BABU BANARASI DAS UNIVERSITY
School of Engineering
(School Code: 04)
Department of Computer Science and Engineering
(University Branch Code: 39)
Bachelor of Technology: Computer Science and Engineering (Artificial Intelligence)

Evaluation Scheme

SEMESTER I									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
BSC	NBS4101	Matrices and Calculus	3	1	0	40	60	100	4
ESC	NCS4101	Computer Concepts & Programming in C	3	0	0	40	60	100	3
ESC	NCS4151	Programming in C Lab	0	0	2	40	60	100	1
Students need to select either GROUP 'A' or GROUP 'B'									
	NGP4101	General Proficiency				100		100	1
Total			6	1	2	220	180	400	9

GROUP 'A'									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
BSC	NBS4102	Engineering Physics	3	1	0	40	60	100	4
ESC	NME4101	Engineering Mechanics	3	1	0	40	60	100	4
ESC	NEC4101	Basic Electronics Engineering	3	0	0	40	60	100	3
CCC	NBSCC1101	Environment & Ecological Sustainability	3	0	0	40	60	100	3
ESC	NME4151	Engineering Mechanics Lab	0	0	2	40	60	100	1
ESC	NME4152	Workshop Practices	0	0	2	40	60	100	1
BSC	NBS4152	Engineering Physics Lab	0	0	2	40	60	100	1
Total			12	2	6	280	420	700	17

GROUP 'B'									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
ESC	NEE4101	Basic Electrical Engineering	3	1	0	40	60	100	4
BSC	NBS4103	Engineering Chemistry	3	1	0	40	60	100	4
ESC	NCS4102	Basics of Artificial Intelligence	3	0	0	40	60	100	3
CCC	NHSCC1101	Communicative English	2	1	0	40	60	100	3
ESC	NEE4151	Basic Electrical Engineering Lab	0	0	2	40	60	100	1
BSC	NBS4153	Engineering Chemistry Lab	0	0	2	40	60	100	1
ESC	NME4153	Engineering Graphics Lab	0	0	2	40	60	100	1
Total			11	3	6	280	420	700	17

SEMESTER II									
Course Category.	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
BSC	NBS4201	Differential Equations and Fourier Analysis	3	1	0	40	60	100	4
ESC	NCS4201	Programming Concepts with Python	3	0	0	40	60	100	3
ESC	NCS4251	Python Programming Lab	0	0	2	40	60	100	1
Students need to select either GROUP 'A' or GROUP 'B'									
	NGP4201	General Proficiency				100		100	1
Total			6	1	2	220	180	400	9

Note: Students who have selected group ‘A’ in the first semester will select group ‘B’ in the second semester and vice-versa.

GROUP 'A'									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
BSC	NBS4202	Engineering Physics	3	1	0	40	60	100	4
ESC	NME4201	Engineering Mechanics	3	1	0	40	60	100	4
ESC	NEC4201	Basic Electronics Engineering	3	0	0	40	60	100	3
CCC	NBSCC1201	Environment & Ecological Sustainability	3	0	0	40	60	100	3
ESC	NME4251	Engineering Mechanics Lab	0	0	2	40	60	100	1
ESC	NME4252	Workshop Practices	0	0	2	40	60	100	1
BSC	NBS4252	Engineering Physics Lab	0	0	2	40	60	100	1
Total			12	2	6	280	420	700	17

GROUP 'B'									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
ESC	NEE4201	Basic Electrical Engineering	3	1	0	40	60	100	4
BSC	NBS4203	Engineering Chemistry	3	1	0	40	60	100	4
ESC	NCS4202	Basics of Artificial Intelligence	3	0	0	40	60	100	3
CCC	NHSCC1201	Communicative English	2	1	0	40	60	100	3
ESC	NEE4251	Basic Electrical Engineering Lab	0	0	2	40	60	100	1
BSC	NBS4253	Engineering Chemistry Lab	0	0	2	40	60	100	1
ESC	NME4253	Engineering Graphics Lab	0	0	2	40	60	100	1
Total			11	3	6	280	420	700	17

SEMESTER III									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
HSC	NHS4301/ NHS4302	Organizational Behavior /Industrial Sociology	2	0	0	40	60	100	**2**
BSC	NBS4301	Complex Analysis and Integral Transforms	3	1	0	40	60	100	**4**
PCC	NAI4302	Artificial Intelligence in Mechanical Engineering Systems	3	1	0	40	60	100	**4**
PCC	NCS4301	Discrete Mathematics	3	0	0	40	60	100	**3**
PCC	NCS4302	Data Structure using 'C'	3	1	0	40	60	100	**4**
ESC	NCS4303	Digital Logic Design	3	0	0	40	60	100	**3**
PCC	NCS4352	Data Structure Lab	0	0	2	40	60	100	**1**
ESC	NCS4353	Digital Logic Design Lab	0	0	2	40	60	100	**1**
CQAC	NVC4301	Indian Constitution*	1	0	0	40	60	100	**1**
	NGP4301	General Proficiency	-	-	-	100	-	100	**1**
Total			**18**	**3**	**4**	**460**	**540**	**1000**	**24**

SEMESTER IV									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
HSC	NHS4402/ NHS4401	Industrial Sociology/ Organizational Behavior	2	0	0	40	60	100	**2**
BSC	NBS4401	Statistical and Numerical Techniques	2	1	0	40	60	100	**3**
PCC	NAI4401	Concepts of Machine Learning With Python	3	0	0	40	60	100	**3**
PCC	NCS4401	Database Management Systems	3	1	0	40	60	100	**4**
PCC	NCS4402	Operating Systems	3	1	0	40	60	100	**4**
PCC	NCS4404	Computer Organization & Architecture	3	1	0	40	60	100	**4**
PCC	NAI4451	Machine Learning Lab	0	0	2	40	60	100	**1**
PCC	NCS4451	Database Management Systems Lab	0	0	2	40	60	100	**1**
CQAC	NCC4451	NSS/YOGA*	0	0	2	100	-	100	**1**
	NGP4401	General Proficiency	-	-	-	100	-	100	**1**
* Compulsory Qualifying Audit Course									
Total			**16**	**4**	**6**	**520**	**480**	**1000**	**24**
SEMESTER V									

Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
HSC	NHS4501	Engineering & Managerial Economics	3	0	0	40	60	**100**	**3**
PCC	NAI4501	Concepts of Data Science with Python	2	1	0	40	60	**100**	**3**
PCC	NAI4502	Artificial Neural Network	3	0	0	40	60	**100**	**3**
PCC	NCS4503	Computer Networks	3	0	0	40	60	**100**	**3**
PCC	NCS4504	Automata Theory and Formal Languages	3	1	0	40	60	**100**	**4**
PCC	NAI4551	Data Science with Python Lab	0	0	2	40	60	**100**	**1**
PCC	NAI4552	Artificial Neural Network Lab	0	0	2	40	60	**100**	**1**
PCC	NCS4553	Computer Networks Lab	0	0	2	40	60	**100**	**1**
SPIC	NAI4554	Minor Project-I	0	0	2	100	0	**100**	**1**
CQAC	NVC4501	Essence of Indian Knowledge Tradition*	1	0	0	40	60	**100**	**1**
	NGP4501	General Proficiency	-	-	-	100	-	**100**	**1**
Total			**15**	**2**	**8**	**560**	**540**	**1100**	**22**

* Compulsory Qualifying Audit Course

SEMESTER VI

Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
HSC	NHS4601	Industrial Management	3	0	0	40	60	**100**	**3**
PEC	-	**Professional Elective Course-I**	3	0	0	40	60	**100**	**3**
PCC	NCS4602	Design & Analysis of Algorithms	3	1	0	40	60	**100**	**4**
PCC	NCS4604	Compiler Design	3	1	0	40	60	**100**	**4**
PEC	**-**	**Professional Elective Course-II**	3	0	0	40	60	**100**	**3**
PCC	NCS4652	Algorithms Lab	0	0	2	40	60	**100**	**1**
PCC	NCS4654	Compiler Design Lab	0	0	2	40	60	**100**	**1**
SPIC	NAI4651	Seminar	0	0	2	100	0	**100**	**1**
SPIC	NAI4653	Minor Project-II	0	0	2	100	0	**100**	**1**
	NGP4601	General Proficiency	-	-	-	100	-	**100**	**1**
Total			**15**	**2**	**8**	**580**	**420**	**1000**	**22**

Note: The students need to undergo a 4 to 6 weeks of industrial training that will be evaluated in the VII Semester.

SEMESTER VII									
Course Category	**Course Code**	**Code Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
PCC	NAI4701	Natural Language Processing	3	1	0	40	60	**100**	**4**
PCC	NAI4702	Fuzzy Logic	2	1	0	40	60	**100**	**3**
PEC	**-**	**Professional Elective Course III**	3	0	0	40	60	**100**	**3**
OE	**-**	**Open Elective I***	3	1	0	40	60	**100**	**4**
PCC	NAI4751	Natural Language Processing Lab	0	0	2	40	60	**100**	**1**
SPIC	NAI4753	Major Project I[#]	0	0	4	100	0	**100**	**2**
SPIC	NAI4754	Industrial Training Evaluation	0	0	2	100	0	**100**	**1**
	NGP4701	General Proficiency	-	-	-	100	-	**100**	**1**
Total			**11**	**3**	**8**	**500**	**300**	**800**	**19**

*Students will opt any one of the open elective from the list of open electives provided by the university.

[#]Students need to submit an abstract for the project, select a guide and will complete the literature review related to the project.

SEMESTER VIII									
Course Category	**Course Code**	**Code Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
PCC	NAI4801	Concepts of Deep Learning	**3**	**0**	**0**	40	60	**100**	**3**
PEC	**-**	**Professional Elective Course IV**	**3**	**0**	**0**	40	60	**100**	**3**
OE	**-**	**Open Elective II****	**3**	**1**	**0**	40	60	**100**	**4**
SPIC	NAI4853	Major Project II[##]	**0**	**0**	**16**	160	240	**400**	**8**
	NGP4801	General Proficiency	**-**	**-**	**-**	100	-	**100**	**1**
Total			**9**	**1**	**16**	**380**	**420**	**800**	**19**

**The opted subject should be different from the one selected in VII Semester.

##This is in continuation with the project work started in Semester VII. In this semester the students will formulate the methodology do experimentation and show the results. Finally all project work will be presented in a report i.e. Project Report.

Legends:

L	Number of Lecture Hours per week
T	Number of Tutorial Hours per week
P	Number of Practical Hours per week
CIA	Continuous Internal Assessment
ESE	End Semester Examination

Category of Courses:

BSC	Basic Science Courses
CCC	Co-Curricular Courses
ESC	Engineering Science Courses
PEC	Professional Elective Course
GP	General Proficiency
HSC	Humanities and Social Science Courses
OE	Open Elective
PCC	Professional Core Courses
SPIC	Seminar/ Project/ Internship/ Community Services
CQAC	Compulsory Qualifying Audit Course

List of Open Electives
Offered by the Department of Computer Science and Engineering

S.N.	Course Code	Open Elective	Credit
1	OE43211	Database Administration	4
2	OE43221	Computational Intelligence	4

List of Vocational Courses
Offered by the Department of Computer Science and Engineering

S. N.	Course Code	Vocational Courses	Credit
1	NVC43241	Programming with Python	2
2	NVC43242	Artificial Intelligence	2
3	NVC43243	Cyber Crime and Computer Forensics	2
4	NVC43244	Meta-verse and Virtual Reality	2

List of Professional Elective Courses

Course Code	Professional Elective Course I
NPEC43911	Robotics and Intelligent System
NPEC43912	Introduction to Unmanned Aerial Vehicles
NPEC43913	Sentiment Analysis
NPEC43914	Internet of Things

Course Code	Professional Elective Course II
NPEC43921	Cyber Law and Security
NPEC43922	Computer Vision
NPEC43923	Recommender Systems
NPEC43924	Block Chain Technology

Course Code	Professional Elective Course III
NPEC43931	System Modeling & Simulation
NPEC43932	Embedded System Design
NPEC43933	Evolutionary Multi-objective Optimization
NPEC43934	Bioinformatics

Course Code	Professional Elective Course IV
NPEC43941	Cloud Computing
NPEC43942	Data Mining and Ware Housing
NPEC43943	Introduction to Drones
NPEC43944	Computer Forensics

BABU BANARASI DAS UNIVERSITY

School of Engineering (School Code: 04)

List of Open Electives for the Department of Computer Science and Engineering

S. No.	Course Name	Course Code
Open Elective-I		
1	Disaster Management	OE43101
2	Non-Conventional Energy Resources	OE43302
Open Elective-II		
3	Quality Management	OE43501
4	Concepts of Climate Smart Agriculture	OE43102

Program	B. Tech CSE (AI)				
Year	I	Semester	I		
Course Name	Computer Concepts and Programming in C				
Code	NCS4101				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Fundamentals of computer	3	0	0	3
Course Objectives	**1.** To learn the fundamentals of computer. **2.** Understand the various steps in programme development. **3.** Study the syntax and semantics of C programming language. **4.** To learn the usage of structured programming approach in solving problems.				
Course Outcomes					
CO1	Develop simple algorithms for arithmetic and logical problems.				
CO2	To translate the algorithms to programs & execution (in C language) and also implement conditional branching, iteration and recursion.				
CO3	To decompose a problem into functions and synthesize a complete Program using divides and conquers approach.				
CO4	Study the use of arrays, pointers and structures to develop algorithms and Programs.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to components of a computer system:** Memory, processor, I/O Devices, storage, operating system, Concept of assembler, compiler, interpreter, loader and linker. **Idea of Algorithm:** Representation of Algorithm, Flowchart, and Pseudo code with examples, From algorithms to programs, source code. **Programming Basics:** Structure of C program, writing and executing the first C program, Syntax and logical errors in compilation, object and executable code. Components of C language. Standard I/O in C, Fundamental data types, Variables and memory locations, Storage classes.	30 Hours	CO1

	Arithmetic expressions and precedence : Operators and expression using numeric and relational operators, mixed operands, type conversion, logical operators, bit operations, assignment operator, operator precedence and Associativity.		
2	**Conditional Branching:** Applying if and switch statements, nesting if and else, use of break and default with switch. **Iteration and loops:** use of while, do while and for loops, multiple loop variables, use of break and continue statements. **Functions:** Introduction, types of functions, functions with array, passing parameters to functions, call by value, call by reference, recursive functions. **Arrays:** Array notation and representation, manipulating array elements, using multi-dimensional arrays. Character arrays and strings, Structure, union, enumerated data types, Array of structures, Passing arrays to functions.	30 Hours	CO2, CO3
3	**Pointers:** Introduction, declaration, applications, Introduction to dynamic memory allocation (malloc, calloc, realloc, free), Use of pointers in self-referential structures, notion of linked list (no implementation). **File handling:** File I/O functions, Standard C pre-processors, defining and calling macros, command-line arguments	30 Hours	CO4

Suggested Readings

1. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson Addison-Wesley, 2006.

