Constraint propagation, backtracking search

UNIT - V

Propositional Logic: Inference, Equivalence, Validity and satisfiability, Resolution, Forward and Backward Chaining, First Order Logic: Syntax and Semantics of FOL, Inference in FOL, Unification algorithm, Forward Chaining, Backward Chaining, and Resolution.

UNIT - VI

Uncertainty Knowledge and Reasoning: Probability and Baye's Theorem, Statistical reasoning: Bayesian networks, Bayes optimal classifier, Naïve bayes algorithm, Fuzzy Logic, Introduction to expert system

Course Outcomes

On successful completion of the course, students will be able to:

1. Represent given problem using state space representation and apply uninformed and informed search techniques on it.
2. Solve the fully informed two player games using different AI techniques.
3. Solve the AI problems by using logic programming
4. Apply uncertainty theory based on techniques such as probability theory and fuzzy logic.

Text Book

Stuart Russel and Peter Norvig; Artificial Intelligence: A Modern Approach; Third Edition; Pearson Education, 2009.

Reference Books

1. E. Rich, K. Knight, S. B. Nair; Artificial Intelligence; 3rd Edition; Tata McGraw Hill, 2014.
2. Denis Rothman; Artificial Intelligence By Example: Develop machine intelligence from scratch using real artificial intelligence use cases; Kindle Edition, Packt Publishing Ltd, 2018

Syllabus for Semester IV, B. E. Computer Science & Engineering

(Artificial Intelligence and Machine Learning)

Course Code : CAP206 Course : Artificial Intelligence Principles and Techniques

Lab L: 0Hrs, T: 0Hr, P: 2Hr, Per Week Total Credits : 01

Course Outcomes

On successful completion of the course, students will be able to:

1. Implement different AI toy problems by using search techniques.
2. Design two player games using min-max algorithm with Alpha-Beta pruning.
3. Simulate AI problems using logic programming.
4. Implement probabilistic based methods to solve classification problems. PRACTICALS BASED ON CAP206

SYLLABUS

Reference Books

1. Stuart Russel and Peter Norvig; Artificial Intelligence: A Modern Approach; Third Edition; Pearson Education, 2009.
2. E. Rich, K. Knight, S. B. Nair; Artificial Intelligence; 3rd Edition; Tata McGraw Hill, 2014.
3. Denis Rothman; Artificial Intelligence By Example: Develop machine intelligence from scratch using real artificial intelligence use cases; Kindle Edition, Packt Publishing Ltd, 2018

Syllabus for Semester IV, B. E. Computer Science & Engineering

(Artificial Intelligence and Machine Learning)

Course Code : CAT207 Course : Theory Computation

L: 3Hrs, T: 1Hr, P: 0Hr, Per Week Total Credits : 04

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.

SYLLABUS

UNIT I

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

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

UNIT III

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

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

Turing machines: The basic model for Turing machines (TM), Turing recognizable recursively enumerable) and Turing-decidable (recursive) languages, variants of Turing machines, unrestricted grammars and equivalence with Turing machines, TMs as enumerators.

UNIT VI

Undecidability: Church-Turing thesis, Universal Turing machine, Undecidable problems about languages, Recursive Function Theory.

Course Outcome

On successful completion of the course, students will be able to demonstrate

1. Describe the formal relationships among machines, languages and grammars.
2. Design and Optimize finite automata for given regular language.

3. Design Push Down Automata, Turing Machine for given languages.
4. Demonstrate use of computability, decidability, recursive function theory through Problem solving.

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 Education Asia.
2. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.
3. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.
4. John Martin, Introduction to Languages and The Theory of Computation, Tata McGraw Hill

Syllabus for Semester IV, B. E. Computer Science & Engineering

(Artificial Intelligence and Machine Learning)

Course Code : CAT208 Course : Design and Analysis of Algorithms

L: 3Hrs, T: 1Hr, P: 0Hr, Per Week Total Credits : 04

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.

SYLLABUS

UNIT - I : Mathematical foundations for arithmetic and geometric series, Recurrence relations and their solutions, Principles of designing algorithms and complexity calculation, Asymptotic notations for analysis of algorithms, worst case and average case analysis, amortized analysis and it's applications.

UNIT - II : 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 : Greedy method – basic strategy, 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 : Dynamic Programming -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.

UNIT - V : 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 - VI : 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

Course Outcomes

On successful completion of the course, students will be able to:

1. Understand mathematical formulation, complexity analysis and methodologies to solve the recurrence relations for algorithms.
2. Design Greedy and Divide and Conquer algorithms and their usage in real life examples.
3. Design Dynamic programming and Backtracking Paradigms to solve the real life problems.
4. Understand NP class problems and formulate solutions using standard approaches.

Text Books

1. Thomas H. Cormen et.al; “Introduction to Algorithms”; 3 Edition; Prentice Hall, 2009.
2. Horowitz, Sahani and Rajasekaram; “Computer Algorithms”, Silicon Press, 2008.
3. 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.

Syllabus for Semester IV, B. E. Computer Science & Engineering

(Artificial Intelligence and Machine Learning)

Course Code : CAP209 Course : Software Lab - 1

L: 0Hrs, T: 0Hr, P: 2Hr, Per Week Total Credits : 01

Course Objective

The course introduces processes, tools, and methodologies to balance needs throughout the software development life cycle, from coding and deployment, to maintenance and updates.

Course Prerequisite

Basic understanding of Linux and operating system fundamentals, Web Development fundamentals and Java and programming fundamentals.

Course Contents

- Introduction to Dev Ops.
- Version Control System (Git and Git Hub).
- Integration, Deployment and Building (Jenkins).
- Resource Management and Configuration (Puppet and Chef).
- Containerization (Docker).
- Working with Nagios Monitoring Tool.
- Cloud services and DevOps.

