



# **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 2021 – 2022**

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**B. Tech. COMPUTER SCIENCE & ENGINEERING  
(ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)**



Published By

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Principal

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ISO 9001 : 2015 CERTIFIED ORGANISATION



### About the Department

The Department of Computer Science & Engineering was established in 2002, is well-equipped with state-of-the-art infrastructure. The state of art infrastructure includes latest configuration desktops organized in four different laboratories. There are total 170 desktops with internet facility and interconnected by a 24 hours server and CISCO router.

The department hosts 300 computers 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 Department has a distinction of consistently achieving above 95% results in the final year. Students are encouraged to appear in GATE, CAT, GRE and other competitive examinations which have resulted in increasing number of students clearing these exams. Students teams of CSE have emerged winners at the Grand Finale of 2018, 2019 and 2020 editions of Smart India Hackthoan and have been excelling at the world renowned prestigious International Collegiate Programming Contest, ACM ICPC Asia West Regional Contents since 2015.

### Department 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 of the 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 for sustainable development.
8. **Ethics** : Apply ethical principles and commit to professional ethics and responsibilities and norms of 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 in independent and lifelong learning in the broadest context of technological change.

### Programme Specific Outcomes (PSOs)

1. The ability to understand, analyse 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.



**B. E. Computer Science and Engineering  
(Artificial Intelligence and Machine Learning)**

**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	-
<b>TOTAL</b>			<b>14</b>	<b>1</b>	<b>9</b>	<b>19.5</b>			<b>700</b>	

**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	-	-	-	-
<b>TOTAL</b>			<b>14</b>	<b>2</b>	<b>11</b>	<b>18.5</b>			<b>600</b>	



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	-
<b>TOTAL</b>			<b>17</b>	<b>1</b>	<b>8</b>	<b>22</b>			<b>750</b>	

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	-	-	-	-
<b>TOTAL</b>			<b>17</b>	<b>4</b>	<b>6</b>	<b>22</b>			<b>650</b>	

Recommended course from MOOC	
1	Computer Graphics
2	Software Engineering



# Programme Scheme & Syllabi B. Tech. Computer Science & Engineering (A I & M L)

## 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	-	-	-	-
<b>TOTAL</b>			17	0	12	21			750	

Recommended course from MOOC	
1	Design Pattern

## 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	-
<b>TOTAL</b>			15	0	14	22			800	

Recommended course from MOOC	
1	Mobile Programming



**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	-
<b>TOTAL</b>			<b>14</b>	<b>0</b>	<b>18</b>	<b>23</b>			<b>700</b>	

Course Code	Program Elective-I	Course Code	Program Elective-II
CAT402-1	Distributed Systems	CAT403-1	Information Security
CAT402-2	Introduction to IOT	CAT403-2	Embedded Systems
CAT402-3	Computer Vision	CAT403-3	Biomedical Image Processing
CAT402-4	Information Retrieval	CAT403-4	Social Network analysis
CAT402-5	Managerial Economics		

**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	-
<b>OR</b>										
1	CAP408	Industry Internship (One semester)	-	-	-	12	150	150	300	-
<b>TOTAL</b>			<b>6</b>	<b>0</b>		<b>12</b>			<b>300</b>	

Course Code	Program Elective-III	Course Code	Program Elective-IV
CAT405-1	Introduction to GAN [Generative Adversarial Networks]	CAT406-1	Cloud Computing
CAT405-2	Cyber Security Intelligence	CAT406-2	Robotics
CAT405-3	Soft Computing Techniques	CAT406-3	Reinforcement learning
CAT405-4	Time-Series Analysis	CAT406-4	Human Computer Interaction
CAT405-5	Cognitive systems	CAT406-5	Big Data Analytics using Hadoop
CAT405-6	Web Technologies	CAT406-6	Game Theory





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

**Course Code : CHT152**

**Course : Chemistry**

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

**Total Credits : 4**

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**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 Nano chemistry :** Definition of Nano, Scientific revolution-Atomic Structure and atomic size, emergence and challenges 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 nano electronics, 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 Spectroscopy, 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, DhanpatRai Publication.
11. S. S. Dara, A Textbook of Engineering Chemistry, S. Chand Publications.
12. J. D. Lee, Concise Inorganic Chemistry, Fourth Edition, Chapman and Hall Publications.