2. Computer Concepts and Programming in C, E Balaguruswami, McGraw Hill

3. The C programming by Kernighan Brain W. and Ritchie Dennis M., Pearson Education .

4. Computer Fundamentals and Programming in C. Reema Thareja, Oxford Publication

5. Computer Concepts and Programming in C by Vikas Gupta, Wiley India Publication

Online Resources

1. https://youtu.be/-wv-OERJK3M

2. https://nptel.ac.in/courses/106104074

Course Articulation Matrix

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1		2								1	2
CO2	2	3	1	1									2	2
CO3	1	3	2	2	2								1	2
CO4	1	1	2	1	1								1	1

Program	B. Tech CSE (AI)				
Year	I	**Semester**	I		
Course Name	Programming in C Lab				
Code	NCS4151				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of C	0	0	2	1
Course Objectives	**1.** Formulate problems and implement algorithms using C programming language. **2.** Learn memory allocation techniques using pointers. **3.** Learn memory allocation techniques using pointers **4.** Use structured programming approach for solving of computing problems in real world.				
Course Outcomes					
CO1	Understand the concept of basics of C, data types and variables.				
CO2	Understand the concept of operators, precedence of operators, conditional statements and looping statements.				
CO3	Explore the concept of strings, functions, recursive functions and differences between call by value and call by reference.				
CO4	Understand the concept of file handling functions, searching and sorting methods and real time applications of C.				

S. No.	List of Experiments	Mapped CO
1	WAP that accepts the marks of 5 subjects and finds the sum and percentage marks obtained by the student.	CO1,2
2	WAP that swaps values of two variables using a third variable.	CO 1,2
3	WAP to find the greatest of three numbers.	CO1,2
4	WAP that finds whether a given number is even or odd.	CO1,2
5	WAP that takes two operands and one operator from the user and perform the operation and prints the result by using Switch statement.	CO2,3
6	WAP to find the factorial of a given number.	CO3,4
7	WAP that simply takes elements of the array from the user and finds the sum of these elements.	CO2,3,4
8	WAP to search an element in a array using Linear Search.	CO2,3,4
9	WAP to add and multiply two matrices of order nxn.	CO2,3,4
10	WAP to implement strlen (), strcat (), strcpy () using the concept of Functions.	CO2,3,4

Suggested Readings

1. Byron Gottfried, “Programming with C”, Schaum's Outlines Series, McGraw Hill Education, 3 rd Edition, 2017.
2. E. Balagurusamy, “Programming in ANSI C”, McGraw Hill Education, 6th Edition, 2012.
3. Yashavant Kanetkar, “Exploring C”, BPB Publishers, 2nd Edition, 2003.
4. Schildt Herbert, “C: The Complete Reference”, Tata McGraw Hill Education, 4th Edition, 2014

Online Resources

1. https://ps-iiith.vlabs.ac.in/
2. https://www.vlab.co.in/ba-nptel-labs-computer-science-and-engineering

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO7**	**PO8**	**PO9**	**PO1 0**	**PO11**	**PO1 2**	**PSO1**	**PSO2**
CO1	**1**				**2**								**1**	**1**
CO2	**1**	**2**	**2**										**2**	**2**
CO3	**2**	**2**	**2**	**2**	**2**						**1**	**2**	**2**	**2**
CO4	**1**	**2**	**2**	**2**	**2**						**2**		**2**	**2**

Program	B. Tech CSE (AI)				
Year	I	**Semester**	I/II		
Course Name	Engineering Mechanics				
Code	NME4101/NME4201				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Physics	3	1	0	4
Course Objectives	**1.** To apply laws of mechanics to actual engineering problems. **2.** To calculate the reactive forces and analyse the structures. **3.** To know the geometric properties of the different shapes. **4.** To understand the elastic properties of different bodies.				
Course Outcomes					
CO1	Solve the engineering problems in case of equilibrium conditions & solve the problems involving dry friction.				
CO2	Calculate the reaction forces and forces in members of statically determinate structures.				
CO3	Determine the centroid and moment of inertia of various plane surfaces.				
CO4	To find out the stress, strain and elastic properties of different bodies.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Two Dimensional Concurrent Force Systems:** Basic concepts, Laws of motion, Principle of Transmissibility of forces, Transfer of a force to parallel position, Resultant of a force system, Simplest Resultant of Two dimensional concurrent Force systems **Two dimensional Non-concurrent Force systems** Resultant of Two dimensional Non-concurrent Force systems, Distributed force system, free body diagrams, Equilibrium and Equations of Equilibrium, Applications.	30 Hours	CO1
2	**Beam**: Introduction, Types of support, Types of load on beam, Types of beam, Reactions from supports of beam. **Friction**: Introduction, Laws of Coulomb Friction, Equilibrium of Bodies involving Dry friction, Belt friction, Application.	30 Hours	CO2
3	**Trusses:** Introduction, Perfect, Deficient, and Redundant truss, Solution of Simple truss by Method of Joints. **Centroid and Moment of Inertia:** Introduction, Centroid of plane figure and composite figure, Moment of inertia of plane area, Parallel Axes Theorem & Perpendicular axes theorem, Moment of inertia of composite bodies.	30 Hours	CO3
4	**Kinematics and Kinetics:** Linear motion, D'Alembert principle, Impulse and momentum principle, Work and energy principle. **Simple Stress and Strain:** Normal and Shear stresses, Stress- Strain Diagrams for ductile and brittle material, Elastic Constants, One Dimensional Loading of members of varying cross-sections.	30 Hours	CO4

Suggested Readings

1. Engineering Mechanics by S.S. Bhavikatti, K.G. Rajashekarappa, New Age Publications.

2. A textbook of Engineering Mechanics by Dr. R.K. Bansal, Laxmi Publications.

3. Engineering Mechanics by Irving H. Shames. Prentice-Hall.

Online Resources

1. **https://nptel.ac.in/courses/112106286**
2. **https://archive.nptel.ac.in/courses/112/106/112106286/**

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO7**	**PO8**	**PO9**	**PO1 0**	**PO11**	**PO1 2**	**PSO1**	**PSO2**
CO1	3	3	3	2	2									
CO2	3	2	2	3	3									
CO3	1	2	3	2	3									
CO4	2	2	2	2	2									

Program	B. Tech CSE (AI)				
Year	I	**Semester**	I/II		
Course Name	Basic Electronics Engineering				
Code	NEC4101/NEC4201				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of Physics & Maths	3	0	0	3
Course Objectives	**1.** Comprehensive idea about basic electronics devices like Diodes, BJT **2.** Comprehensive idea about basic electronics devices like JFET. **3.** Fundamental principles of Operational Amplifier and its application **4.** To have an idea about Digital electronics and principle of communication.				
Course Outcomes					
CO1	Understanding the fundamentals of electronic circuits like Diode as Rectifier and Clippers.				
CO2	Analysing the fundamentals of electronic devices like BJT and JFET.				
CO3	Evaluate the Number system, Boolean algebra, logic gates, Karnaugh map.				
CO4	Understanding the principles of Operational Amplifier and its application				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**DIODES** Energy band theory, Semiconductor material, Mass action law, PN junction: Forward and Reverse Bias characteristics, Diode as Rectifier: Half wave and Full wave Rectifiers, Clippers: Series Clippers, Breakdown Mechanism: Zener & Avalanche breakdown, Zener Diode and its application, Light Emitting Diode(LED).	30 Hours	CO1
2	**TRANSISTORS** Construction of Bipolar Junction Transistor: PNP and NPN, Working of Transistor, Base-Width modulation (Early Effect),Thermal Runaway BJT configurations: CE, CB and CC, Input & Output characteristics of CB & CE configuration, Biasing: Fixed bias, Emitter bias, Potential divider bias, Collector feedback Configuration, Comparison of biasing circuits. Transistor Amplifying Action. JFET: Basic construction and characteristics, Concept of pinch off, maximum drain saturation current, Input and transfer characteristics, Biasing: Self bias, fixed bias and Voltage divider bias.	30 Hours	CO2
3	**OPERATIONAL AMPLIFIER AND DIGITAL ELECTRONICS:** Introduction to OP-AMP, Equivalent Circuit and Pin diagram of Op-amp IC741, Characteristics of ideal OP-AMP, Input Offset Current , Input Bias Current, Basics of ideal and practical OP-AMP, Configurations: Open loop and closed loop, Applications of OP-AMP, Inverting amplifier, Non-inverting amplifier, Voltage follower, summing amplifier, Difference Amplifier, Integrator and Differentiator. Principle of feedback, Concept of positive and Negative feedback. Number System, Complements, Subtraction of binary number using 1's and 2's Complements, Excess 3 code, Gray	30 Hours	CO3, CO4

	Code (Cyclic Code), Boolean Algebra: Basic Theorems and De Morgan Theorems, Standard logic gates, Universal Logic Gates, Implementation of Boolean function using Basic gates and Universal gates.		

Suggested Readings

1. Robert L. Boylestad and Louis Nashelsky Electronic Devices and Circuit Theory, Pearson India.
2. Kennedy, Electronic Communication System, TMH
3. M. Morris Mano, Digital Logic and Computer Design, PHI

Online Resources

1. **https://onlinecourses.nptel.ac.in/noc21_ee55/preview**
2. **https://archive.nptel.ac.in/courses/122/106/122106025/**

Course Articulation Matrix

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1									
CO2	1	1	1	1	1									
CO3	1	1	3	3	3									
CO4	1	2	1	1	3									

Program	B. Tech CSE (AI)				
Year	I	**Semester**	I/II		
Course Name	Engineering Mechanics Lab				
Code	NME4151/NME4251				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Intermediate School Education	0	0	2	1
Course Objectives	**1.** To gain the practical knowledge of equilibrium and non- equilibrium conditions. **2.** To perform experimental analysis of Torsion tese. **3.** To apply the practical knowledge of finding bendinding moment of simply-supported and cantilever beam.				
Course Outcomes					
CO1	Able to understand the behaviour of metals under tension, compression and impact load condition.				
CO2	To gain the practical knowledge of indentation effect on material using different hardness testing methods.				
CO3	To apply the role of friction in lifting and lowering of loads.				
CO4	To analyse the effect of load in deflection for simply supported beam.				

S. No.	**List of Experiments**	
1	To conduct the tensile test and determine the ultimate tensile strength, percentage elongation for a steel specimen.	CO1
2	To conduct the Impact-tests (Izod) on Impact-testing machine to find the toughness.	CO1
3	To conduct the Impact-tests (Charpy) on Impact-testing machine to find the toughness.	CO1
4	To determine the compression test and determine the ultimate compressive strength for a Specimen.	CO1
5	Friction experiment(s) on inclined plane and/or on screw-jack.	CO3
6	Worm & worm-wheel experiment for load lifting.	CO3
7	Bending of simply-supported and cantilever beams for theoretical & experimental deflection.	CO4
8	Statics experiment on equilibrium.	CO2
9	Belt-Pulley experiment.	CO3
10	Torsion of rod/wire experiment.	CO4

Online Resources

1. https://www.vlab.co.in/broad-area-mechanical-engineering

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	**2**	**3**	**2**	**3**	**3**									
CO 2	**3**	**2**	**2**	**2**	**2**									
CO 3	**3**	**2**	**3**	**3**	**2**									
CO 4	**2**	**3**	**2**	**2**	**3**									

Program	B. Tech CSE(AI)				
Year	I	**Semester**		I/II	
Course Name	Workshop Practices				
Code	NME4152/NME4252				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Intermediate School Education	0	0	2	1
Course Objectives	**1.** To gain the practical knowledge of making male-female join, lap and butt join, half lap corner joint etc. **2.** To perform experimental analysis of upsetting, drawing down, punching, bending etc. in black smithy shop. **3.** To apply the practical knowledge of making Plane turning, Step turning, Taper turning, Threading, Grinding in machine shop.				
Course Outcomes					
CO1	To apply practical knowledge of making different types of joint in carpentry and fitting shop.				
CO2	Able to gain the practical knowledge of bending, upsetting, drawing down and punching of metals.				
CO3	To understand knowledge of joining of metals using various welding methods.				
CO4	To Study of machine tools and operations like Plane turning, Step turning, Taper turning, Threading, grinding of metals.				

S. No.	List of Experiments	Mapped CO
1	**Carpentry Shop:** Study of tools & operations and carpentry joints, Simple exercise using jack plane, to prepare half-lap corner joint, mortise & tennon joints, Simple exercise on wood working lathe.	CO1
2	**Fitting Bench Working Shop:** Study of tools & operations, Simple exercises involving fitting work, Make perfect male-female joint, Use of drills/taps.	CO1
3	**Black Smithy Shop:** Study of tools & operations, Simple exercises base on black smithy operations such as upsetting, drawing down, punching, bending, fullering & swaging.	CO2
4	**Welding Shop:** Study of tools & operations of Gas welding & Arc welding, Simple butt and Lap welded joints, Oxy-acetylene flame cutting.	CO3
5	**Sheet-metal Shop:** Study of equipment & operations, Making Funnel complete with 'soldering', Fabrication of tool-box, tray, electric panel box etc.	CO2
6	**Machine Shop:** Study of machine tools and operations, Plane turning, Step turning, Taper turning, Threading, Grinding of turning equipment.	CO4
7	**Foundry Shop:** Study of tools & operations, Pattern making, Mould making with the use of a core, Method of material pouring and Casting.	CO4

Online Resources

1. https://cgpit-bardoli.edu.in/engineering-graphics-eg-lab/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	**3**	**3**	**2**	**3**	**2**							**1**		
CO 2	**3**	**3**	**3**	**3**	**3**							**1**		
CO 3	**3**	**2**	**3**	**3**	**2**							**1**		
CO 4	**2**	**3**	**2**	**2**	**3**							**1**		

Program	B. Tech CSE(AI)				
Year	I	**Semester**	I/II		
Course Name	Basic Electrical Engineering				
Code	NEE4101/NEE4201				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Intermediate with PCM	3	1	0	4
Course Objectives	1. This course provides comprehensive idea about circuit analysis. 2. The subject gives the knowledge about combinational circuits. 3. Subject gives the knowledge about the analysis and design of new electrical circuits. 4. Other logical working principles of machines and common Measuring instruments.				
Course Outcomes					
CO1	To understand basic theorem of electrical engineering.				
CO2	To understand the basic concepts of magnetic, AC & DC circuits.				
CO3	To explain the working principle, construction, applications of DC & AC machines & measuring instruments.				
CO4	To gain knowledge about the fundamentals of electric components, devices.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Electric Circuit:** Introduction to linear and nonlinear circuits, circuit elements, various sources and source transformation, Star delta transformation, solution of D.C. circuits using Kirchhoff's laws- Mesh Analysis and Nodal Analysis, Signal wave forms, Passive elements specifications. **Basic theorems:** Thevenin, Norton, Maximum Power, Superposition, Millman's Theorem, Tellegen's Theorem applied to DC networks.	30 Hours	CO1, CO2
2	**A. C. Circuits:** A.C. voltage and currents, average and r.m.s. values, Form factor and peak factor, Phasor representation of sinusoidal quantities, phasor in polar, rectangular and exponential forms. Analysis of single phase series, parallel and series-parallel circuits, Active & reactive and apparent power, p.f., Volt-amperes, frequency response and Q-factor. Analysis of balanced three phase a.c. circuits, Introductory concept, voltage, current and power in three phase balanced circuits. Star-delta connections. Measurement of three phase power by Wattmeter Method.	30 Hours	CO2
3	**Measuring Instruments & Electromagnetic and Transformer:** Types of instruments, construction, working principles & applications, PMMC, MI, Single phase dynamometer, Ammeter, Voltmeter, Wattmeter, Induction type Energy meter, Use of shunt and multiplier. Magnetic circuit concept, B-H curves characteristics of magnetic materials, Practical magnetic circuits. Magnetic circuits with D.C. and A.C. excitation, Hysteresis and eddy current losses, Magnetic force. Self and mutual inductances, Faraday`s laws, Lenz`s Law,	30 Hours	CO3

	Statically and dynamically induced emfs, Energy stored in magnetic fields. Principle of Transformer operation, emf equation, Equivalent circuit of transformer, Losses and efficiency, Introduction of Auto Transformer and its applications.		
4	**Electrical Machines:** Basic concepts of rotating electric machines, DC machines (motor and generator), working principle, types, EMF and torque equations characteristics and application of DC motor. Three phase induction motors, types, principle of operation, applications. Single phase induction motors, principle of operation, starting methods, applications. Synchronous machines (motor and generator), principle of operation and applications.	30 Hours	CO4

Suggested Readings

1. Fundamental of Electric Circuits' by Charles K Alexander and Matthew N.O. Sadiku, Tata McGraw Hill Publication.
2. Electrical Engineering Fundamentals' by Vincent Del Toro, PHI Publication.
3. Basic Electrical Technology' by Kothari and I.J. Nagrath, Tata McGraw Hill.