Course Outcome

On Successful completion of course student will be able to:

1. Understand Processes, Tools, and Methodologies in Software Development Lifecycle.
2. Implement Agile Software Development Life Cycle.
3. Integrate Software Development and its Operations.
4. Use Cloud Environment and its Services

Reference Books

1. The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations by by Gene Kim, Patrick Debois, John Willis , Jez Humble.
2. Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale by Jennifer Davis.
3. Python for DevOps: Learn Ruthlessly Effective Automation by Noah Gift , Kennedy Behrman, Alfredo Deza, Grig Gheorghiu.
4. Building Microservices: Designing Fine-Grained Systems by Sam Newman.
5. Effective DevOps with AWS: Ship faster, scale better, and deliver incredible productivity by Nathaniel Felsen

Syllabus for Semester IV, B. E. Computer Science & Engineering (Artificial Intelligence and Machine Learning)

Course Code : CHT252 Course : Environmental Science

L: 2Hrs, T: 0Hr, P: 0Hr, Per Week Total Credits : Nil (Audit Course)

SYLLABUS

Principle of contaminant behaviour and recent trends in environmental pollution control.

UNIT - I

Air pollution and its control techniques: (4 lectures)

Contaminant behaviour in the environment, Air pollution due to SOx, NOx, photochemical smog, Indoor air pollution Natural pathways for degradation: Carbon cycle, Sulphur cycle, Nitrogen cycle, Oxygen cycle Factors responsible for altering the composition of atmosphere (deforestation, burning of fossil fuels, industrial and vehicular emissions, CFCs). Techniques to control Air pollution, ambient air quality and continuous air quality monitoring, Control measures at source, Kyoto Protocol, Carbon Credits.

UNIT - II

Noise pollution and its control techniques: (2 lectures)

Introduction to noise pollution and its causes. Noise pollution control: Recent advances in noise pollution control and benefits.

UNIT - III

Soil pollution and its control techniques: (5 lectures)

Soil pollution: Soil around us, Soil water characteristics, soil pollution.

Solid waste management: Composting, vermiculture, landfills, hazardous waste treatment, bioremediation technologies, conventional techniques (land farming, constructed wetlands),and phytoremediation. Degradation of xenobiotics in environment: Petroleum hydrocarbons, pesticides, heavy metals

UNIT - IV

Water pollution and its control techniques: (8 lectures)

Major sources of water pollution: Eutrophication, acid mine drains, pesticides and fertilizers, dyeing and tanning, marine pollution, microplastics Techniques to control water pollution: Conventional waste water treatment-types of sewage, ewerage system, alternative systems, primary, secondary and tertiary processes including aerobic and anaerobic techniques, safe disposal. Case studies: Treatment schemes for waste water from dairy, textile, power plants, pharmaceutical industries, and agro based industries such as rice mills.

UNIT - V

E-wastes (2 lectures)

Introduction, types of e-wastes, environmental impact, e-waste recycling, e-waste management rules.

Unit - VI

Environmental Sustainability: Role of Green technology (5 lectures)

Concept of green technologies, categories, goals and significance, sustainability Green energy, green chemistry, challenges to green technology, advantage and disadvantages of green processes, Eco mark certification- its importance and implementation VII- Different government initiatives (2 lectures) National ambient air quality standard 2009, Swacch Bharat Abhiyan, National afforestation program and Act-2016, National river conservation plan, Formation of National Green Tribunal

Course Outcomes

On successful completion of the course, students

1. Will get sufficient knowledge regarding different types of environmental pollutions, their causes, detrimental effects on environment and effective control measures.
2. Will realize the need to change an individual's outlook, so as to perceive our Environmental issues correctly, using practical approach based on observations and self-learning.
3. Will become conversant with recent waste management techniques such as E-wastes, its recycling and management.
4. Will gain knowledge about the modes for sustainable development, importance of green energy and processes.
5. Will be able to identify and analyze environmental problems as well as risks associated with these problems and greener efforts to be adopted, to protect the environment from getting polluted.

Suggested Books

1. Benny Joseph, Environmental Studies, Mc Graw Hill Education (India) Private Limited
2. B. K. Sharma, Environmental Chemistry, Goel Publishing House, Meerut
3. P Aarne Vesilind, J. Jeffrey Peirce and Ruth F. Weiner, Environmental Pollution and Control, Butterworth - Heinemann
4. D. D. Mishra, S. S. Dara, A Textbook of Environmental Chemistry and Pollution Control, S. Chand & Company Ltd. Sultan Chand & Company
5. Shree Nath Singh, Microbial Degradation of Xenobiotics, Springer-Verlag Berlin Heidelberg
6. P.T. Anastas & J.C. Warner, Green Chemistry: Theory & practice, Oxford University Press
7. P. Thangavel & Sridevi, Environmental Sustainability: Role of Green technologies, Springer publications.

Syllabus for Semester V, B. Tech. Computer Science & Engineering (Artificial Intelligence and Machine Learning)

Course Code:	**CAT301**	**Course:**	**Database Management Systems**
L:3 Hrs, T: 0 Hr, P: 0 Hr, Per Week		**Total Credits:**	**3**

Course Objectives

The objective of this course is:
To understand the role of a database management system in an organization.
To construct simple and advanced database queries using a data language.
To understand and apply logical database design principles and database normalization.
To recognize the need for transaction management and query processing.

Syllabus

Unit 1: Database - Fundamentals and Architecture

Databases and Database Users, Characteristics of the Database Approach, Advantages of Using the DBMS Approach, When Not to Use a DBMS, Data Models, Schemas, and Instances, Three-Schema Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment. Introduction to NoSQL databases and In-Memory databases.

Unit 2: Relational Model and SQL

Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions, and Dealing with Constraint Violations, SQL Data Definition, Data Types and Constraints, Data Management in SQL, Transforming ER Model into Relational Model.

Unit 3: Database Design and Normalization

Functional Dependencies, Inference Rules, Equivalence, and Minimal Cover, Properties of Relational Decomposition, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form, Other Dependencies and Normal Forms.

Unit 4: Indexing and Hashing

Ordered Indices, B+-Tree Index Files and its Extensions, Static Hashing and Dynamic Hashing, Comparison of Ordered Indexing and Hashing, Bitmap Indices, Some General Issues Concerning Indexing.

Unit 5: Query Processing and Optimization

Measures of Query Cost, Query Operation: Selection, Sorting and Join Operation, Transformation of Relational Expressions, Estimating Statistics of Expression Results, Choice of Evaluation Plans.