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

**Course Code : CHP152**

**Course : Chemistry Lab**

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

**Total Credits : 1.5**

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**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.





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

**Course Code : MAT152**

**Course : Differential Equations, Linear Algebra,  
Statistics & Probability**

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

**Total Credits : 3**

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**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 in a comprehensive 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 p, 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. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009.
3. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
4. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
5. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
7. Theory and Problems of probability and statistics: 2nd ed: J. R. Spiegel, Schaum series
8. A text book of Applied Mathematics Volume I & II, by P. N. Wartikar and J. N. Wartikar, Pune Vidhyarthi Griha Prakashan, Pune-411030 (India).
9. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.





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

**Course Code : CAT101**

**Course : Programming for Problem Solving**

**L: 4 Hrs, T: 0 Hr, P: 0Hr, Per Week**

**Total Credits : 4**

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**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 /Pseudo code with examples. Arithmetic expressions and precedence

**UNIT-II: C Programming Language**

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

Pre-processor 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. E. Computer Science & Engineering  
(Artificial Intelligence and Machine Learning)**

**Course Code : CAP101**

**Course : Programming for Problem Solving Lab**

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

**Total Credits : 1**

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**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. E. Computer Science & Engineering (Artificial Intelligence and Machine Learning)

Course Code: IDT151

Course: Creativity, Innovation & Design Thinking

L: 1 Hrs, T: 0 Hr, P: 0Hr, Per Week

Total Credits : 1

### Course Outcomes

C1: Be familiar with processes and methods of creative problem solving

C2: Enhance their creative and innovative thinking skills

C3: Practice thinking creatively and innovative design and development

### Detailed Topics

**UNIT 1. 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/Brain writing, 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 group's hands-on projects
- Eight-dimensional (8D) ideation method examples Large teams videos



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

**Course Code : CAT102**

**Course : Computer Workshop**

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

**Total Credits : 1**

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**Course Objectives**

1. Understand the definition and principles of UI/UX Design in order to design with intention.
2. Achieve a deep understanding of the entire life-cycle of design—the process, purpose, and tools.
3. Learn the basics of HCI (human-computer interaction) and the psychology behind user decision-making.
4. Discover the industry-standard tools and specific project deliverables in UI/UX.
5. Explain why you made design decisions, through presentations of assignments and your personal portfolio.

**Unit 1:**

**UI/UX Overview:** Intro to UI/UX, Notion & Figma Setup, Design Thinking.

**User Research:** How to identify stakeholders, Figma Basics, How to identify user needs.

**Unit 2:**

**User Journeys:** Mapping the user journey, Figma Grayscales, Finding solutions & constraint cards, Grayscales & User Testing: UX Principles, Figma Prototype, Understanding user testing.

**Unit 3:**

**UI Principles:** UI Principles, Color and Font.

**Style Guide:** Components, Responsive Design.

**Course Outcomes**

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

1. Understand basics of UI/UX
2. Find solutions and constraint cards.
3. Design responsive UI.

**Text Books**

1. UI/UX design for designer and developers: by Nathan Clark
2. User Story mapping software for agile age [Paid subscription on yearly basis]
3. User story mapping by Jeff Patton, O'Reilly Publication





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

**Course Code : CAP102**

**Course : Computer Workshop Lab**

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

**Total Credits : 1**

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**Course Objectives**

Throughout the course, students will be expected to learn following concept:

1. Understand UI/UX basics and its use in software industry
2. Understand basic use cases of UI/UX.
3. Develop small utilities using UI/UX tools
4. Develop and integrate UI/UX with basic programs

**Syllabus**

Programs based on:

1. Illustration tool box
2. Storytelling and typography tools
3. UX writing and AR/VR tools
4. Voice technology tools
5. Motion Design, Animated graphics

**Course Outcomes**

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

1. Design UI/UX use cases using Illustration tool box
2. Design and use storytelling and typography for requirement specification.
3. Use UX writing, AR and VR models to develop interfaces for use cases
4. Develop small applications using voice technology, motion design, and animation.