Online Resources

1. **https://archive.nptel.ac.in/courses/108/108/108108076/**
2. **https://nptel.ac.in/courses/108105112**
3. **https://archive.nptel.ac.in/courses/108/105/108105112/**
4. **https://archive.nptel.ac.in/courses/108/104/108104139/**

Course Articulation Matrix														
PO-PSO	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	2									
CO2	3	3	3	3	3									
CO3	3	1	2	1	2	3								
CO4	2	2	2	2	1	2								

Program	B Tech CSE(CCML)				
Year	I	**Semester**	I/II		
Course Name	Basics of Artificial Intelligence				
Code	NCS4102/NCS4202				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Knowledge of computer	3	0	0	3
Course Objectives	**1.** Study of historical perspectives of AI and its foundations. **2.** Understanding the fundamental principles of AI. **3.** Study of advanced AI techniques; like soft computing and nature inspired computing. **4.** Understanding different AI approaches like problem solving, inference, perception, knowledge representation and learning.				
Course Outcomes					
CO1	Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.				
CO2	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.				
CO3	Demonstrate advanced AI techniques; like soft computing and nature inspired computing				
CO4	Demonstrate awareness and a fundamental understanding of various applications of AI techniques.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Artificial Intelligence (AI): definition, foundation and history of AI, types of AI, intelligent agents, structure of intelligent agents, introduction to soft computing, introduction and operations on fuzzy sets, nature inspired computing and algorithms.	30 Hours	CO1
2	AI terminologies & basic concepts, searching for solutions, search strategies: informed and uninformed, local and global search algorithms for optimistic problems, adversarial search, searching techniques for games, Alpha Beta pruning.	30 Hours	CO2

3	Knowledge representation and reasoning, propositional logic, theory of first order logic, inference mechanism in first order logic, forward and backward chaining, probabilistic reasoning, utility theory, Bayesian Networks. Applications and future of Artificial Intelligence, ethical issues, impact of AI on public life: understanding application of AI in Healthcare, Gaming, Finance, Data Security, Social Media, Travel & Transport, Automotive Industry, Robotics, AI in Entertainment, Agriculture, E-commerce and Education.	30 Hours	CO3, CO4

Suggested Readings

1. Stuart Russell and Peter Norvig, Artifcial Intelligence: A Modern Approach, Pearson Education, Inc., 2010.
2. Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", Harcourt Asia Pvt. Ltd., 2000.
3. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw-Hill, 2003.
4. George F. Luger, "Artificial Intelligence-Structures and Strategies For Complex Problem Solving", Pearson Education / PHI, 2002.
5. F. O. Karry, C. D. Silva, Soft Computing and Intelligent Systems Design, Pearson, 2009.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc21_ge20/preview
2 https://www.youtube.com/@IITDelhiJuly

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**2**	**2**	**1**									**2**	**2**	
CO2	**2**	**2**	**1**									**2**	**2**	
CO3	**2**	**2**	**1**									**2**	**2**	
CO4	**2**	**2**	**1**									**2**	**2**	

Program	B. Tech CSE(AI)				
Year	I	**Semester**	I/II		
Course Name	BASIC ELECTRICAL ENGINEERING LAB				
Code	NEE4151/NEE4251				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	INTERMEDIATE WITH PCM	0	0	2	1
Course Objectives	**1.** Understanding and application of network theorems and analysis of D.C. circuits. **2.** Fundamental understanding of Transformer, AC and DC circuit concepts. **3.** Understanding three-phase ac circuit devices for measurement and a three-phase system. **4.** Study and application of AC and DC Machines.				
Course Outcomes					
CO1	To have basic knowledge of various electrical equipment.				
CO2	To Understand the concept of Network Theorems and D.C Circuits.				
CO3	Know about concept of Three Phase AC Circuits and three phase system.				
CO4	Study and application of AC and DC Machines.				

S. No.	List of Experiments	Mapped CO
1	Study of Electrical Equipment used in daily life.	CO1
2	Transistor input-output characteristic.	CO1
3	Full wave rectifier circuit using diodes.	CO2
4	Verification of KCL & KVL.	CO2
5	Verification of Thevenin's theorem & Norton's theorem.	CO2
6	Verification of Superposition theorem.	CO2
7	Measurement of active power in 3 -phase circuit using TWO wattmeter methods.	CO3
8	Study of dc shunt motor speed control using (1) Armature control (2) Field Control.	CO4
9	Measurement of load test and Calculating efficiency of DC Machine.	CO4
10	Determination of equivalent circuit parameters of a single phase transformer by O.C. and S.C. tests and estimation of voltage regulation and efficiency at various loading conditions and verification by load test.	CO4

Virtual Lab Source:

1. https://ems-iitr.vlabs.ac.in/exp/lab-equipment-familiarization/
2. https://vlab.amrita.edu/?sub=3&brch=110&sim=245&cnt=526
3. http://vlabs.iitkgp.ernet.in/be/exp7/index.html
4. https://vlab.amrita.edu/?sub=1&brch=75&sim=217&cnt=1
5. http://vlabs.iitkgp.ernet.in/asnm/index.html#
6. http://vlabs.iitkgp.ernet.in/asnm/index.html#
7. http://vlabs.iitkgp.ernet.in/asnm/exp7/index.html
8. https://em-coep.vlabs.ac.in/exp/speed-control-dc-motor/index.html
9. https://em-coep.vlabs.ac.in/exp/load-test-dc-motor/
10. https://ems-iitr.vlabs.ac.in/exp/circuit-parameters-oc-test/index.html

Course Articulation Matrix														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**2**	**3**	**1**	**3**								**1**	**2**
CO2	**3**	**2**	**3**	**2**	**2**								**1**	**2**
CO3	**3**	**3**	**2**	**3**	**3**								**2**	**1**
CO4	**3**	**2**	**3**	**2**	**2**								**1**	**2**
CO5	**3**	**3**	**2**	**1**	**2**								**2**	**1**

Program	B. Tech CSE (AI)				
Year	I	**Semester**		I/II	
Course Name	Engineering Graphics Lab				
Code	NME4153/NME4253				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Intermediate School Education	0	0	2	1
Course Objectives	**1.** To gain the practical knowledge of different types of line and different type of projection. **2.** To draw the projection of point on VP & HP and projection of line like line inclined to one plane, inclined with the plane, true length and true inclination. **3.** To understand the use of Computer aided drafting in engineering graphics design.				
Course Outcomes					
CO1	Able to gain the knowledge of types of projection, orthographic projection, first and third angle projection.				
CO2	To understand the projection of lines, Planes like circle and polygons in different positions				
CO3	To draw Isometric scale, Isometric axes, Isometric Projection from orthographic drawing.				
CO4	Able to understand the software's basic commands of drafting entities like line, circle, polygon, polyhedron, cylinders.				

S. No.	List of Experiments	Mapped CO
1	1. **Scales**: Representative factor, plain scales, diagonal scales, scales of chords.	CO1
2	**2. Projection**: Types of projection, orthographic projection, first and third angle projection.	CO1
3	**3. Projection of points:** The principle of orthographic projections of a point on HP and VP, Conventional representation, Projection of a point in all the quadrants.	CO1
4	**4. Projection of Lines:** Line inclined to one plane, inclined with both the plane, True Length and True Inclination, Traces of straight lines.	CO2
5	**5. Projection of planes and solids**: Projection of Planes like circle and polygons in different positions; Projection of polyhedrons like prisms, pyramids and solids of revolutions like cylinder, cones in different positions.	CO2
6	**6. Section of Solids:** Section of right solids by normal and inclined planes; Intersection of cylinders.	CO3
7	**7. Isometric Projections:** Isometric scale, Isometric axes, Isometric Projection from orthographic drawing.	CO3
8	**8. Perspective Projection:** Nomenclature of Perspective Projection, Method of drawing perspective views, Visual Ray Method, using Top and Front, Top and Side views.	CO3
9	**9. Computer Aided Drafting (CAD)-**I: Introduction, benefit, software's basic commands of drafting entities like line, circle, polygon, polyhedron, cylinders.	CO4
10	**Computer Aided Drafting (CAD)-**II: Transformations and editing commands like move, rotate, mirror, array; solution of projection problems on CAD.	CO4

Online Resources

1. https://cgpit-bardoli.edu.in/engineering-graphics-eg-lab/

Course Articulation Matrix														
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	2								
CO2	2	2	3	2	2	3						1		
CO3	3	2	3	3	3	2						1		
CO4	3	3	3	2	3	2						1		

Program	B. Tech CSE(AI)				
Year	I	**Semester**	II		
Course Name	Programming Concepts with Python				
Code	NCS4201				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Prerequisite	Basic Knowledge of computer fundamentals and Programming Concepts.	3	0	0	3
Course Objectives	**1.** To have a strong foundation on Python Programming. **2.** Develop analytical ability on different real world situations. **3.** Easy mapping and respective conversion of real world problems to Python programs. **4.** Capability to work with large amounts of data for analytical purposes using Python.				
Course Outcomes					
CO1	Understand and write simple Python programs.				
CO2	Analysis of conditions in a problem and implement it in a program.				
CO3	Development of Python blocks using functions and data structures and their evaluation using function calls.				
CO4	Apply input/output with files in Python for secondary storage management and to apply OOPs concepts for analysis of real world problems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction and Conditional Statements:** Programming Cycle for Python, Python IDE, Interacting with Python Programs, Elements of Python, Type Conversion. **Basics:** Expressions, Assignment Statement, Arithmetic Operators, Operator Precedence, Boolean Expression. **Conditionals:** Conditional statement in Python (if-else statement, its working and execution), Nested-if statement and Elif statement in Python, Expression Evaluation & Float Representation.	30 Hours.	CO1
2	**Loop , Function and Strings:** **Loops:** Purpose and working of loops, While loop including its working, For Loop, Nested Loops, Break and Continue. **Function:** Parts of A Function, Execution of A Function, Keyword and Default Arguments, Scope Rules. **Strings:** Length of the string and perform Concatenation and Repeat operations in it, Indexing and Slicing of Strings. **Python Data Structure:** Tuples, Unpacking Sequences,Lists,Mutable Sequences, List Comprehension, Sets, Dictionaries.	30 Hours.	CO2
3	**Sieve Of Eratosthenes & File I/0:** **Sieve of Eratosthenes:** Generate prime numbers with the help of an algorithm given by the Greek Mathematician named Eratosthenes, whose algorithm is known as Sieve of Eratosthenes. **File I/O:** File input and output operations in Python Programming. **Exceptions and Assertions Modules :** Introduction, Importing Modules. **Abstract Data Types:** Abstract data types and ADT interface in Python Programming. **Classes:**	30 Hours.	CO3/CO4

	Class definition and other operations in the classes, Special Methods (such as init, str, comparison methods and Arithmetic methods etc.), Class Example, Inheritance, Inheritance and OOP.		

Suggested Readings:

1.Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.

2.Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

3.John V Guttag ―Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press, 2013.

Online Resources:

1. https://nptel.ac.in/courses/106106145

2. https://onlinecourses.swayam2.ac.in/cec22_cs20/preview

Course Articulation Matrix

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	3							1	1	1
CO2	3	2	2	2	3							2	2	2
CO3	3	3	2	2	3							2	2	2
CO4	3	2	2	2	3							2	2	2

Program	B.Tech: CSE (AI)				
Year	I	Semester		II	
Course Name	Python Programming Lab				
Code	NCS4251				
Course Type	ESC	L	T	P	Credit
Pre-Requisite		0	0	2	1
Course Objectives	**1.** Describe the core syntax and semantics of Python programming language. **2.** Illustrate the process of structuring the data using lists, dictionaries, tuples, strings and sets. **3.** Discover the need for working with the functions, modules and packages. Infer the Object-oriented Programming concepts in Python. **4.** Familiarize the advanced concepts like regular expressions, date and time. Able to handle abnormal termination of the python scripts				
Course Outcomes					
CO1	Interpret the fundamental Python syntax and semantics and able to solve, test and debug python programs				
CO2	Fluency in the use of Python control flow statements and determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples, strings and sets				
CO3	Express proficiency in the handling of functions, modules, packages and handle abnormal termination of the programs.				
CO4	Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python.				