Unit 6: Transaction Processing, Concurrency Control and Recovery

Introduction to Transaction Processing, Characterizing Schedules Based on Recoverability, Characterizing Schedules Based on Serializability, Two-Phase Locking Techniques for Concurrency Control, Deadlock Handling and Multiple Granularity, Database Recovery Techniques.

Course Outcomes:

After successful completion of this course, the student will be able to:
1. Model data requirements for an application using conceptual modeling tools.
2. Design database schemas by applying normalization techniques.
3. Execute efficient data storage and retrieval queries using SQL.
4. Use concurrency control and database recovery in transaction management.

Text Books:

Abraham Silberschatz, Henry F. Korth and S. Sudarshan; “Database System Concepts”; Sixth Edition, Tata McGraw Hill, 2011.
Ramez Elmasri and Shamkant Navathe; “Fundamentals of Database Systems”; Sixth Edition, Addison

Wesley 2011.

Reference Books:

Raghu Ramakrishnan and Johannes Gehrke; “Database Management Systems”; Third Edition; Tata McGraw Hill Publication, 2003.
Rini Chakrabarti and Shilbhadra Dasgupta; “Advanced Database Management System”; Dreamtech Press India Pvt. Ltd (Wiley India); 2014.

Syllabus for Semester V, B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code: CAP301 Course: Database Management Systems Lab

L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week Total Credits: 01

Course Objectives

The objective of this Lab is:

To enable students to use DDL, DML and DCL.

To prepare students to conceptualize and realize database objects (tables, indexes, views and sequences) and execute SQL queries.

To encourage students to design and execute PL/SQL blocks and triggers.

P**RACTICALS BASED ON CAT301 SYLLABUS**

Experiments covering CAT301 syllabus in Oracle 11g or12c | MySQL.

[Added experiments to be conducted to demonstrate handling of databases on cloud and demonstrating use of NoSQL]

Course Outcomes:

After successful completion of this course, the student should be able to:

Demonstrate database user administration and authorizations.

Execute simple, nested, multiple table, and advanced queries for data retrieval.

Construct PL-SQL block structure and Trigger for specific application.

Implement various integrity constraints, views, sequences, indices and synonym on database.

Reference Books

James Groff, Paul Weinberg and Andy Oppel, SQL - The Complete Reference, 3rd Edition, McGraw Hill, 2017

Syllabus for Semester V, B. Tech. Computer Science & Engineering (Artificial Intelligence and Machine Learning)

Course Code:	**CAT302**	**Course:**	**Machine Learning**
L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week		**Total Credits:**	**03**

Course Pre-requisite
Artificial Intelligence, Mathematics for machine learning

Course Objectives
To introduce the basic concepts and techniques of machine learning.
To understand major machine learning algorithms.
To identify machine learning techniques suitable for a given problem.

Syllabus:
Unit-1
Foundations for ML: ML Techniques overview, Validation Techniques (Cross-Validations), Over-fitting and under-fitting, Data Normalization, Hypothesis Evaluation, Feature Reduction/Dimensionality reduction, Linear and Logistic regression

Unit-2
Discriminative Methods: K-nearest neighbor, Linear Discriminant Functions, Decision Tree, Random Forest algorithm, Bagging and Boosting

Unit -3
Artificial Neural Network: Linear threshold units, Perceptron, Multilayer networks, Feature extraction, Feature selection techniques: Filter Method, Wrapper Method, Dimensionality Reduction techniques: Introduction to PCA, LDA.

Unit-4
Parameter Estimation: Maximum Likelihood and Bayesian Parameter Estimation
Kernel Machines: SVMs (primal and dual forms), Kernel Tricks, Radial Basis function

Unit-5
Bayes Decision Theory: Bayes decision rule, Minimum error rate classification, Normal density and discriminant functions, Naïve Bayes Classifiers, probably approximately correct (PAC) learning

Unit-6
Unsupervised Learning: Clustering (K means, Fuzzy-c means), Hidden Markov Models, Gaussian Mixture Modeling, EM-algorithms

Course Outcomes
On successful completion of the course, students will be able to:
1. Apply various preprocessing techniques before solving the problems
2. Use supervised machine learning techniques to solve different problems.
3. Apply probability based models to solve different problems.
4. Apply un-supervised machine learning techniques to solve different problems.

Text Books

Shalev-Shwartz,S., Ben-David,S., (2014), Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press
Christopher Bishop, Pattern Recognition and machine learning; Springer Verlag, 2006.

Reference Books

1. Tom Mitchell; Machine Learning- an Artificial Intelligence Approach, Volume-II; Morgan Kaufmann, 1986.
2. A. K. Jain and R. C. Dubes; Algorithms for Clustering Data; Prentice Hall PTR, 1988.
3. Ethem Alpaydin, Introduction to Machine Learning, PHI.

Syllabus for Semester V, B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code:	**CAP302**	**Course:**	**Machine Learning Lab**
L: 0Hrs, T: 0 Hr, P: 2 Hr, Per Week		**Total Credits:**	**01**

Course Prerequisite:
Python programming

Course Objectives
To implement basic machine learning algorithm for solving problem.
To understand the usage of datasets in implementing machine learning problems.
To learn various modern tools, packages and techniques for machine learning.

Course Syllabus
Experiments based on CAT 302(Machine Learning) Syllabus. Technology: Python.

Course Outcomes
On successful completion of the course, students will be able to:
1. Apply various preprocessing techniques before solving the problems
2. Use supervised machine learning techniques to solve different problems.
3. Apply probability based models to solve different problems.
4. Apply un-supervised machine learning techniques to solve different problems.

Text Books
Shalev-Shwartz,S., Ben-David,S., (2014), Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press
Christopher Bishop, Pattern Recognition and machine learning; Springer Verlag, 2006.

Reference Books
1. Tom Mitchell; Machine Learning- an Artificial Intelligence Approach, Volume-II; Morgan Kaufmann, 1986.
2. A. K. Jain and R. C. Dubes; Algorithms for Clustering Data; Prentice Hall PTR, 1988.
3. Ethem Alpaydin, Introduction to Machine Learning, PHI.