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

**Course Code : HUT151**

**Course : English**

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

**Total Credits : 2**

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**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 Precise 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 Heasley. Cambridge University Press. 2006.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press





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

**Course Code : HUP151**

**Course : English Lab**

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

**Total Credits : 1**

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**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  
(Artificial Intelligence and Machine Learning)**

**Course Code : PHT154**

**Course : Introduction to Quantum Computing**

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

**Total Credits : 4**

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**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, Bloch Sphere, 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, Cambridge University Press 2008
2. Introduction to Quantum Mechanics, 2nd Edition, David J. Griffiths, Prentice Hall New Jersey 1995

### Reference Books

1. Quantum computing explained, David McMahon, Wiley-interscience, John Wiley & Sons, Inc. Publication 2008
2. Quantum computation and quantum information, Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press 2010





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

**Course Code : PHP154**

**Course: Introduction to Quantum Computing Lab**

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

**Total Credits : 1.5**

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**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  
(Artificial Intelligence and Machine Learning)**

**Course Code : MAT151**

**Course : Calculus**

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

**Total Credits : 4**

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**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:

1. The fallouts of Mean Value 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.
2. Basics of improper integrals, Beta and Gamma functions, Curve Tracing, tool of power series and Fourier series for learning advanced Engineering Mathematics.
3. 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 - 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. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
5. 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  
(Artificial Intelligence and Machine Learning)**

**Course Code : MAP151**

**Course: Computational Mathematics Lab**

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

**Total Credits : 1**

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**Course Outcomes**

The Computational Mathematics Lab course will consist of experiments demonstrating the principles of mathematics relevant to the study of science and engineering. Students will show that they have learnt laboratory skills that will enable them to properly acquire and analyze the data in the lab and draw valid 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 compare the results obtained with theoretical calculations.
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. A minimum of 8 experiments to be performed based on the above list.





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

**Course Code : CAT103**

**Course : Digital Electronics**

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

**Total Credits : 3**

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**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  $\mu$ p 8085, Addressing modes, Instruction set, Programming of  $\mu$ p 8085.

### Text Books

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  
(Artificial Intelligence and Machine Learning)**

**Course Code : CAP103**

**Course : Digital Electronics Lab**

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

**Total Credits : 1**

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**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  
(Artificial Intelligence and Machine Learning)**

**Course Code : CAT104**

**Course : Object Oriented Programming**

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

**Total Credits : 3**

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**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, Treaset.

#### 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  
(Artificial Intelligence and Machine Learning)**

**Course Code : CAP104**

**Course : Object Oriented Programming Lab**

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

**Total Credits : 1**

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**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  
(Artificial Intelligence and Machine Learning)**

**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 (Artificial Intelligence and Machine Learning)

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 Department of RCOEM.
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, the objective 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 injuries and illness associated with sports.
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**

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**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  
(Artificial Intelligence and Machine Learning)**

**Course Code : CAP201**

**Course : Data Structure Lab**

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

**Total Credits : 01**

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**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) data structures in solving problems.
3. To encourage students to design and execute tree-based algorithms for solving real- world problems.

**SYLLABUS**

Experiments based on CAP201 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**

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**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 of a 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 McGraw Hill, 2002.
2. W. Stallings; Computer Organization & Architecture; PHI publication; 2001.
3. J. P. Hayes; Computer Architecture & Organization; 3rd edition; McGraw-Hill; 1998.

### Reference Books

1. M Mano; Computer System and Architecture; PHI publication; 1993.
2. A.S.Tanenbaum; Structured Computer Organization; Prentice Hall of India Ltd.Programme Scheme & 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**

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**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:

1. 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.
2. 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.
3. 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) :** Dimensionality 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  
P.G. Bhattacharya, S.K. Jain and S.R.
3. 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**

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**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, Dining 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**

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**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 CAP203 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**

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**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**

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**Course Objectives**

1. Describe laws governing cyberspace and analyze the role of Internet Governance in framing policies for Internet security
1. 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, Ethics 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 affects the software professional.
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 development field.
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 Public at ions.
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**

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**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
- Beautiful 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**

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**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, Time division and Wave division

**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, Selective Repeat ARQ.

**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, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

**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. Understand basics of computer networks and reference models
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**

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**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, equipments

**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**

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**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

1. 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**

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**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**

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**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

1. 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**

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**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 its 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**

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**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 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)**

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**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 SO<sub>x</sub>, NO<sub>x</sub>, 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, sewerage 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.