S. No.	List of Experiments	Mapped CO
1	To write a Python program to compute the GCD of two numbers.	**CO1**
2	To write a Python program to find the most frequent words in a text file.	**CO1**
3	To write a python program find the square root of a number (Newton's method).	**CO2**
4	To write a python program exponentiation (power of a number).	**CO2**
5	To write a python program find the maximum of a list of numbers.	**CO3**
6	To write a python program to perform Matrix Multiplication.	**CO4**
7	To write a python program linear search.	**CO3**
8	To write a python program Binary search.	**CO2**
9	To write a python program selection sort.	**CO4**
10	To write a python program merge sort.	**CO4**

Online Resources

1. https://pythoniitk.vlabs.ac.in/
2. https://www.vlab.co.in/participating-institute-iit-kanpur

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO7**	**PO8**	**PO9**	**PO1 0**	**PO11**	**PO1 2**	**PSO1**	**PSO2**
CO1	**2**	**2**	**3**		**1**								**1**	**1**
CO2	**2**	**2**	**2**	**2**	**2**								**1**	**2**
CO3	**2**	**1**	**3**	**3**	**1**								**2**	**1**
CO4	**2**	**2**	**2**	**2**	**1**								**1**	**1**

Program	B. Tech CSE (AI)				
Year	II	**Semester**	III		
Course Name	Artificial Intelligence in Mechanical Engineering System				
Code	NAI4302				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Intermediate School Education	3	1	0	4
Course Objectives	**1.** To learn how Artificial Intelligence (AI) works in Mechanical Engineering system. **2.** To Study about Mechanical Engineering system. **3.** To learn how to Apply AI in Mechanical Engineering system. **4.** To understand the application of AI in Mechanical Engineering system.				
Course Outcomes					
CO1	To analyses the usefulness of AI system for Mechanical Engineering systems.				
CO2	To understand designing, selection and application AI system for Mechanical Engineering systems.				
CO3	To apply the knowledge base system and software in Mechanical Engineering systems.				
CO4	To understand the application AI in selection Mechanical Engineering systems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Definition of Artificial Intelligence, Mechanical Engineering System, Types of Mechanical Engineering Systems (MES), Machine learning (ML), Artificial Intelligence and Mechanical Engineering, Benefits of AI for Mechanical Engineering systems. Application of AI in MES.	30 Hours	CO1
2	Basic Elements of an Automated System, Control Systems, Advanced Automation Functions, Levels of Automation, Sensors, Actuators, Analog–Digital Conversions, Input/output Devices for Discrete Data, Contact Input/output Interfaces.	30 Hours	CO2
3	Expert System, Definition, Structure Characterization Knowledge Sources, Expert Knowledge Acquisition, Expert System software for Mechanical Engineering application in CAD, CAPP, MRP, Adaptive Control. Robotics, Process control. Typical cases for ML in Mechanical Engineering, Human-like machine vision, Adaptive control for process optimization.	30 Hours	CO3
4	Application of Artificial Intelligence in Thermal Engineering, Artificial Intelligence in Additive Manufacturing, Artificial Intelligence in 3D printing, Application of Artificial Intelligence in Manufacturing.	30 Hours	CO4

Suggested Readings

1. Artificial Intelligence in Mechanical and Industrial Engineering Edited By Kaushik Kumar Divya Zindani J. Paulo Davim.
2. Artificial Intelligence: Implications for Cim (Artificial Intelligence in Industry) by Andrew Kusiak.

3. R. J. Schalkoff, “Artificial Intelligence - an Engineering Approach”, McGraw Hill Int. Ed., Singapore, 1992.

Online Resources

1. https://www.digimat.in/nptel/courses/video/112103280/L01.html

2. https://youtube.com/playlist?list=PLp6ek2hDcoNB_YJCruBFjhF79f5ZHyBuz

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	3	3	2								2	1
CO2	3	3	2	2	3						2		1	2
CO3	3	2	3	3	2						1	3	2	2
CO4	2	3	2	2	2						2	2	2	1

Program	B. Tech CSE (AI)				
Year	II	**Semester**	III		
Course Name	Discrete Mathematics				
Code	NCS4301				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basics knowledge of functions and set theory	3	0	0	3
Course Objectives	**1.** To introduce Discrete Mathematical Structures (DMS) used in theoretical computer science. **2.** Investigate functions as relations and their properties **3**. Investigate use of Groups, Rings, Fields & Lattice **4.** Investigate proportional logic and relations for problem solving				
Course Outcomes					
CO1	Explore application of Set Theory, Relations, Functions & Natural Numbers				
CO2	To apply the basic principles Algebraic Structures				
CO3	To analyse the simple mathematical proofs by logic and relations				
CO4	To introduce Generating function and Combinatorics				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Set Theory, Relations, Functions & Natural Numbers** Set Theory: Introduction, Combination of sets, Multisets, Ordered pairs, Proofs of some general identities on sets. Relations: Definition, Operations on relations, Properties of relations, Composite Relations, Equality of relations, Recursive definition of relation, Order of relations. Functions: Definition, Classification of functions, Operations on functions, Natural Numbers: Introduction, Mathematical Induction, Induction with Nonzero Base cases, Proof Methods, Proof by contradiction.	30 Hours	CO1
2	**Groups, Rings, Fields & Lattice** Algebraic Structures: Definition, Groups, Subgroups and order, Cyclic Groups, Cosets, Lagrange's theorem, Normal Subgroups, Definition and elementary properties of Rings and Fields, Integers Modulo n; Partial order sets: Definition, Partial order sets, Combination of partial order sets, Hasse diagram. Lattices: Definition, Properties of lattices, Bounded, Complemented, Modular, Complete lattice	30 Hours	CO2
3	**Proposition Logic** Propositional Logic: Proposition, well-formed formula, Truth tables, Tautology, Satisfiability; Contradiction; Algebra of proposition; Theory of Inference; Predicate Logic: First order predicate-well- formed formula of predicate, quantifiers, Inference theory of predicate logic. **Recurrence Relation & Combinatorics** Recurrence Relation & Generating function: Recursive definition of functions, Recursive algorithms, Method of solving recurrences. Combinatorics: Introduction; Counting Techniques: Pigeonhole Principle	30 Hours	CO3, CO4

Suggested Readings

1. Kenneth H. Rosen, “Discrete Mathematics and Its Applications”, McGraw- Hill

2. R.P. Grimaldi, “Discrete and Combinatorial Mathematics”, Addison Wesley.

3. Jean Paul Trembley, R Manohar, “Discrete Mathematical Structures with Application to Computer Science,” McGraw-Hill.

Online Resources

1. https://archive.nptel.ac.in/courses/106/108/106108227/

2. https://archive.nptel.ac.in/courses/106/105/106105192/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO 9**	**PO10**	**PO1 1**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	3	2									3	
CO2	3	1	3	1									1	
CO3	3	1	3	2									2	
CO4	2	1	2	2									3	

Program	B. Tech CSE(AI)				
Year	II	**Semester**	III		
Course Name	Digital Logic Design				
Code	NCS4303				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic of computer fundamentals	3	0	0	3
Course Objectives	**1.** To Introduce the concept of digital and binary systems **2.** Able to design and analyse combinational logic circuits. **3.** Able to design and analyse sequential logic circuits. **4.** To reinforce theory and techniques taught in the classroom through experiments and projects in the laboratory.				
Course Outcomes					
CO1	Define different number systems, binary addition and subtraction, 2's complement representation and operations with this representation.				
CO2	Understand the different switching algebra theorems and apply them for logic functions.				
CO3	Define the Karnaugh map for a few variables and perform an algorithmic reduction of logic functions and combinational circuits				
CO4	Understand sequential circuits, like counters and shift registers, and to perform simple projects with them.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Digital Design and Binary Numbers:** Binary Arithmetic, Negative Numbers and their Arithmetic, Floating point representation, Binary Codes, Cyclic Codes, Error Detecting and Correcting Codes, Hamming Codes. Min term and Max term Realization of Boolean Functions, **Gate-level minimization:** The map method up to four variable, don't care conditions, SOP and POS simplification, NAND and NOR implementation, Quine Mc - Cluskey Method (Tabular method).	30 Hours	CO1
2	**Combinational Logic:** Combinational Circuits, Analysis Procedure, Design Procedure, Binary Adder-Subtractor, Code Converters, Parity Generators and Checkers, Decimal Adder, Binary Multiplier, Magnitude Comparator, Decoders, Encoders, Multiplexers, Hazards and Threshold Logic. **Memory and Programmable Logic Devices:** Semiconductor Memories, RAM, ROM, PLA, PAL, Memory System design.	30 Hours	CO2, CO4
3	**Synchronous Sequential Logic:** Sequential Circuits, Storage Elements: Latches, Flip Flops, Analysis of Clocked Sequential circuits, state reduction and assignments, design procedure. Registers and Counters: Shift Registers, Ripple Counter, Synchronous Counter, Other Counters. **Asynchronous Sequential Logic:** Analysis procedure, circuit with latches, design procedure, reduction of state and flow table, race free state assignment, hazards.	30 Hours	CO3

Suggested Readings

1. Donald D. Givone, “Digital Principles and Design”, Tata MCGraw Hill.
2. Marcovitz : Introduction to logic Design ,Tata Mcgraw-hill Education (India) Pvt. Ltd.
3. Raj Kamal, ‖Digital Systems Principle and Design‖, Pearson Education.
4. Balbaniam, Carison, ‖Digital Logic Design Principles‖, Wiley Publications.
5. R.P. Jain, ―Modern Digital Electronics‖, McGraw Hill.

Online Resources

1. **https://nptel.ac.in/courses/106105185**
2. **https://nptel.ac.in/courses/108106177**

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO 5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO1 2**	**PSO1**	**PSO2**
CO1	**3**	**1**	**1**	**2**	**2**									
CO2	**2**	**2**	**2**	**1**	**2**									
CO3	**2**	**1**	**2**	**1**	**2**									
CO4	**3**	**2**	**2**	**2**	**3**									

Program	B. Tech CSE (AI)				
Year	II	**Semester**	III		
Course Name	Data Structure Using 'C'				
Code	NCS4302				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Fundamentals of computer knowledge	3	1	0	4
Course Objectives	**1.** To introduce the basis and advanced data structures **2.** To understand various data operations performed on in data structures **3.** To understand various sorting and searching techniques in data structures **4.** To analyse the performance of data structures algorithms				
Course Outcomes					
CO1	Understand the applications of data structures including the ability to implement algorithms for the creation, insertion, deletion, searching and sorting of each data structure.				
CO2	Apply knowledge of underlying data structures needed for solving problems and programming.				
CO3	Analyse the application of data structures for storage and retrieval of ordered and unordered data.				
CO4	Understanding the graph representation and traversal				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction** Introduction: Basic Terminology, Data types and its classification, Algorithm complexity notations like big Oh, Time- Space trade-off. Abstract Data Type (ADT). **Array**: Array , Definition, Representation and Analysis of Arrays, Single and Multidimensional Arrays, Address calculation, Array as Parameters, Sparse Matrices, Recursion- definition and processes, simulating recursion, Backtracking, Recursive algorithms, Tail recursion, Removal of recursion, Tower of Hanoi.	30 Hours	CO1
2	**Stack and Linked List** Stack, Array Implementation of stack, Linked Representation of Stack, Application of stack: Conversion of Infix to Prefix and Postfix Expressions And Expression evaluation, Queue, Array and linked implementation of queues, Circular queues, D-queues and Priority Queues. Linked list, Implementation of Singly Linked List, Two-way Header List, Doubly linked list, Linked List in Array. Generalized linked list, Application: Garbage collection and compaction, Polynomial Arithmetic.	30 Hours	CO2
3	**Tree, Searching, Sorting and Hashing** Trees: Basic, terminology, Binary Trees, algebraic Expressions, Complete Binary Tree, Extended Binary Trees, Array and Linked Representation of Binary trees, Traversing Binary trees, Threaded Binary trees, Binary Search Tree(BST), AVL Trees, B-trees. Application: Algebraic Expression, Huffman coding Algorithm. Internal and External sorting, Insertion Sort, Bubble Sort, selection	30 Hours	CO3

	sort, Quick Sort, Merge Sort, Heap Sort, Radix sort, Searching Hashing: Sequential search, binary search, Hash Table, Hash Functions, Collision Resolution Strategies, Hash Table Implementation. Symbol Table, Static tree table, Dynamic Tree table.		
4	**Graphs** Graphs: Terminology, Sequential and linked Representations of Graphs: Adjacency Matrices, Adjacency List, Adjacency Multi-list, Graph Traversal: Depth First Search and Breadth First Search, Connected Component, Spanning Trees, Minimum Cost Spanning Trees: Prims and Kruskal algorithm. Transitive Closure and Shortest Path algorithm: Warshall Algorithm and Dijkstra Algorithm.	30 Hours	CO4

Suggested Readings

1. Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein, "Data Structures Using C and C++", PHI, 2000.
2. Horowitz and Sahani, "Fundamentals of Data Structures",Galgotia Publication, 1982.
3. Jean Paul Trembley and Paul G. Sorenson, "An Introduction to Data Structures with Applications", McGraw-Hill, 1984
4. R. Kruse Et Al, "Data Structures and Program Design in C", Pearson Education, 2006
5. Lipschutz, "Data Structures", Schaum's Outline Series, TMH, 2014
6. GAV Pai, "Data Structures and Algorithms", TMH, 2009

Online Resources

1. https://archive.nptel.ac.in/courses/106/102/106102064/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**1**	**2**	**1**										**1**	
CO2	**1**	**1**	**2**										**1**	
CO3	**2**	**1**	**2**										**1**	
CO4	**2**	**2**	**2**										**1**	

Program	B.Tech CSE (AI)				
Year	II	Semester		III	
Course Name	Data Structure Lab				
Code	NCS4352				
Course Type	PCC	L	T	P	Credit
Pre-Requisite	Basic knowledge of C language	0	0	2	1
Course Objectives	**1.** Understand various data representation techniques in the real world. **2.** Implement linear and non-linear data structures. **3.** Analyze various algorithms based on their time and space complexity. **4.** Develop real-time applications using suitable data structure.				
Course Outcomes					
CO1	Understand the concept of data structures and apply algorithm for solving problems like Sorting, searching, insertion and deletion of data.				
CO2	Understand linear data structures for processing of ordered or unordered data.				
CO3	Explore various operations on dynamic data structures like single linked list, circular linked list and doubly linked list				
CO4	Understand the binary search trees, hash function, and concepts of collision and its resolution methods				

S. No.	List of Experiments	Mapped CO
1	Implementation of List using Dynamic memory Allocation.	CO1
2	Implementation of Queue.	CO1
3	Implementation of Searching and Sorting Algorithms.	CO1
4	Array implementation of Stack.	CO2
5	Array implementation of Queue.	CO2
6	Array implementation of Circular Queue.	CO2
7	Array implementation of List	CO2
8	Implementation of Stack	CO3
9	Implementation of Circular Queue	CO3
10	Implementation of Tree Structures	CO4
11	Implementation of Binary Tree.	CO4
12	Implementation of Tree Traversal.	CO4
13	Implementation of Binary Search Tree.	CO4
14	Implementation of Insertion in BST.	CO4
15	Implementation of Deletion in BST.	CO4
16	Graph Implementation, BFS.	CO4
17	Graph Implementation, DFS.	CO4
18	Graph Implementation, Minimum cost spanning tree.	CO4
19	Graph Implementation, shortest path algorithm.	CO4

Online Resources

1. https://cse01-iiith.vlabs.ac.in/
2. https://cse.iitkgp.ac.in/~rkumar/pds-vlab/index1.html

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO7**	**PO8**	**PO9**	**PO1 0**	**PO11**	**PO1 2**	**PSO1**	**PSO2**
CO1	**2**	**1**	**2**	**2**	**1**								**1**	**1**
CO2	**2**	**2**	**1**	**1**										
CO3	**2**	**2**	**2**	**3**	**2**									
CO4	**2**	**3**	**2**	**2**	**1**								**1**	**1**

Program	B. Tech CSE (AI)				
Year	II	**Semester**	III		
Course Name	Digital Logic Design Lab				
Code	NCS4353				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Hardware Devices	0	0	2	1
Course Objectives	1. To study the basic of various number systems, negative number representation, binary. 2. To study the combinational logic design of various logic and switching devices and their realization. 3. To study the sequential logic circuits design both in synchronous and asynchronous modes. 4. To study some of the programmable logic devices and their use in realization of switching functions.				
Course Outcomes					
CO1	Understand various types of number systems and their conversions.				
CO2	Design and implement variety of logical devices using combinational circuits concepts.				
CO3	Demonstrate and compare the construction of programmable logic devices and different types of ROM.				
CO4	Analyze sequential circuits like Registers and Counters using flip-flops.				