Syllabus for Semester V, B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code: CAT303 Course: Microcontroller Design

L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week Total Credits: 03

Course Pre-requisite
Fundamentals of Digital Electronics

Course Objectives
Understand the architecture of microcontroller.
Acquire the knowledge, techniques and skill to interface external peripheral devices with microcontroller.
Design microcontroller-based system to solve the real world problem.
To make students aware of evolution of microcontrollers and their advancement in recent time

Syllabus:
Unit-1
Introduction to Computer, Microprocessor and Microcontroller
Introduction to components of computer, microprocessor and microcontroller, family of microcontrollers, architecture of 8051, functional pin diagram and its description, Internal program and data memory,
organization of internal RAM, ROM and register banks, Special function registers, oscillator and clock circuit, Reset circuit, I/O Port, Memory organization,.
Unit-2
Addressing Modes, Instruction Sets and Assembly Language programming
Instruction Syntax, Data types, Subroutines, addressing modes (register, direct, indirect, Immediate) Instruction set of 8051, Data transfer Instruction, Assembly language programming, assembler directives, concepts with examples for various software routines.
Unit-3
Hardware Interfacing using I/O ports
Basic I/O concepts, data transfer techniques, Input/output technique, Port structures and operation, Interfacing commonly used peripherals like switches, matrix keypads and seven segment LEDs, matrix keyboard and Alphanumeric LCD, Interfacing A/D and D/A converter using parallel ports, Interfacing serial A/D converter, Interfacing Stepper Motor and DC motor.
Unit-4
Interrupts, Timer and Counter
Basics of timers, 8051 timers/counters, Timer/counter operation modes, Programming timers/counter, Basics of interrupts, 8051 interrupts, response time, interrupt control registers, example of interrupts applications with programming
Unit-5
ARM Processor Fundamentals
ARM Processor architecture: Register Set, Modes of operation, data processing and data transfer Instructions, control flow instructions, ARM instructions set, ARM organization, 3-stage pipeline, 5-stage pipelines, ARM memory interface, Arm Processor Families.
Unit-6
ARM Applications
Basic Concepts of RTOS, Hard and Soft Real Time Systems, Tasks –periodic and aperiodic tasks, Timing parameters –release time, execution time, deadline, period, Basic real time Task Scheduling Algorithms, Resource Contention, Deadlocks, Priority Inversion, Basics of Re-entrancy and Thread

Safety in Embedded Software Development.

Course Outcome:
At the end of the course, the students should be able to:
Implement Assembly language programming for microcontroller.
Develop interfacing of peripherals like, I/O, A/D, D/A, timer etc.
Design microcontroller based system using Timer & interrupts.
Learn RISC processors and design ARM microcontroller based systems

Text Books:

1. The 8051 Microcontroller and Embedded Systems Using Assembly and C; Muhammad Ali Mazidi, 2nd Edition, Pearson.
2. 8051 Microcontroller Hardware, Software and Applications; V. Udayashankara and M. Mallikarjunaswamy, McGraw-Hill.

3. Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication, 2000

Reference Books:

1. Real Time Systems – Design for distributed Embedded Applications: Herma K.Kluwer Academic.
2. Operating Systems – A Design Oriented approach: Charles Crowley, McGraw Hill.

3. The 8051 Microcontroller – Architecture, Programming and Applications – Kenneth J. Ayala, West Publishing Company.

4. ARM Architecture Reference Manual, David Seal, Adison Wesley Publication

Syllabus for Semester V, B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code: CAP303 Course: Microcontroller Design Lab

L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week Total Credits: 01

Course Pre-requisite
Fundamentals of Digital Electronics

Course Outcome:
At the end of the course, the students should be able to:
Implement Assembly language programming for microcontroller.
Develop interfacing of peripherals like, I/O, A/D, D/A, timer etc.
Design microcontroller based system using Timer & interrupts.
Design ARM microcontroller based systems by applying RISC concepts.

Syllabus:
Experiments based on CAT303 Syllabus in assembly language and embedded C.

Syllabus for Semester V, B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code: CAT304 Course: Compiler Design

L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week Total Credits: 03

Course Pre-requisite
Theory of Computation

Course Objectives
To understand the theory & practice of Compiler implementation.
To explore the principles, algorithms, and data structures involved in the design and construction of compilers.
To understand various phases of compiler and their working.

Syllabus:
Unit-1
Introduction to Compilers- Introduction to Compilers, Phases of compiler design, Relating Compilation Phases with Formal Systems.
Lexical Analysis- Lexical analysis, tokens, pattern and lexemes, Design of Lexical analyzer, Regular Expression, transition diagram, recognition of tokens, Lexical Errors.
Unit-2
Syntax Analysis- Specification of syntax of programming languages using CFG, Top-down parser, design of LL (1) parser, bottom-up parsing techniques, LR parsing, Design of SLR, CLR, LALR parsers, Parser Conflicts.
Unit-3
Syntax directed translation- Study of syntax directed definitions & syntax directed translation schemes, Type and Type Checking, implementation of SDTS, intermediate notations- postfix, syntax tree, TAC, translation of Assignment Statement, expressions, controls structures, Array reference.
Unit-4
Code optimization- Machine-independent Optimisation- Local optimization techniques, loop optimization- control flow analysis, data flow analysis, Loop invariant computation, Induction variable removal, other loop optimization techniques, Elimination of Common sub expression, and Machine-dependent optimisation techniques.
Unit-5
Code generation – Problems in code generation, Simple code generator, code generation using labelling algorithm, Code Generation by Dynamic Programming.
Unit-6
Storage allocation & Error Handling- Run time storage administration stack allocation, Activation of Procedures, Storage Allocation Strategies, symbol table management, Error detection and recovery- lexical, syntactic and semantic.

Course Outcome:
At the end of the course, the students should be able to:
Implement lexical analyzer from language specification.
Realize bottom up and top down parsers incorporating error handling.
Demonstrate syntax directed translation schemes, their implementation for different programming language constructs.
Implement different code optimization and code generation techniques using standard data structures.

Text Books:

Aho, Sethi, and Ullman; Compilers Principles Techniques and Tools; Second Edition, Pearson education, 2008.
Alfred V. Aho and Jeffery D. Ullman; Principles of Compiler Design; Narosa Pub.House, 1977.
Manoj B Chandak, Khushboo P Khurana; Compiler Design; Universities Press, 2018.

Reference Books:

Vinu V. Das; Compiler Design using Flex and Yacc; PHI Publication, 2008.
V. Raghavan; Principles of Compiler Design, McGraw Hill Education (India), 2010.

Syllabus for Semester V, B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code: CAP304 Course: Compiler Design Lab

L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week Total Credits: 01

Course Pre-requisite
Course on Formal Language & Automata Theory, Programming

Course Objectives
The laboratory course is intended to make the students experiment on the basic techniques of compiler construction and use of various tools for implementation. The course will provide deeper insights into the aspects of programming languages and various phases of compiler.

Syllabus:
Experiments based on syllabus of Complier Design (CAT 304).

Course Outcome:
At the end of the course, the students should be able to:
Use Open-Source tools to create a lexical analyzer and parser.
Implement different types of Parsing techniques.
Implement various syntax directed translation schemes to generate intermediate code.
Implement various code optimization techniques to improve performance of a program segment and code generation.

Text Books:
Doug Brown, John Levine, Tony Mason, LEX and YACC, O'Reilly Media, 2nd Edition, 2012.
Des Watson, A Practical Approach to Compiler Construction, Springer, 1st ed. edition, 2017.

Syllabus for Semester V, B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code: CAP305 Course: Mini Project-1

L:0 Hrs, T: 0 Hr, P: 4 Hrs, Per Week Total Credits: 02

Course Objectives:

The objective of the mini project is to let the students map and utilize the technical knowledge acquired in the previous semesters to solve a real-world problem through team effort.

Course Outcomes:

On completion of the mini-project, the student will be able to

1. Identify and finalize the problem statement by investigating various domains and society needs.
2. Perform requirement analysis and design methodology for solving the identified problem.
3. Apply programming techniques and modern tools for the development of the solution.
4. Apply ethical principles, project management skills
5. Demonstrate the ability to work in teams for project development within the confines of a deadline.
6. Communicate technical information employing written reports and presentations.

Syllabus for Semester V, B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code: HUT353 Course: Indian Traditional Knowledge

L: 2 Hrs, T: 0 Hr, P: 0 Hr, Per Week Total Credits:02

Course Pre-requisite

NIL

Course Objectives

The course is designed with the objective of developing understanding of the students about the essence of Indian traditional knowledge in terms of its scientific approach, legality, role in natural resource protection, as well as its contribution to philosophy and art.

Syllabus:

Unit 1: Basic Structure of Indian Traditional Knowledge: Vedas, Upavedas, Vedang, Upadang, scientific approach

Unit 2: Ecology and Indian Traditional Knowledge: Meaning, role, case studies

Unit 3: Intellectual Property Rights and Indian traditional Knowledge: Meaning, role in protection of Indian traditional knowledge, cases studies

Unit 4: Indian Philosophical traditions: Nyay, Sankaya, Yog, Mimansa, Jainism, Buddhism, Sikhism, and other approaches

Unit 5: Indian Artistic Traditions: Chitrakala, Murtikala, Vastukala, Sangeet, Sthpatya, Nritya evam Sahitya, case studies.

Unit 6: Knowledge of traditional Indian Science and Technology

Course Outcomes

On successful completion of the course, students will have increased ability to understand the importance and application of:

1. Indian Knowledge system and its scientific approach.
2. Traditional knowledge and protection of nature.
3. The legality and its importance for the protection of Indian traditional knowledge.
4. Indian philosophical tradition.
5. Indian artistic tradition

Reference Books/Material.

1. Amit Jha (2009), Traditional Knowledge System in India, Atlantic Publishers and Distributors.
2. RR Gaur, Rajeev Sangal, GP Bagaria, Human Values and Professional Ethics (Excel Books, New Delhi, 2010)
3. V. Sivaramakrishanan (ed.), Cultural Heritage of India – Course material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014
4. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan
5. Swami Jitatmanand, Holistic Science and Vedant, Bharatiya Vidya Bhavan
6. S.C. Chatterjee and D.M. Datta, An introduction to Indian Philosophy, University of Calcutta, 1984
7. Pramod Chandra, Indian Arts, Howard University Press, 1984
8. Krishna Chaitanya, Arts of India, Abhinav Publications, 1987
9.https://www.researchgate.net/publication/299625768_Traditional_Knowledge_systems_in_India_ for_biodiversity_conservation/link

Syllabus for Semester VI, B. Tech. Computer Science & Engineering (Artificial Intelligence and Machine Learning)

Course Code:	**CAT306**	**Course:**	**Deep Learning**
L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week		**Total Credits:**	**03**

Course Pre-requisite
Artificial Intelligence, Machine Learning

Course Objectives
To introduce the basic concepts and techniques of deep learning.
To understand major deep learning algorithms.
To identify deep learning techniques suitable for a given problem.

Syllabus:
Unit-1
Introduction to Neural Networks: FeedForward Neural Networks, Backpropagation ,Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam.

Unit-2
Principal Component Analysis: Eigenvalues and eigenvectors, Eigenvalue Decomposition, Basis, Principal Component Analysis and its interpretations, Singular Value Decomposition.

Unit -3
Autoencoders: Autoencoders and relation to PCA, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders

Unit-4
Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout.

Unit-5
Convolutional Neural Networks: The Convolution Operation, Motivation, Pooling, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation.

Unit-6
Recurrent Neural Networks: Recurrent Neural Networks, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, LSTMs, GRUs, Attention Mechanism and the Transformer Architecture

Course Outcomes
On successful completion of the course, students will be able to:
Solve various deep learning problems
Apply autoencoders for unsupervised learning problems
Implement Convolutional Neural Networks to image classification problems
Apply recurrent neural network to sequence Learning Problem.

Text Books

Neural Networks and Deep Learning A Textbook, Charu C. Aggarwal, Springer
Deep Learning from Scratch ,Building with Python from First Principles, Seth Weidman, O'Reilly

Reference Books.

1. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville MIT press.

Syllabus for Semester VI, B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code:	**CAP306**	**Course:**	**Deep Learning Lab**
L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week		**Total Credits:**	**01**

Course Prerequisite:
Python programming, Machine Learning

Course Syllabus
Experiments based on CAT 306(Deep Learning) Syllabus.
Technology: Python, Tensorflow, Keras

Course Outcomes
On successful completion of the course, students will be able to:
Solve various deep learning problems
Apply autoencoders for unsupervised learning problems
Implement Convolutional Neural Networks to image classification problems
Apply recurrent neural network to sequence Learning Problem.