S. No.	List of Experiments	Mapped CO
1	Verification, Simplification and Realization of Boolean Expressions using Logic gates/Universal gates.	CO1
2	Realization of Binary to Gray code conversion and vice versa.	CO1
3	Realization of Half/Full adder and Half/Full Subtractors using logic gates.	CO2
4	Realization of parallel adder/Subtractors using 7483 chips.	CO2
5	BCD to Excess-3 code conversion and vice versa.	CO1
6	MUX/DEMUX–use of 74153, 74139 for arithmetic circuits and code converter.	CO2
7	Realization of One/Two-bit comparator and study of 7485 magnitude comparator.	CO3
8	Truth table verification of Flip-Flops: a. JK Master slave (ii) T type (iii) D type	CO4
9	Realization of 3-bit counters as a sequential circuit and MOD–N counter design (7476, 7490, 74192, 74193)	CO4
10	Perform Shift left; Shift right, SIPO, SISO, PISO, PIPO operations using 74S95.	CO4
11	Wiring and testing of Ring counter/Johnson counter	CO4
12	Wiring and testing of Sequence generator.	CO2

Online Resources

1. https://cse15-iiith.vlabs.ac.in/
2. https://nptel.ac.in/courses/117106086

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**2**	**3**	**3**	**2**	**1**									
CO2	**2**	**2**	**3**	**2**										
CO3			**3**											
CO4	**3**	**2**	**3**	**2**										

Program	B.TECH: CSE/CSE-AI/CSE-CCML/CSE-IOTBC				
Year	II	**Semester**		III/IV	
Course Name	INDIAN CONSITUTION				
Code	NVC4301/NVC4401				
Course Type	CQAC	**L**	**T**	**P**	**Credit**
Pre-Requisite	The basic knowledge of Indian Constitutions	1	0	0	1
Course Objectives	**1.** To realise the significance of constitution of India to students from all walks of life and help them to understand the basic concepts of Indian constitution. To Know the need and importance of protecting traditional **2.** To identify the importance of fundamental rights as well as fundamental duties. **3.** To understand the functioning of Union, State and Local Governments in Indian federal system **4.** To learn procedure and effects of emergency, composition and activities of election commission and amendment procedure.				
Course Outcomes					
CO1	Understand the concept of Indian constitution.				
CO2	Identify the powers and functions of Supreme Court and High court.				
CO3	Analyse the role Governor and Chief Minister.				
CO4	Explain the district administration role and importance.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Indian Constitution** Constitution meaning of the term - The making of the Indian Constitution - Sources and constitutional history – Philosophy of Constituent Assembly - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy. Union Government and its Administration Structure: President and Vice President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, LokSabha, RajyaSabha, The Supreme Court and High Court: Powers and Functions.	30 Hours	CO1, CO2
2	**The States and The Union Territories** State Government and its Administration: Governor - Role and Position - CM and Council of ministers, State Secretariat: Organisation, Structure and Functions – Relation between the Union and the States. **Local Administration** District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative – Pachayati Raj: Functions PRI: Zilla Panchayat, Elected officials and their roles - Block level Organizational Hierarchy, Village level - Role of Elected and Appointed officials - Importance of grass-root democracy	30 Hours	CO3, CO4

Suggested Readings

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt.Ltd.. New Delhi
2. SubashKashyap, Indian Constitution, National Book Trust
3. J.A. Siwach, Dynamics of Indian Government & Politics
4. D.C. Gupta, Indian Government and Politics
5. H.M.Sreevai, Constitutional Law of India, 4th Edition, Universal Law Publication.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc20_lw03/preview

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1		**2**					**2**	**3**	**1**	**2**		**3**	**1**	
CO2		**3**					**1**	**2**	**3**	**2**		**1**	**2**	
CO3		**1**					**2**	**2**	**2**	**1**		**2**	**1**	
CO4		**2**					**1**	**3**	**2**	**2**		**2**	**2**	

Program	B.Tech CSE(AI)				
Year	II	**Semester**	IV		
Course Name	Concepts of Machine Learning with Python				
Code	NAI4401				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Programming Knowledge of Python	3	0	0	3
Course Objectives	**1.** Acquire knowledge of setting hypotheses for problems. **2.** Applying suitable machine learning techniques for problems. **3.** Evaluate the performance of machine learning. **4.** Identify and integrate more than one technique to enhance the performance of learning.				
Course Outcomes					
CO1	Understanding machine learning strategies, hypothesis testing and python.				
CO2	Understanding and Appling Supervised learning techniques.				
CO3	Understanding and Appling Unsupervised Learning techniques				
CO4	Understanding and Appling probabilistic and Ensemble Learning techniques				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Machine Learning** Introduction, Examples of various Learning Paradigms, Perspectives and Issues, Version Spaces, Finite and Infinite Hypothesis Spaces, PAC Learning, VC Dimension. **Machine Learning using Python** Introduction to python; basic library; functions of library; implementation of library; Design, Analysis and Evaluation of Machine Learning Experiments, Other Issues: Handling imbalanced data sets.	30 Hours	CO1
2	**Supervised Learning Algorithms** Learning a Class from Examples, Linear, Non- linear, Multi-class and Multi-label classification, Decision Trees: ID3, Classification and Regression Trees (CART), Regression: Linear Regression, Multiple Linear Regression, Logistic Regression. **Advanced Supervised Learning** Neural Networks: Introduction, Perceptron, Multilayer Perceptron, Support vector machines: Linear and Non-Linear, Kernel Functions, K- Nearest Neighbors **Ensemble Learning** Ensemble Learning Model Combination Schemes, Voting, Bagging: Random Forest Trees, boosting: Adaboost, Stacking.	30 Hours	CO2
3	**Unsupervised Learning** Introduction to clustering, Hierarchical: AGNES, DIANA, Partitional: K-means clustering, K-Mode Clustering, Self-Organizing Map, Expectation Maximization, Gaussian Mixture Models, Principal Component Analysis (PCA), Locally Linear Embedding (LLE), Factor Analysis **Probabilistic Learning** Bayesian Learning, Bayes Optimal Classifier, Naïve Bayes	30 Hours	CO3, CO4

	Classifier, Bayesian Belief Networks, Mining, Frequent Patterns		

Suggested Readings

1. Ethem Alpaydin,"Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition 2014
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations
3. of Machine Learning", MIT Press, 2012.
4. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition,1997.
5. Charu C.Aggarwal,"Data Classification Algorithms and Applications", CRC Press, 2014.
6. Stephen Marsland, "Machine Learning – An Algorithmic Perspective",2nd Edition, CRC Press, 2015.
7. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012
8. Jiawei Han and Micheline Kamber and Jian Pei, "Data Mining – Concepts and Techniques", 3rd Edition,Morgan Kaufmann Publications, 2012.
9. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, "Mathematics for Machine Learning", Cambridge University Press, 2019.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc19_cs52/preview

2. https://nptel.ac.in/courses/106106139

PO-PSO	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO1 2	PSO1	PSO2
CO1	**2**	**2**	**1**	**2**	**3**								**3**	**3**
CO2	**3**	**3**	**3**	**2**		**1**							**2**	**1**
CO3	**2**	**3**	**2**	**3**		**1**							**1**	**2**
CO4	**3**	**3**	**3**	**3**		**1**							**2**	**1**

Program	B. Tech CSE				
Year	II	**Semester**	IV		
Course Name	Database Management System				
Code	NCS4401				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Fundamentals of computer	3	1	0	4
Course Objectives	**1.** To introduce the basics of Database Management System **2.** Understanding the fundamental relational system, data model. **3.** Understanding the fundamental of architecture, and manipulations. **4.** To develop Understanding of Transaction Processing System, Concurrency control, and Recovery procedures in database.				
Course Outcomes					
CO1	Understand terms related to database design and management.				
CO2	Constructing conceptual data model.				
CO3	Understand the functional dependencies, normalization and using SQL				
CO4	Understand and applying issues of transaction processing and concurrency control				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Database System Concepts, Database Users, and Architecture** Introduction to Database System with example, Characteristics of the Database Approach, Users of Database System, Advantages and disadvantages of Using a DBMS, Implications of the Database Approach, Data Models, Schemas, and Instances, DBMS Architecture and Data Independence, Database Languages and Interfaces, The Components of Database System, Classification of Database Management Systems	30 Hours	CO1
2	**Data Modelling & Relational Database Management System** Data Modelling Using the Entity-Relationship Model, concepts, notation for ER diagram, mapping constraints, keys, Concepts of Super Key, candidate key, primary key, Entity Types, Entity Sets, and Attributes, Relationships, Relationship Types, Roles, and Structural Constraints, Strong vs Weak Entity Types, ER Diagrams, Naming Conventions, and Design Issues, Enhanced Entity-Relationship Modelling, Subclasses, Super classes, and Inheritance, Specialization and Generalization, Constraints and Characteristics of Specialization and Generalization, Modelling of UNION Types Using Categories, The Relational Data Model, Relational Constraints, and the Relational Algebra, Relational Model Concepts, Relational Constraints and Relational Database Schemas, Update Operations and Dealing with Constraint Violations, Basic Relational Algebra Operations, Additional Relational Operations, Examples of Queries in Relational Algebra	30 Hours	CO2
3	**SQL and Database Design Theory and Methodology** Structured Query Language- The Relational Database Standard, Data Definition, Constraints, and Schema	30 Hours	CO3

	Changes in SQL, Types of SQL Commands, SQL Operators and their Procedure, Insert, Delete, and Update Statements in SQL, Queries and Subqueries, Aggregate Functions, Joins, Unions, Intersection, Minus, Views (Virtual Tables) in SQL, Cursors, Triggers and PL/SQL, Functional Dependencies and Normalization for Relational Databases, Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form		
4	**Transaction Processing, Concurrency Control and Database Recovery** Transaction Processing Concepts, Introduction to Transaction Processing, Transaction states and State Diagram, Transaction and System Concepts, Desirable Properties of Transactions, Schedules and Recoverability, Serializability of Schedules, Concurrency Control Techniques, Locking Techniques for Concurrency Control, Concurrency Control Based on Timestamp Ordering, Multiversion Concurrency Control Techniques, Validation (Optimistic) Concurrency Control Techniques, Granularity of Data Items and Multiple Granularity Locking, Database Recovery Techniques, Recovery Concepts, Recovery Techniques Based on Deferred Update, Recovery Techniques Based on Immediate Update, Shadow Paging, The ARIES Recovery Algorithm, Database Backup and Recovery from Catastrophic Failures	30 Hours	CO4

Suggested Readings

1. Data base System Concepts, Silberschatz, Korth, McGraw hill, Sixth Edition.

2. Fundamentals of Database Systems, Elmasri Navathe Pearson Education.

3. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill 3rd Edition.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc22_cs51/preview

2. https://www.udemy.com/topic/database-management/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	1										1	1
CO2	2	2	2		2								2	2
CO3	2	1	3		2								2	2
CO4	2	2	2		3								2	2

Program	B. Tech CSE				
Year	II	Semester	IV		
Course Name	Operating Systems				
Code	NCS4402				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Knowledge of Computer System.	3	1	0	4
Course Objectives	**1.** Understand the structure and functions of OS and analyse Processes, Threads and Scheduling algorithms. **2.** Analyse O.S concepts that include architecture mutual exclusion algorithms, deadlock detection algorithms and agreement. **3.** Understand the principles of concurrency and Deadlocks. **4.** Analyse various memory management schemes. Study I/O management and File systems.				
Course Outcomes					
CO1	Understanding of the concepts, structure and design of OS and Learning about Processes, Threads and Scheduling algorithms.				
CO2	Understand the principles of concurrency and Deadlock.				
CO3	Evaluate various memory management schemes.				
CO4	Analyse and Implement a prototype file system.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Operating System and Process Concept** Operating system and functions, Classification of Operating systems, Operating System Structure, Operating System Services, System call and System program, Process concept, Process state, Process control block, Context switching, Operation on process, Threads and their management, Benefits of multithreading, Types of threads, Threading issues, CPU-scheduling, Scheduling criteria, Scheduling Algorithms, Concurrent Processes, Inter Process Communication models and Schemes	30 Hours	CO1
2	**Process Synchronization and Deadlock** Process synchronization, Producer/Consumer Problem, Critical Section Problem, Peterson's solution, Synchronization of hardware, Semaphore, Classical-problem of synchronization, Deadlock, Deadlock characterization, Deadlock Prevention, Deadlock Avoidance, Resource allocation graph algorithm, Banker's algorithm, Deadlock detection, Recovery from deadlock	30 Hours	CO2
3	**Memory Management** Memory Management, Multiprogramming with fixed partitions, Multiprogramming with variable partitions, Paging, Segmentation, Paged segmentation, Virtual memory concepts, Demand paging, Performance of demand paging, Page replacement algorithms, Thrashing	30 Hours	CO3
4	**I/O Management and File System** File System Structure, File System Implementation, Directory Implementation and Allocation Methods, Free space Management, Kernel I/O Subsystems, Disk Structure, Disk Scheduling, Disk Management, Swap-Space	30 Hours	CO4

	Management		

Suggested Readings

1. Silberschatz, Galvin and Gagne, “Operating Systems Concepts”, Wiley Publication

2. Sibsankar Halder and Alex A Aravind, “Operating Systems”, Pearson Education

3. Harvey M Dietel, “An Introduction to Operating System”, Pearson Education

4. D M Dhamdhere, “Operating Systems: A Concept-based Approach”, TMH

5. William Stallings, “Operating Systems: Internals and Design Principles”, Pearson Education

Online Resources

1. https://onlinecourses.nptel.ac.in/noc21_cs72/preview

2. https://www.coursera.org/specializations/codio-introduction-operating-systems

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	1	2	3							1	1	
CO2	2	3	2	1	1								1	2
CO3	2	2	1	1	2							2	2	1
CO4	2	1	2	3	2								1	