Text Books

Neural Networks and Deep Learning A Textbook, Charu C. Aggarwal, Springer
Deep Learning from Scratch ,Building with Python from First Principles, Seth Weidman, O'Reilly

Reference Books.
1. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville MIT press.

Syllabus for Semester VI, B. Tech. Computer Science & Engineering (Artificial Intelligence and Machine Learning)

Course Code:	**CAT307**	**Course:**	**Data Warehousing and Mining**
L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week		**Total Credits: 03**	

Course Pre-requisite
Database Management Systems

Course Objectives
Methods and theory for development of data warehouses and data analysis using data mining.
Data quality and methods and techniques for preprocessing of data.
Modeling and design of data warehouses.
Algorithms for classification, clustering and association rule analysis.

Syllabus:
Unit-1
Introduction to Data Warehouse, Data Warehouse basic Concepts, Architecture of Data Warehouse, Overview of ETL and OLAP OLTP integration – comparison of OLAP with OLTP systems, ROLAP,MOLAP and HOLAP, Multidimensional modeling

Unit-2
Data Cube, Data Cube Computation methods, Advanced SQL support for OLAP, Data Preprocessing Data Cleaning methods, Descriptive Data Summarization, Data Reduction, Data Discretization and Concept hierarchy generation

Unit-3
Space Management in Data warehouse - Schemas for storing data in warehouse using different storage structures, B-tree index, hash index, clusters, Bitmap index functional index, domain index, Data partitions.

Unit-4
Introduction: - What is Data mining? Data Mining on what kind of data, Data mining Functionalities, Classification of Data Mining Systems, Major Issues on Data mining, KDD Process, Association Rule mining.

Unit-5
Classification and Prediction:- Classification by decision tree induction, Bayesian Classification, Rulebased Classification, Associative Classification.

Unit-6
Clustering: Measuring Data Similarity and Dissimilarity Partition based Clustering, Hierarchical based clustering, Density based clustering.

Course Outcome:
At the end of the course, the students should be able to:
Use the fundamental theories and concepts of data warehousing in real life application.
Apply multi-dimensional modeling techniques in designing data warehouses.
Use the principles of data mining for designing data mining applications.

Apply different methods and techniques involved in data mining.

Text Books:

Jaiwei Han and Micheline Kamber; Data Mining Concepts and Techniques; 2 edition; Morgan Kaufmann Publishers, 2006.

Reference Books:

Tang and MacLennan, Data Mining with SQL Server 2005, Wiley Publishing, 2005

Data Warehousing and Fundamentals by Paulraj Ponniah, A Wiley-Interscience Publication

Syllabus for Semester VI, B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code: CAP307 Course: Data Warehousing and Mining Lab

L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week **Total Credits: 01**

Course Pre-requisite
Database Management Systems

Course Objectives
Methods and theory for development of data warehouses and data analysis using data mining.
Data quality and methods and techniques for preprocessing of data.
Modeling and design of data warehouses.
Algorithms for classification, clustering and association rule analysis.

Syllabus:
Experiments based on CAT307 syllabus.

Course Outcome:
At the end of the course, the students should be able to:
Use the fundamental theories and concepts of data warehousing in real life application.
Apply multi-dimensional modeling techniques in designing data warehouses.
Use the principles of data mining for designing data mining applications.
Apply different methods and techniques involved in data mining.

Text Books:
Jaiwei Han and Micheline Kamber; Data Mining Concepts and Techniques; 2 edition; Morgan Kaufmann Publishers, 2006.
Reference Books:
Tang and MacLennan, Data Mining with SQL Server 2005, Wiley Publishing, 2005
Data Warehousing and Fundamentals by Paulraj Ponniah, A Wiley-Interscience Publication

Syllabus for Semester VI, B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code:	**CAT308**	**Course:**	**Natural Language Processing**
L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week		**Total Credits: 03**	

Course Pre-requisite
Theory of Computation, Compiler

Course Objectives
To familiarize the concepts and techniques of Natural language Processing for analyzing words based on Morphology and CORPUS.
To relate mathematical foundations, Probability theory with Linguistic essentials such as syntactic and semantic analysis of text.
To apply the Statistical learning methods and cutting-edge research models to solve NLP problems

Syllabus:
UNIT 1: Introduction to NLP, Morphology
Introduction to NLP, Stages of NLP, Ambiguity, Information Theory Essentials , Linguistic Essentials : Parts of Speech and Morphology, Morphological analysis and generation using Finite State Automata and Finite State transducer.

UNIT 2: Markov Model and POS Tagging
Markov Model: Hidden Markov model, Fundamentals, Probability of properties, Parameter estimation, Variants, Multiple input observation. The Information Sources in Tagging: Markov model taggers, Viterbi algorithm, Applying HMMs to POS tagging, Applications of Tagging

UNIT 3: Syntax and Semantics
Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), Lexical Semantics, WordNet, Thematic Roles, Semantic Role Labelling with CRFs.

UNIT 4: Language Modelling
Corpus based work, Statistical Inference: n -gram Models over Sparse Data, Methodological Preliminaries, Supervised Disambiguation: Bayesian classification, An information- theoretic approach, Dictionary-Based Disambiguation: Disambiguation based on sense, Thesaurus-based disambiguation, Disambiguation based on translations in a second-language corpus.

UNIT 5: Probabilistic Parsing and Disambiguation
Probabilistic Context Free Grammars and Probabilistic parsing The Probability of a String, Problems with the Inside-Outside Algorithm, Parsing for disambiguation, Treebanks, Parsing models vs. language models, Phrase structure grammars and dependency, Lexicalized models using derivational histories, Dependency-based models.

UNIT 6: NLP Applications
Statistical Alignment and Machine Translation, Text alignment, Word alignment, Information extraction, Text mining, Information Retrieval, NL interfaces, Sentimental Analysis, Question Answering Systems, Social network analysis.

Course Outcome:

At the end of the course, the students should be able to:
Apply the Principles and Process of Human Languages using computers.
Demonstrate the state-of-the-art algorithms and techniques for text-based processing of natural languages with respect to morphology.
Perform POS tagging for a given natural language
Create Linguistics CORPUS based on Text Corpus method
Realize semantics and pragmatics of natural languages for text processing
Develop a Statistical Methods for Real World NLP Applications.

Text Books:

Christopher D. Manning and Hinrich Schutze, "Foundations of Natural Language Processing" , 6th Edition, The MIT Press Cambridge, Massachusetts London, England, 2003
Daniel Jurafsky and James H. Martin "Speech and Language Processing", 3rd edition, Prentice Hall, 2009.

Reference Books:

James Allen "Natural Language Understanding", Pearson Publication 8th Edition. 2012.

Syllabus for Semester VI, B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code:	**CAP308**	**Course:**	**Natural Language Processing Lab**
L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week		**Total Credits: 01**	

Course Pre-requisite
Database Management Systems

Course Objectives
To familiarize the concepts and techniques of Natural language Processing for analyzing words based on Morphology and CORPUS.
To relate mathematical foundations, Probability theory with Linguistic essentials such as syntactic and semantic analysis of text.
To apply the Statistical learning methods and cutting-edge research models to solve NLP problems

Syllabus:
Experiments based on CAT308 syllabus.

Course Outcome:
At the end of the course, the students should be able to:
Apply the Principles and Process of Human Languages using computers.
Demonstrate the state-of-the-art algorithms and techniques for text-based processing of natural languages with respect to morphology.
Perform POS tagging for a given natural language
Create Linguistics CORPUS based on Text Corpus method
Realize semantics and pragmatics of natural languages for text processing
Develop a Statistical Methods for Real World NLP Applications.

Text Books:
Natural Language Processing with Python by Steven Bird, Ewan Klein and Edward Loper , Oreily Publications

Syllabus for Semester VI, B. Tech. Computer Science & Engineering (Artificial Intelligence and Machine Learning)

Course Code: CAT309 **Course: Fundamentals of Digital Image and Video Processing**

L:3 Hrs, T: 0 Hr, P: 0 Hrs, Per Week **Total Credits: 03**

Course Prerequisite:
Design and Analysis of Algorithms, Fundamentals of Discrete Mathematics, Fourier Transform, Probability and Statistics is desired.

Course Objectives:
This course offers fundamentals of digital image and video processing. Through this course, students will get a clear understanding of the breadth and practical scope of digital image and video processing. A brief view of basic enhancement techniques, different models and various algorithms used for digital image and video processing are discussed in the course. This course introduces the students with real time applications and its implementation using various techniques and algorithms, which will enable them to undertake further study, research and/or implementation work in this area.

Syllabus:

UNIT-I
Fundamentals of Image processing and Image Transforms: Basic steps of Image processing system, Digital Image Formation and Camera Geometry, sampling and quantization of an Image, Basic relationship between pixels, Image representation, types of images (binary, grayscale, color, indexed), and Mathematical operations.

UNIT-II
Image Enhancement: Spatial Domain methods- Intensity transformations, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters.
Frequency Domain methods- Basics of filtering in frequency domain, The Fourier transform- 2D Discrete Fourier Transform and its inverse, properties of DFT, image smoothing, image sharpening, Homomorphic filtering, selective filtering.

UNIT-III
Morphological Image Processing: Erosion, Dilation, Opening, Closing, Hit or Miss Transformation, Boundary Extraction, Hole Filing, Extraction of Connected components.
Image Segmentation: Point, Line, edge detection, boundary detection, Thresholding, region based segmentation

UNIT-IV
Image Compression: Image compression fundamentals, coding Redundancy. Compression models- Huffmann coding, run length coding, Bit Plane coding, and JPEG standards
Image restoration: Types of Noise and removal methods – Mean filter, Median, Min, Max, Midpoint, Adaptive filters etc.

UNIT-V
Introduction to Video Processing: Digital Video, Time varying Image Formation models: 3D

motion models, Geometric Image formation, Motion Estimation- Optical flow, general methodologies, background subtraction and modelling, pixel based motion estimation, Lucas-Kanade algorithm, Kalman filter.

UNIT-VI

Video Segmentation, Object detection in videos: Basics of background modeling and foreground detection, connected component labelling, etc., Object recognition in images and videos, Viola Jones algorithm for face detection, Case study of applications like automated video surveillance.

Course Outcomes:

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

1. Describe basic methods of image processing, video processing and their applications.
2. Performing image processing by application of various techniques like image enhancement, morphological processing, image Segmentation, compression, etc.
3. Interpret image and video processing algorithms.
4. Select, apply and use various algorithms in image and video processing applications.

Text Books:

R. C. Gonzalez, R. E. Woods. Digital Image Processing. Pearson Education, 3rd ed.
Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India. 2nd edition 2004
John Willam, K. Pratt, Digital Image Processing. Willey & Sons (3rd Edition).
D. A. Forsyth, J. Ponce, Computer Vision: A Modern Approach. Prentice Hall, 2011.

Reference Books:

Image Processing, Analysis, and Machine Vision. Sonka, Hlavac, and Boyle. Thomson, 2009.
E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press, 2012
Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012
Richard Szeliski, Computer Vision: Algorithms and Applications. Springer, 2010.

Syllabus for Semester VI, B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code: CAP309 **Course: Fundamentals of Digital Image and Video Processing Lab**

L:0Hrs, T: 0 Hr, P: 2 Hrs, Per Week **Total Credits: 01**

Course Objectives:

This laboratory course is intended to make the students experiment with various algorithms and techniques of image and video processing techniques, to gain deeper insights of visual representations.

This course will introduce the students to working of real world applications and enhance the problem solving skills to solve the real world problems.

Syllabus:

Experiments based on syllabus of Fundamentals of Digital Image and Video Processing Lab (CAP309).

Course Outcomes:

On successful completion of the course, students will be able to

1. Implement and test fundamental image and video processing algorithms.
2. Perform various image processing tasks like morphological operations, image enhancement, image segmentation, image compression, etc.
3. Implement various video processing tasks, and perform motion computation.