Program	B. Tech CSE (AI)				
Year	II	**Semester**	IV		
Course Name	Computer Organization & Architecture				
Code	NCS4404				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of Digital Logic Design	3	1	0	4
Course Objectives	**1.** To Study of the basic structure and operation of a digital computer system. **2.** To understand how computer are constructed by a set of functional units. **3.** Ability to analyse memory hierarchy and its impact on computer cost/performance. **4.** Analyzing fundamental issues in architecture design and their impact on application performance.				
Course Outcomes					
CO1	Identify the basic structure and function unit of a digital computer.				
CO2	Understanding and analyze the effect of addressing modes and instructions				
CO3	Understanding Control Unit and ALU				
CO4	Understanding Interrupts and I/O				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Computer Evolution & Arithmetic** A Brief History of computers: Von Neumann Architecture, Hardware Architecture, Computer Components, Interconnection Structures, Bus Interconnection, Register Transfer Language, Bus and Memory Transfers, Bus Architecture, Bus Arbitration Techniques, Arithmetic Logic, Shift Micro operation, Arithmetic Logic Shift Unit, Arithmetic Algorithms (Addition, subtraction, Booth Multiplication, Division).	30 Hours	CO1
2	**Control Unit** Control Design: Hardwired & Micro Programmed, Performing of arithmetic or logical operations, Multiple Bus organization, Hardwired Control, Micro programmed control, Microinstruction, Micro program sequencing, Wide-Branch addressing, Microinstruction with Next-address field, Prefetching, Microinstruction, Pipeline control: Instruction pipelines, Pipeline performance.	30 Hours	CO2
3	**Processor Organization and Input-Output Organization** Processor Design: General register organization, Stack organization, Addressing mode, Instruction format, Data transfer & manipulations, Program Control, Reduced Instruction Set, Computer Memory Organization: Basic concept and hierarchy, semiconductor RAM memories,2D&2 1/2D memory organization, ROM memories, Cache memories, Concept and design issues & performance, Address mapping and replacement, Auxiliary memories: Magnetic disk, Magnetic tape and optical disks, Virtual memory, Concept implementation.	30 Hours	CO3

4	**Interrupts** Interrupt hardware, Types of interrupts and exceptions, Modes of Data Transfer: Programmed I/O, Interrupt initiated I/O, Direct Memory Access: I/O channels and processors, Serial Communication: Synchronous & asynchronous communication, Standard communication interfaces	30 Hours	CO4

Suggested Readings

1. Patterson, "Computer Organization and Design", Elsevier Publication.

2. Vravice, Hmacher & Zaky,"Computer Organization", TMH.

3. Moris Mano,"Computer System Architecture", PHI.

4. John P Hays,"Computer Organization", McGraw Hill.

5. Tannenbaum, "Structured Computer Organization", PHI.

6. P Pal Chaudhry," Computer Organization & Design", PHI.

Online Resources

1. https://nptel.ac.in/courses/106102062

2. https://archive.nptel.ac.in/courses/106/105/106105163/

Course Articulation Matrix														
PO-PSO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	**2**	**1**												
CO2	**2**	**1**	**1**	**1**										
CO3	**2**	**1**	**1**	**1**										
CO4	**2**	**1**	**1**	**1**										

Program	B. Tech CSE (AI)				
Year	II	Semester		IV	
Course Name	Machine Learning Lab				
Code	NAI4451				
Course Type	PCC	L	T	P	Credit
Pre-Requisite	Python	0	0	2	1
Course Objectives	**1.** Make use of Data sets in implementing the machine learning algorithms **2.** To implement unsupervised learning **3.** Implement the machine learning concepts and algorithms in any suitable language of choice. **4.** To implement handle unbalanced data sets				
Course Outcomes					
CO1	Application of supervised learning				
CO2	Application and Implementation of unsupervised learning				
CO3	Design Java/Python programs for various Learning algorithms.				
CO4	Apply appropriate data sets to the Machine Learning algorithms				

S. No.	List of Experiments	Mapped CO
1	Implement Decision Tree learning	CO1
2	Implement Logistic Regression	CO1
3	Implement classification using Multilayer perceptron	CO1
4	Implement classification using SVM	CO2
5	Implement Bagging using Random Forests	CO2
6	Implement k-nearest Neighbors algorithm	CO3
7	Implement K-means, K-Modes Clustering to Find Natural Patterns in Data	CO3
8	Implement Hierarchical clustering	CO3
9	Implement Gaussian Mixture Model Using the Expectation Maximization	CO3
10	Evaluating ML algorithm with balanced and unbalanced datasets Comparison of Machine Learning algorithms	CO4

Online Resources

1. **https://www.digimat.in/nptel/courses/video/106105152/L01.html/**
2. **https://nptel.ac.in/courses/106105152**

Course Articulation Matrix

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO8	PO9	PO1 0	PO11	PO1 2	PSO1	PSO2
CO1	2	2	1	2	1							2	1	3
CO2	2	1	2	2	1							2	2	2
CO3	2	2	2	1	1							2	2	2
CO4	2	1	2	2	1							2	3	1

Program	B. Tech CSE (AI)				
Year	II	Semester		IV	
Course Name	Database Management System Lab				
Code	NCS4451				
Course Type	PCC	L	T	P	Credit
Pre-Requisite	Fundamentals of computer knowledge	0	0	2	1
Course Objectives	**1.** Students are able to designing, developing database. **2.** Students are able to querying a database. **3.** Students are able to take backup and rollback database **4.** Students are able to write functions and procedure				
Course Outcomes					
CO1	Infer database language commands to create simple database				
CO2	Analyze the database using queries to retrieve records				
CO3	Applying PL/SQL for processing database				
CO4	Develop solutions using database concepts for TCL Commands				

S. No.	List of Experiments	Mapped CO
1	Write the queries for Data Definition and Data Manipulation Language.	CO1
2	Write SQL queries using logical operations (=, <,>, etc).	CO1
3	Write SQL queries using SQL operators.	CO2
4	Write SQL query using character, number, date and group functions.	CO1
5	Write SQL queries for extracting data from more than one table.	CO4
6	Write SQL queries for sub queries, nested queries.	CO2
7	Write programme by the use of PL/SQL.	CO3
8	Concepts for ROLL BACK, COMMIT.	CO4
9	Create VIEWS and understand its concept	CO3
10	Create CURSORS and understand its concept.	CO3

Online Resources

1. http://vlabs.iitkgp.ernet.in/se/4/theory/
2. https://vsit.edu.in/vlab.html

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	1		2								1	1
CO2	3	2	2	1	1								2	1
CO3	2	3	1	1	2							2	2	1
CO4	3	3		1	2								3	1

Program	B.TECH: CSE/CSE-AI/CSE-CCML/CSE-IOTBC				
Year	II	**Semester**		III/IV	
Course Name	NSS/YOGA				
Code	NCC4351/NCC4451				
Course Type	CQAC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Fundamental Concepts of Yoga	0	0	2	1
Course Objectives	**1.** To enable the student to have good health. **2.** To practice mental hygiene. **3.** To possess emotional stability. **4.** To integrate moral values. And To attain higher level of consciousness.				
Course Outcomes					
CO1	To Understand the Concept of Yoga and its Historical Development.				
CO2	To Analyse the relevance of Yoga in modern age and its scope.				
CO3	To Apply, the Concept of Yoga in different texts.				
CO4	To evaluate the difference between Yogic and non-yogic system of exercises.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**General Introduction of Yoga:** Yoga it's Origin, Meaning, Definition & Objectives, Historical Development of Yoga, Relevance of Yoga in modern age and scope, Misconceptions about Yoga and their solutions, Difference between yogic and non-yogic system of exercises.	30 Hours	CO1, CO2
2	**Yoga Practices**. **1.Asanas** Yoga Stretching, Surya namaskar (Warming-up), Standing Asana, Sitting Asana, Prone position Asana, Supine position Asana, Meditative Asana, Relaxation Asana **2.Pranayam-** • Surya Anuloma Viloma/Surya Bhedana Pranayama • Chandra Anuloma Viloma/Chandra Bhedana Pranayama • Ujjayi Pranayama • Kumbhaka Pranayama • Sampoorna Yoga Shwasana (Full Yogic Breathing) **3.Meditation and Mudras**	30 Hours	CO3, CO4

Suggested Readings

1. Prof. Ramharsh Singh – Yoga Avam Yoga Chikitsa, Chaukhambha Sanskrit Pratishthan, Delhi-07 2.
2. K.S. Joshi - Yoga in Daily Life, Orient Paper Back Publication, New Delhi, 1985
3. Vijnananand Saraswati - Yoga Vigyan, Yoga Niketan Trust, Rishikesh, 1998.
4. Rajkumari Pandey-Bhartiya Yoga Parampara ke Vividh Ayam, Radha Publication, New Delhi, 2008

Online Resources

1. Yoga and Positive Psychology for Managing Career and Life - Course (nptel.ac.in) https://nptel.ac.in/courses/106105218
2. NPTEL :: Management - NOC:Yoga and Positive Psychology for Managing Career and Life.

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1							**2**	**2**				**2**		**2**
CO2							**2**	**2**				**2**		**2**
CO3							**1**	**2**				**2**		**2**
CO4							**2**	**2**				**2**		**2**

Program	B.Tech CSE (AI)				
Year	III	**Semester**	V		
Course Name	Concepts of Data Science with Python				
Code	NAI4501				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Probability and statistics	2	1	0	3
Course Objectives	**1.** Understand and use Python data structures – lists, tuples and dictionaries. **2.** Understand the data science process and exploration. **3.** Evaluate Machine learning algorithms. **4.** Analyse types of learning, processes, techniques and models.				
Course Outcomes					
CO1	Understand the data science concepts, techniques and models.				
CO2	Identify appropriate data visualization techniques given particular requirements imposed by the data together with the driving questions.				
CO3	Build data graphics with the appropriate data visualization and analytics software for the task at hand.				
CO4	Student must be able to preprocess the data using cleaning, integration, transformation and find correlations among the data.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Data Science** Case for data science, data science classification, data science algorithms; Data Science Process, prior Knowledge, Data Preparation, Modeling, Application, Knowledge; Data Exploration, Objectives of data Exploration; Datasets, Descriptive Statistics; Data Visualization, Roadmap for data exploration.	30 Hours	CO1
2	**Data Manipulation and Visualization** Introduction, Forms of data graphics, Visualizing categories Design principles, Visualizing locations Interaction / animation, Visualizing locations, Visualizing time Building and using metrics, Visualizing multivariate displays Perception principles and presenting data graphics, Visualizing multivariate displays.	30 Hours	CO2, CO3
3	Introduction to NumPy, Pandas and Matplotlib, How to Import NumPy module, what is a data Manipulation using Panda's library? Series object in pandas, Data Frame in Pandas, loading a handling data with Pandas, Introduction to Matplotlib, Using Matplotlib for plotting Graphs and charts like Scatter, Bar, Pie, Line, Histogram and more.	30 Hours	CO4

Suggested Readings

1. Data Science Fundamentals and Practical Approaches: Understand Why Data Science Is the Next by Dr Gypsy Anand/ Dr Rupam Sharma.
2. Wes McKinney. "Python for Data Analysis", O'Reilly Media, 2017, 2nd Edition.
3. Grus, Joel. "Data Science from Scratch: First Principles with Python", O'Reilly Media, 2015, 1st Edition.
4. Brian K. Jones and David M. Beazley. "Python Cookbook", O'Reilly Media, 2013, 3rd Edition.

5. Dipanjan Sarkar, “Text Analytics with Python: A Practitioner‟s Guide to Natural Language Processing”, A Press, 2019, 2nd Edition.
6. Daniel Jurafsky, James H. Martin, “Speech and Language Processing”, Pearson, 2009.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc23_cs21/preview

Course Articulation Matrix														
PO-PSO	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**1**	**1**	**2**	**2**	**1**							**2**	**1**	**1**
CO2	**2**	**1**	**3**	**1**	**2**							**1**	**1**	**1**
CO3	**1**	**1**	**2**	**1**	**3**							**2**	**2**	**2**
CO4	**1**	**2**	**2**	**2**	**1**							**1**	**1**	**1**

Program	B. Tech CSE (AI)				
Year	III	**Semester**	V		
Course Name	Artificial Neural Network				
Code	NAI4502				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Probability and statistics	3	0	0	3
Course Objectives	**1.** Introduction of biological neuron and artificial neuron for solving problems **2.** To understand basis neural networks models **3.** To understand the application areas of neural networks **4.** To apply ANN for solving problems.				
Course Outcomes					
CO1	Introduction to basic working of neuron working and learning				
CO2	To understand Perceptron learning techniques and application				
CO3	To understand and apply back propagation for ANN learning				
CO4	To understand the basics of supervised learning.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Human Brain, Neural Network, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks, Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process.	30 Hours	CO1
2	**Perceptron:** Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment Multilayer Perceptron: Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection.	30 Hours	CO2
3	**Back Propagation:** Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues, and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning	30 Hours	CO3, CO4

Suggested Readings

1. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition, 2004.
2. Artificial Neural Networks - B. Yegnanarayana Prentice Hall of India P Ltd 2005.
3. Neural Networks in Computer Inteligance, Li Min Fu TMH 2003.

Online Resources

1. https://nptel.ac.in/courses/117105084

Course Articulation Matrix													
PO-PSO	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**2**	**3**	**2**									**2**	**1**
CO2	**3**	**2**	**2**	**2**									**2**	**2**
CO3	**3**	**1**	**2**	**1**									**1**	**2**
CO4	**3**	**2**	**3**	**3**									**3**	**3**

Program	B. Tech CSE (AI)				
Year	III	**Semester**	V		
Course Name	Computer Networks				
Code	NCS4503				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of Computer Operations	3	0	0	3
Course Objectives	**1.** To understand the organization of computer networks with the concept of layered approach **2.** To understand the working of computer networks hardware like LAN, Switch, Hub etc. **3.** To understand the concept of data communication **4.** To understand the concept of various routing and protocols used in data communication				
Course Outcomes					
CO1	Explain basic concepts of OSI reference model and TCP/IP model and networks devices and transmission media, Analog and digital data transmission				
CO2	Describe the functions Data link layer and Network layer				
CO3	Describe the functions Transport, Session and Presentation layer				
CO4	Describe the functions Application Layer				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction** Introduction: Network objectives and applications; network structure and architecture; OSI reference model; network services; network standardization; examples of network, TCP/IP model **Physical layer:** Fundamentals of data communication; transmission media; analog transmission; digital transmission; switching; ISDN; terminal handling; Broadcast channels and medium access: LAN protocols	30 Hours	CO1
2	**Data link layer and Network layer** **Data link layer:** Design issues; error detection and corrections; elementary data link protocols; sliding window protocols. Examples; **Network layer**: Design issues; routing algorithms; congestion control; internetworking. Examples. CSMA with collision detection; collision free protocols; IEEE standard 802 for LANs; comparison of LANs; Fiber optic network and FDDI.	30 Hours	CO2
3	**Transport, Session and Presentation layer** **Transport layer:** Design Issues; connection management; example of a simple transport protocol. **Session layer:** Design issues; remote procedure call; examples, Presentation layer: Design issues; data compression and encryption; network security and privacy.	30 Hours	CO3, CO4

	Examples; **Application Layer** Design issues; File transfer and file access; electronic mail; virtual terminals; other applications, Case study based on available network software.		

Suggested Readings

1. Andrew S. Tanenbaum "Computer Networks" Prentice Hall of India

2. William Stallings "Local Networks" Maxwell Macmillan International Edition.

3. B.A. Frozen "Data Communication and Networking". Tata McGraw Hill.

Online Resources

1. https://nptel.ac.in/courses/106105183

2. https://archive.nptel.ac.in/courses/106/105/106105081/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**1**	**1**											**1**	**1**
CO2	**2**	**1**	**1**										**1**	**1**
CO3	**2**	**1**	**1**										**1**	**1**
CO4	**2**	**1**	**1**									**1**	**1**	**1**

Program	B. Tech CSE (AI)					
Year	III	**Semester**	V			
Course Name	Automata Theory and Formal Languages					
Code	NCS4504					
Course Type	PCC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Discrete Mathematics, Data Structure	3	1	0	4	
Course Objectives	**1.** To illustrate finite state machines to solve problems in computing **2.** To explain the hierarchy of problems arising in the computer sciences. **3.** To familiarize Regular grammars, context frees grammar. **4.** To determine the decidability and intractability of computational problems.					
Course Outcomes						
CO1	Apply the knowledge of automata theory, grammars & regular expressions for solving the problem					
CO2	Analyse the give automata, regular expression & grammar to know the language it represents					
CO3	Design Automata & Grammar for pattern recognition and syntax checking.					
CO4	Identify limitations of some computational models and possible methods of proving them					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals:** Formal Languages, Strings, Alphabets, Languages, Chomsky Hierarchy of languages. **Finite Automata:** Introduction to Finite State machine, Acceptance of strings and languages, Deterministic finite automaton (DFA) and Non-deterministic finite automaton (NFA), Equivalence of NFA and DFA – Equivalence of NDFAs with and without €-moves, Minimization of finite automata, Equivalence between two DFA's, Finite automata with output – Moore and Mealy machines, conversion of Moore to Mealy and Mealy to Moore.	30 Hours	CO1
2	**Regular Languages:** Regular expressions, Identity rules, Conversion of a given regular expression into a finite automaton, Conversion of finite automata into a regular expression, Pumping lemma for regular sets, Closure properties of regular sets**.** **Context Free Grammars:** Context free grammars and languages, Derivation trees, Leftmost and rightmost derivation of strings and Sentential forms, Ambiguity, left recursion and left factoring in context free grammars, Minimization of context free grammars, Normal forms for context free grammars, Chomsky normal form, Greibach normal form, Pumping Lemma for Context free Languages, Closure and decision properties of context free languages.	30 Hours	CO2
3	**Pushdown Automata:** Introduction to Pushdown automata, Acceptance of context free languages, Acceptance by final state and acceptance by empty state and its equivalence,	30 Hours	CO3

	Equivalence of context free grammars and pushdown automata, Inter-conversion.		
4	**Turing Machine (TM):** Problems That Computers Cannot Solve, The Turing Machine, Programming Techniques for Turing Machines ,Extensions to the Basic Turing Machine, Restricted Turing Machines, Turing Machines and Computers, Definition of Post's Correspondence Problem, A Language That Is Not Recursively Enumerable, An Undecidable Problem That Is RE, Context sensitive languages and Chomsky hierarchy, Other Undecidable Problems	30 Hours	CO4

Suggested Readings

1. Introduction to Languages and Automata Theory By John C Martin, Tata McGraw-Hill

2. Introduction to computer theory By Deniel I. Cohen ,Joh Wiley & Sons, Inc

3. Computation: Finite and Infinite By Marvin L. Minsky Prentice-Hall

Online Resources

1. https://nptel.ac.in/courses/106104028/theory of computation.

2.https://lagunita.stanford.edu/courses/coursev1:ComputerScience+Automata+SelfPaced/about

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**3**	**3**	**2**	**1**							**1**	**2**	**1**
CO2	**3**	**3**	**2**	**2**	**1**							**2**	**1**	**1**
CO3	**3**	**3**	**2**	**2**	**2**							**2**	**3**	**1**
CO4	**3**	**2**	**1**	**1**	**2**							**2**	**2**	**1**

Program	B. Tech CSE (AI)				
Year	III	Semester		V	
Course Name	Data Science with Python Lab				
Code	NAI4551				
Course Type	PCC	L	T	P	Credit
Pre-Requisite	Basic knowledge of Python	0	0	2	1
Course Objectives	**1.** Implement the fundamentals of data science. **2.** Know how to analyse data through summary statistics. **3.** Use a range of Python features for numerical analysis. **4.** Implementing data visualization				
Course Outcomes					
CO1	Implement python programming to read files				
CO2	Implement Statistics Algorithms				
CO3	Perform data loading, cleaning, transformation and merging				
CO4	Create different plots for basic exploratory data analysis				

S. No.	List of Experiments	Mapped CO
1	Implementation of a program for reading of different types of data sets (.txt,.csv) from web and disk and writing in file in specific disk location.	CO1
2	Implementation of a program for reading of EXCEL and XML data sheets Using Numpy .	CO1
3	Implementation of Basic Statistics functions and performs visualization.	CO2
4	Write a program to Find the data distributions using box and scatter plot.	CO2,CO3
5	Working with Pandas data frames.	CO1,CO3
6	Write a program to Devolops python program for Normal Curves.	CO3,CO4
7	Write a program to Devolops python program for Correlation and scatter plots.	CO4
8	Write a program to Develop python program for Frequency distributions.	CO3,CO4
9	Write a program to Develop python program for Correlation coefficient.	CO3,CO4
10	Write a program to Develop python program for Variability.	CO3,CO4

Online Resources

1. https://python-iitk.vlabs.ac.in/
2. https://www.iiitmk.ac.in/DAVirtalLab/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO7**	**PO8**	**PO9**	**PO1 0**	**PO11**	**PO1 2**	**PSO1**	**PSO2**
CO1	**3**	**2**	**1**	**1**									**1**	**2**
CO2	**2**	**1**	**2**	**2**									**3**	**2**
CO3	**3**	**2**	**2**	**1**								**2**	**2**	**2**
CO4	**2**	**2**	**1**	**2**								**1**	**3**	**2**

Program	B. Tech CSE (AI)				
Year	III	**Semester**	V		
Course Name	Artificial Neural Network Lab				
Code	NAI4552				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Python	0	0	2	1
Course Objectives	**1.** Application of Perceptron. **2.** Application of CNN **3.** Application of BP. **4.** Application of Recurrent Network.				
Course Outcomes					
CO1	Implementation of Perceptron for solving various problems.				
CO2	Implement recurrent network.				
CO3	Implement time Series.				
CO4	Implement CNN, Back Propagation.				

S. No.	List of Experiments	Mapped CO
1	Write a program to implement Perceptron.	CO1
2	Write a program to implement AND, OR, NOT, NAND, NOR, XOR gates using Perceptron.	CO1
3	Write a program to implement Addition, Subtraction, Multiply and Divide functions.	CO1
4	Write a program to implement classification of linearly separable Data with a perceptron.	CO1
5	Write a program to implement Gated Recurrent Units to predict the stock prices based on historic data.	CO2
6	Write a program to implement Crab Classification using pattern net.	CO3
7	Write a program to implement Long Short Term Memory for Time Series Prediction.	CO3
8	Write a program to implement Wine Classification using Back propagation.	CO4
9	Write a program to implement Convolutional Neural Network and Recurrent Neural Network.	CO4
10	Write a program to implement ImageNet, Google Net, Res Net convolutional Neural Networks.	CO4

Online Resources

1. https://cse22-iiith.vlabs.ac.in/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO 5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO1 2**	**PSO1**	**PSO2**
CO1	**1**	**3**	**1**		**3**								**1**	
CO2	**1**	**2**	**2**	**1**									**1**	**1**
CO3	**2**	**1**	**3**	**1**	**2**								**1**	
CO4	**1**	**2**	**1**		**3**								**1**	

Program	B. Tech CSE (AI)				
Year	III	**Semester**	V		
Course Name	Computer Networks Lab				
Code	NCS4553				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic of Networking.	0	0	2	1
Course Objectives	**1.** Understanding the concepts of Networking. **2.** Studying about different Stuffing Concepts. **3.** Gaining knowledge of different Topologies. **4.** Applying the various concepts in the real world.				
Course Outcomes					
CO1	1. Understand the concepts of Network Cables and Network Commands.				
CO2	2. Analyze the use of Local Area Networks.				
CO3	3. Evaluate the performance of different programs related to Networking.				
CO4	4. Design and Apply different Topologies through simulation.				

S. No.	List of Experiments	CO Mapping
1	Study of different type of Network cables and practically implement the cross wired cable.	CO1
2	Study and implementation of basic network command and network configuration commands.	CO1
3	Connect the computers in local area network.	CO2
4	To write a socket program for implementation of echo.	CO2
5	Write a program in C to perform character stuffing.	CO3
6	Write a program in C to perform Bit stuffing.	CO3
7	Implement CRC (Cyclic redundancy check) in C.	CO3
8	Write a program in C to implement sliding window protocol.	CO3
9	To create Scenario and Study the performance of Ring topology through simulation.	CO4
10	To create Scenario and Study the performance of Bus topology through simulation.	CO4

Online Resources

1. http://vlabs.iitkgp.ac.in/ant/1/

Course Articulation Matrix														
PO-PSO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	3	2	2	1	2							1	2	1
CO2	2	3	2	2	1							1	2	3
CO3	3	2	2	1	3							1	3	2
CO4	3	2	2	1	2							2	3	1

Program	B.TECH:CSE/CSE-AI/CSE-CCML/CSE-IOTBC				
Year	III	**Semester**	V		
Course Name	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE				
Code	NVC4501				
Course Type	CQAC	**L**	**T**	**P**	**Credit**
Pre-Requisite	The Concepts Of Indian Traditional Knowledge And To Make ThemUnderstand The Importance of Roots Of Knowledge System.	1	0	0	1
Course Objectives	**1.** To Understand the concept of Traditional knowledge and its importance **2.** To Know the need and importance of protecting traditional **3.** To Apply, Know the various enactments related to the protection of traditional knowledge **4.** To Understand the concepts of Intellectual property to protect the traditional.				
Course Outcomes					
CO1	To Understand and elucidate the basic knowledge of traditional knowledge to develop the physical and social changes in traditional knowledge systems.				
CO2	To Analyse the significance of traditional knowledge protection to communicate the traditional knowledge information				
CO3	To Apply toRecognize the role of government on traditional knowledge to measure its impact on the global economy.				
CO4	To Evaluate and Summarize the strategies of patents and global legal FORA for excel protection of Indian traditional knowledge				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**INTRODUCTION TO TRADITIONAL KNOWLEDGE** *Introduction to Indian Traditional Knowledge:* Understanding the concept and significance of Indian Traditional Knowledge, Historical background, and evolution of traditional knowledge in India. *Intellectual Property Rights (IPR):* Overview of Intellectual Property Rights and its importance in the context of traditional knowledge, Different types of IPRs: Copyright, Trademarks, Patents, and Geographical Indications. *Traditional Knowledge and Traditional Cultural Expressions (TCEs):* Introduction to Traditional Cultural Expressions and the challenges in their protection, Examination of international frameworks like the WIPO Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge, and Folklore. *Traditional Knowledge and Traditional Ecological Knowledge (TEK)* Understanding the relationship between traditional	30 Hours	CO1, CO2

	knowledge and traditional ecological knowledge, Analysis of the role of TEK in environmental conservation and sustainable development.		
2	**TRADITIONAL KNOWLEDGE AND IPR LAWS IN INDIA** *Traditional Knowledge and IPR Laws:* Study of the legal framework for the protection of traditional knowledge in India, Examination of relevant laws and regulations, such as the Traditional Knowledge Digital Library (TKDL), Traditional Knowledge and Patent Law: Understanding the challenges and issues surrounding the patenting of traditional knowledge, Analysis of case studies highlighting the controversies and debates in the field. *Traditional Knowledge and Copyright Law:* Exploring the relationship between traditional knowledge and copyright law, Discussion on the issues of cultural appropriation and protection of traditional expressions. *Traditional Knowledge and Geographical Indications (GI):*Overview of Geographical Indications and their significance in protecting traditional knowledge, Case studies on the successful registration and protection of traditional products and practices. *Traditional Knowledge, IPR, and the Future*: Analysis of the current trends and future prospects for the protection and preservation of Indian traditional knowledge, Examination of emerging issues such as digital platforms and traditional knowledge dissemination.	30 Hours	CO3, CO4

Suggested Readings

1. Traditional Knowledge System in India, by Amit Jha, 2009.
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan 2012.
3. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
4. Sampath, P. G. (2012). Traditional Knowledge Systems and Intellectual Property Rights. Routledge.
5. Sharma, G., & Kumar, V. (Eds.). (2016). Indian Traditional Knowledge and Intellectual Property Rights: Innovations in Traditional Knowledge Preservation. Springer.
6. Ganguli, P. (2010). Indian Traditional Knowledge and Intellectual Property Rights: Indigenous Community Initiatives. Ane Books Pvt Ltd.

Online Resources

1. https://aec.edu.in/knowledge/
2. https://www.iare.ac.in/?q=node/3745

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1								**1**	**2**	**2**		**2**		**1**
CO2								**2**	**2**	**4**		**3**		**2**
CO3								**1**	**1**	**4**		**2**		**2**
CO4								**2**	**2**	**3**		**1**		**2**

Program	B. Tech CSE (AI)				
Year	III	**Semester**	VI		
Course Name	Design & Analysis of Algorithms				
Code	NCS4602				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Data Structure	3	1	0	4
Course Objectives	**1.** Analyze the asymptotic performance of algorithms. **2.** Proving correctness of algorithms. **3.** Demonstrate a familiarity with major algorithms and data structures. **4**. Apply important algorithmic design paradigms and methods of analysis.				
Course Outcomes					
CO1	Analyze the problem and design an efficient algorithm to solve it by using & modifying classical design techniques or creating a new solution technique				
CO2	Evaluate and compare those using standard mathematical techniques and select the best solution				
CO3	Understand the mathematical criterion for deciding whether an algorithm is efficient, and know many practically important problems that do not admit any efficient algorithms.				
CO4	Apply the different kind of complexities and develop non deterministic solution to problems having large complexities.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction and Advanced Data Structure:** Notion of Algorithm, Analysis of algorithms, Designing of Algorithms, Growth of Functions, Master's Theorem Asymptotic Notations and Basic Efficiency Classes, Shorting and Searching Algorithm: Insertion Sort Selection Sort and Bubble Sort Divide and conquer - Merge sort , Quick Sort, Heap Sort, Sequential Search and Binary Search	30 Hours	CO1
2	**Advanced Data Structures**: Red-Black Trees, B – Trees, Binomial Heaps, and Fibonacci Heaps. **Greedy Methods** with Examples Such as Optimal Reliability Allocation, Knapsack, Minimum Spanning Trees – Prim's and Kruskal's Algorithms, Single Source Shortest Paths - Dijkstra's and Bellman Ford Algorithms.	30 Hours	CO2
3	**Dynamic Programming** with Examples Such as Knapsack. All Pair Shortest Paths – Warshal's and Floyd's Algorithms, Resource Allocation Problem, Matrix chain multiplication Backtracking, Branch and Bound with Examples Such as Travelling Salesman Problem, Graph Coloring, n-Queen Problem, Hamiltonian Cycles and Sum of Subsets.	30 Hours	CO3
4	**Selected Topics:** String Matching-The naive method, Rabin-Karp method, Boyer-Moore, Knuth-Morris-Pratt(KMP) Theory of NP-Completeness, Approximation Algorithms and Randomized Algorithms	30 Hours	CO4