Syllabus for Semester VI, B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code: CAP310 Course: Mini Project-2

L:0 Hrs, T: 0 Hr, P: 4 Hrs, Per Week Total Credits: 02

Course Objectives:

The objective of the mini project is to let the students map and utilize the technical knowledge acquired in the previous semesters to solve a real-world problem through team effort.

Course Outcomes:

On completion of the mini-project, the student will be able to

1. Identify the problem statement by investigating various domains and society needs.
2. Perform requirement analysis and design methodology for solving the identified problem.
3. Apply programming techniques and modern tools for the development of the solution.
4. Apply ethical principles, project management skills and demonstrate the ability to work in teams for project development within the confines of a deadline.
5. Communicate technical information employing written reports and presentations.

Syllabus for Semester VI, B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code:	**CAP311**	**Course:**	**Comprehensive Viva**
L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week		**Total Credits: 01**	

Course Objectives

To assess the overall knowledge of the student in Computer Science and Engineering .
To assess preparedness of the student for placements and entrance examinations for higher learning through the examination like GATE, GRE, CAT.
To facilitate the students in selecting appropriate career track for themselves.

Syllabus:

The Comprehensive Viva will cover the contents from the courses, both the theory and the lab practice which the student learnt during third thru sixth semester of the undergraduate programme.

Course Outcome:

At the end of the course, the students should be able to:
Respond to the queries and issues covering various computing domain
Exhibit oral presentation skills and inter-personal skills
Prepare the students to face interview both in the academic and the industrial sector

Syllabus for Semester IV, B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code: CAT299 Course: Statistical Computing with R (Open Elective)

L:3 Hrs, T: 0 Hr, P: 0 Hr, Per Week Total Credits: 3

Course Objectives

The objective of this course is:
To understand the use of R for effective data analysis
To understand the statistical tests

Syllabus

Unit 1: Introduction to R programming, Data structures, variables, and data types
Unit 2: R packages and scripts, Descriptive statistics in R
Unit 3: Statistical graphs: Scatter Plots, Box Plots, Histograms, Working with messy data
Unit 4: Conditional statements, Iterations, Writing functions Reporting
Unit 5: Data exploration and visualization
Unit 6: Data querying: SQL and R, Interactive reporting with Rmarkdown

Course Outcomes:

After successful completion of this course, the student will be able to:
Access online resources for R and import new function packages into the R workspace
Import, review, manipulate and summarize data-sets in R
Perform appropriate statistical tests using R
Create and edit visualizations with R

Text book:

Wickham, H. & Grolemund, G. (2018). R for Data Science. O'Reilly: New York.

Syllabus for Semester V, B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code:	**CAT398**	**Course:**	**Machine Learning – Tools and Techniques (Open Elective)**
L:3 Hrs, T: 0 Hr, P: 0 Hr, Per Week		**Total Credits:**	**3**

Course Objectives

The objective of this course is:
To understand machine learning concepts
To understand the concepts of libraries and tools for solving machine learning problems.

Syllabus

Unit 1: Machine Learning Basics: Types of ML, Data preprocessing, Over fitting and under fitting; Introduction to IPython
Unit 2: Introduction to NumPy ; Data Manipulation with Python
Unit 3: Visualization with Matplotlib & Scipy; Sci-kit Learn
Unit 4: Tensorflow, Pytorch
Unit 5: Keras, Rapid Minor
Unit 6: Colab, Shogun, Weka

Course Outcomes:

After successful completion of this course, the student will be able to:
Apply python to solve machine learning problems
Use different data manipulation methods of python for solving machine learning problems
Use different ML libraries for solving ML problems.

Text book:

Jake Vanderplas , Python Data Science Handbook: Essential Tools for Working with Data , O'Reilly: New York.
Aurelien Geron, Hands-On Machine Learning with Scikit-Learn, Keras and Tensor Flow: Concepts, Tools and Techniques to Build Intelligent Systems (2019), O'Reilly: New York.

Syllabus for Semester VI, B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code: CAT399 Course: Data Analytics (Open Elective)

L:3 Hrs, T: 0 Hr, P: 0 Hr, Per Week Total Credits: 3

Course Objectives

To understand of data analysis techniques in business decision making.
To understand data analysis techniques for solving real world problems.
To understand concepts of time series analysis

Syllabus:

Unit 1: Data Definitions and Analysis Techniques:

Elements, Variables, and Data categorization, Levels of Measurement, Data management and indexing

Unit 2: Descriptive Statistics:

Measures of central tendency, Measures of location of dispersions

Unit 3: Basic Analysis Techniques:

Statistical hypothesis generation and testing, Chi-Square test, t-Test, Analysis of variance,Correlation analysis,Maximum likelihood test

Unit 4: Data analysis techniques

Regression analysis,Classification techniques,Clustering,Association rules analysis

Unit 5 : Time Series Analysis

Time Series Analysis : Box-Jenkins Methodology, ARIMA (Auto Regressive Integrated Moving Average) Model, Choice of a Model, Overview of ARMAX, Spectral Analysis and GARCH.

Unit 6: Creating Stories with Data

Why Planning?, Creating Interesting Stories with Data – Reader-driven Narratives, Author-driven Narratives; Perceptions and Presentation Methods

Course Outcomes

On successful completion of the course, students will be able to:
Demonstrate understanding of data analysis techniques in business decision making.
Apply data analysis techniques for solving real world problems.
Apply time series analysis on different problems

Text Books

David Dietrich, Barry Heller and Beibel Yang, - Data Science and Big Data Analytics –Discovering, Analyzing, Visualizing, and Presenting Data||, John Wiley and Sons [EMCEducation Services], 2015.
Python: Data Analytics and Visualization, Packt Publishing, 2017
Probability & Statistics for Engineers & Scientists (9th Edn.), Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Prentice Hall Inc.
Data Mining and Analysis, Mohammed J. Zaki, Wagner Meira, Cambridge, 2012

Reference Books.

Jiawei Han, Micheline Kamber and Jian Pei, - Data Mining Concepts and Technique, 3rd edition; Morgan Kaufmann Publishers, 2011.

The Elements of Statistical Learning, Data Mining, Inference, and Prediction (2nd Edn.), Trevor Hastie Robert Tibshirani Jerome Friedman, Springer, 2014