Suggested Readings

1. Thomas H. Coreman, Charles E. Leiserson and Ronald L. Rivest, “Introduction to Algorithms”, Printice Hall of India.
2. E. Horowitz & S Sahni, "Fundamentals of Computer Algorithms",
3. Aho, Hopcraft, Ullman, “The Design and Analysis of Computer Algorithms” Pearson Education, 2008.
4. LEE "Design & Analysis of Algorithms (POD)",McGraw Hill

Online Resources

1. **https://nptel.ac.in/courses/106106131**

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	3	3	1	3								1	3
CO2	1	1	1	2	3								1	3
CO3	2	2	1	2	2								2	2
CO4	1	2	1	3	1								1	2

Program	B. Tech: CSE(AI)				
Year	III	**Semester**	VI		
Course Name	Compiler Design				
Code	NCS4604				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Automata Theory	3	1	0	4
Course Objectives	**1.** To apply the theory of language translation to build compilers and interpreters. **2.** Building of translators both from scratch and using compiler generators. **3.** Identifies and explores the main issues of the design of translators. **4.** The construction of a compiler/interpreter for a small language				
Course Outcomes					
CO1	Understand different phases and passes of the compiler and use the compiler tools like LEX, YACC, etc.				
CO2	Analyse the concepts of parser and its types.				
CO3	Understanding translation and applying it.				
CO4	Applying code generation and optimization on target machine				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Compiler:** Phases and passes, Bootstrapping, Finite state machines and regular expressions and their applications to lexical analysis, Optimization of DFA-Based Pattern Matchers implementation of lexical analyzers, lexical-analyzer generator, LEX compiler, Formal grammars and their application to syntax analysis, BNF notation, ambiguity, YACC. The syntactic specification of programming languages: Context free grammars, derivation and parse trees, capabilities of CFG. **Basic Parsing Techniques:** Parsers, Shift reduce parsing, operator precedence parsing, top down parsing, predictive parsers.	30 Hours	CO1
2	**Automatic Construction of efficient Parsers:** LR parsers, the canonical Collection of LR(0) items, constructing SLR parsing tables, constructing Canonical LR parsing tables, Constructing LALR parsing tables, using ambiguous grammars, an automatic parser generator, implementation of LR parsing tables. Parse trees & syntax trees, three address code, quadruple & triples, translation of assignment statements, Boolean expressions, statements that alter the flow of control, postfix translation, translation with a top down parser.	30 Hours	CO2, CO3
3	**Syntax-directed Translation:** Syntax-directed Translation schemes, Implementation of Syntax directed Translators, Intermediate code, postfix notation. **More about translation:** Array references in arithmetic expressions, procedures call, declarations and case statements. **Symbol Tables:** Data structure for symbols tables, representing scope information. Run-Time Administration:	30 Hours	CO3

	Implementation of simple stack allocation scheme, storage allocation in block structured language.		
4	**Error Detection & Recovery:** Lexical Phase errors, syntactic phase errors semantic errors. **Code Generation:** Design Issues, the Target Language. Addresses in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Code Generator. Code optimization: Machine-Independent Optimizations, Loop optimization, DAG representation of basic blocks, value numbers and algebraic laws, Global Data-Flow analysis.	30 Hours	CO4

Suggested Readings

1. Aho, Sethi& Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education.
2. K. Muneeswaran,CompilerDesign,FirstEdition,Oxford University Press.
3. J.P. Bennet, "Introduction to Compiler Techniques", Second Edition, McGraw-Hill,2003.
4. HenkAlblas and Albert Nymeyer, "Practice and Principles of Compiler Building with C", PHI, 2001.
5. V Raghvan, " Principles of Compiler Design", McGraw-Hill.
6. Kenneth Louden," Compiler Construction", Cengage Learning.
7. Charles Fischer and Ricard LeBlanc," Crafting a Compiler with C", Pearson Education.

Online Resources

1. https://nptel.ac.in/courses/106104123

2. https://nptel.ac.in/courses/106105190

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO1 2**	**PSO1**	**PSO2**
CO1	3	2	1	1	1							1	2	1
CO2	3	3	2	1	2							2	1	2
CO3	3	3	2	2	3							2	2	1
CO4	3	2	1	1	1							1	1	1

Program	B. Tech CSE (AI)				
Year	III	Semester		VI	
Course Name	Algorithms Lab				
Code	NCS4652				
Course Type	PCC	L	T	P	Credit
Pre-Requisite	Command on Programming Language	0	0	2	1
Course Objectives	**1.** Analyze the asymptotic performance of algorithms. **2.** Write rigorous correctness proofs for algorithms. **3.** Demonstrate a familiarity with major algorithms and data structures. **4.** Apply important algorithmic design paradigms and methods of analysis.				
Course Outcomes					
CO1	Implement various search techniques				
CO2	Implement various sorting techniques.				
CO3	Implement backtracking strategy.				
CO4	Implement various greedy and dynamic programming techniques.				

S. No.	List of Experiments	Mapped CO
1	Program for Recursive Binary & Linear Search.	CO1
2	Implement Merge Sort.	CO2
3	Implement Quick Sort (Divide & Conquer).	CO2
4	Implement Heap Sort.	CO2
5	Implement Knapsack problem (Greedy ALGO.).	CO4
6	Implement Insertion Sort.	CO2
7	Implement Shortest path by Dijkstra Algorithm.	CO1
8	Implement 8- Queen problem (Back Tracking).	CO3
9	Implement Prim's Algorithms.	CO1
10	Implement Kruskal's Algorithm.	CO4

Online Resources

1. https://cse01-iiith.vlabs.ac.in/exp/sorting/
2. http://ebootathon.com/labs/beta/csit/DAA/exp1/simulation.html

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**2**	**1**	**3**	**1**							**1**	**2**	**3**
CO2	**3**	**2**	**3**	**1**	**1**							**1**	**2**	**3**
CO3	**1**	**3**	**2**	**2**	**1**								**1**	
CO4	**1**	**2**	**3**	**1**	**2**							**2**	**2**	**2**

Program	B Tech CSE (AI)				
Year	III	**Semester**		VI	
Course Name	Compiler Design Lab				
Code	NCS4654				
Course Type	Lab	**L**	**T**	**P**	**Credit**
Pre-Requisite	Concept of Data Structures and Theory of Automata & Formal Languages.	0	0	2	1
Course Objectives	1. To understand the various phases in the design of a compiler 2. To understand the design of top-down and bottom-up parsers 3.To understand syntax directed translation schemes. 4.To introduce lex and yacc tools.				
Course Outcomes					
CO1	Ability to design, develop, and implement a compiler for any language.				
CO2	Implement a parser for different context free grammars.				
CO3	Implement code optimization techniques.				
CO4	Able to use lex and yacc tools for developing a scanner and a parser.				

S. No.	List of Experiments	CO Mapped
1	Implementation of LEXICAL ANALYZER for IF STATEMENT.	CO1
2	Implementation of LEXICAL ANALYZER for ARITHMETIC EXPRESSION.	CO4
3	Construction of NFA from REGULAR EXPRESSION.	CO2
4	Construction of DFA from NFA.	CO2
5	Implementation of SHIFT REDUCE PARSING ALGORITHM.	CO3
6	Implementation of OPERATOR PRECEDENCE PARSER.	CO3
7	Implementation of RECURSIVE DESCENT PARSER	CO4
8	Implementation of LALR PARSER	CO1
9	Implementation of CODE OPTIMIZATION TECHNIQUES.	CO2
10	Implementation of CODE GENERATOR.	CO2

Online Resources

1. https://nptel.ac.in/courses/106108113

2. https://github.com/topics/compiler-design?o=desc&s=updated

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	**3**	**3**	**3**	**3**					**3**	**3**		**3**	**3**	
CO2	**3**	**3**		**3**					**2**	**3**			**3**	
CO3	**3**	**3**	**2**	**3**					**3**	**3**		**3**	**3**	
CO4	**3**	**3**		**2**	**3**				**3**	**3**			**2**	

Program	B. Tech CSE(AI)				
Year	IV	**Semester**		VII	
Course Name	Natural Language Processing				
Code	NAI4701				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Python, Image Processing	3	1	0	4
Course Objectives	**1.** To tag a given text with basic Language features **2.** To design an innovative application using NLP components **3.** To learn the fundamentals of natural language processing **4.** To understand the use of CFG and PCFG in NLP				
Course Outcomes					
CO1	Understating leading trends and systems in natural language processing.				
CO2	Understating parsing of language				
CO3	Understating the syntactic, semantic and pragmatic processing of language and familiarize with applications of NLP				
CO4	Understand approaches to discourse, generation, dialogue and summarization within NLP.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to NLP:** Need of NLP, History of NLP, Advantages and Disadvantages of NLP, Applications of NLP. How does NLP work, components of NLP, Phases of NLP, NLP vs. Machine learning? NLP examples, Future of NLP.	30 Hours	CO1
2	**Lexical analysis:** Unsmoothed N grams, evaluating N grams, Morphology and Finite state Transducers, Interpolation and Back off word classes, Part of Speech Tagging–Markov Models, Hidden Markov Models. Transformation based Models – Maximum Entropy Models.	30 Hours	CO2
3	**Syntax Parsing:** Concept of Parser, Types of Parsing, Concept of Derivation, Types of Derivation, Concept of Grammar, CFG, Definition of CFG. Grammar rules for English Treebank's, Normal forms for grammar– Dependency Grammar, Syntactic Parsing, Ambiguity, Dynamic Programming Parsing- Shallow Parsing.	30 Hours	CO3
4	**Semantic Analysis and Disclosure Pragmatic:-**Elements of Semantics Analysis, Difference between Polysemy and Homonymy. Meaning Representatives, Need of Meaning Representative, and Disclosure Pragmatic- Concept of Coherence, Disclosure structure, Text coherence, and Building Hierarchical Disclosure structure. Reference Resolution, Terminology used in Reference Resolution.	30 Hours	CO4

Suggested Readings

1. Daniel Jurafsky, James H. Martin: "Speech and Language Processing", 2/E, Prentice Hall, 2008.
2. James Allen, "Natural Language Understanding", 2/E, Addison-Wesley, 199Christopher D. Manning, Hinrich Schutze: "Foundations of Statistical Natural Language Processing", MIT Press,1999

3. Steven Bird, Natural Language Processing with Python, 1st Edition, O'Reilly, 2009.
4. Jacob Perkins, Python Text Processing with NLTK 2.0 Cookbook, Packt Publishing,2010

Online Resources

1. **https://onlinecourses.nptel.ac.in/noc19_cs56/preview**
2. **https://onlinecourses.nptel.ac.in/noc20_cs87/preview**

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**2**	**1**	**2**	**1**									**1**	**2**
CO2	**1**	**2**	**2**	**3**									**2**	**2**
CO3	**2**	**1**	**1**	**2**									**1**	**1**
CO4	**2**	**1**	**1**	**1**									**2**	**1**

Program	B. Tech CSE (AI)				
Year	IV	**Semester**	VII		
Course Name	Fuzzy Logic				
Code	NAI4702				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Fundamentals of AI	2	1	0	3
Course Objectives	**1.** To teach about the concept of fuzziness involved in various systems. To provide adequate knowledge about fuzzy set theory. **2.** To provide adequate knowledge of application of fuzzy logic control to real time systems. **3.** Comprehend the fuzzy logic control and to design the fuzzy control using genetic algorithms. **4.** Apply basic fuzzy system modelling methods.				
Course Outcomes					
CO1	Understand fuzzy logic membership function.				
CO2	Analyse on Fuzzy logic membership function and fuzzy inference systems.				
CO3	Design the fuzzy set theory on the statistical method which is given.				
CO4	Analyse statistical data by using fuzzy logic methods.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction, Classical Sets and Fuzzy Sets:** Classical sets: Operations and properties of classical sets, Mapping of classical sets to the functions. Fuzzy sets - Membership functions, Fuzzy set operations, Properties of fuzzy sets. Classical and Fuzzy relations: Cartesian product, crisp relations-cardinality, operations, and properties of crisp relations. Fuzzy relations-cardinality, operations, properties of fuzzy relations, fuzzy Cartesian product and composition, Fuzzy tolerance and equivalence relations, value assignments and other format of the composition operation.	30Hours	CO1
2	**Fuzzification and Defuzzification:** Features of the membership functions, various forms, fuzzification, defuzzification to crisp sets, - cuts for fuzzy relations, Defuzzification to scalars. Fuzzy logic and approximate reasoning, other forms of the implication operation. **Fuzzy Systems:** Natural language, Linguistic hedges, Fuzzy (Rule based) System, Aggregation of fuzzy rules, Graphical techniques of inference, Membership value assignments: Intuition, Inference, rank ordering, Fuzzy Associative memories.	30Hours	CO2, CO3
3	**Fuzzy decision making:** Fuzzy synthetic evaluation, Fuzzy ordering, Preference and consensus, Multi objective decision making, Fuzzy Bayesian, Decision method, Decision making under Fuzzy states and fuzzy actions. **Fuzzy Classification**: Classification by equivalence relations-crisp relations, Fuzzy relations, Cluster analysis, Cluster validity, C-Means clustering, Hard C-Means clustering, Fuzzy C-Means algorithm, Classification metric, Hardening the Fuzzy C-Partition.	30Hours	CO3

Suggested Readings

1. Timothy J. Ross - Fuzzy logic with engineering applications, 3rd edition, Wiley, 2010.
2. George J. KlirBo Yuan - Fuzzy sets and Fuzzy logic theory and Applications, PHI, New Delhi, 1995.

Online Resources

1. http://www.nptel.ac.in/syllabus/syllabus.php?subjectId=111106048

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO7**	**PO8**	**PO9**	**PO1 0**	**PO11**	**PO1 2**	**PSO1**	**PSO2**
CO1	**1**	**3**	**1**		**3**								**1**	
CO2	**1**	**2**	**2**	**1**									**1**	**1**
CO3	**2**	**1**	**3**	**1**	**2**								**1**	
CO4	**1**	**2**	**1**		**3**								**1**	

Program	B. Tech CSE (AI)				
Year	IV	**Semester**	VII		
Course Name	Natural Language Processing Lab				
Code	NAI4751				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Proficiency in Python Programming	0	0	2	1
Course Objectives	**1.** Understand machine learning techniques used in NLP, **2.** Analyse various algorithms applied within NLP.				
Course Outcomes					
CO1	Implement approaches to syntax and semantics in NLP.				
CO2	Implement approaches to discourse, generation, dialogue and summarization within NLP.				
CO3	Implement current methods for statistical approaches to machine translation.				
CO4	Implement Hidden Markov models and probabilistic context-free grammars.				

S. No.	List of Experiments	Mapped CO
1	**Word Analysis** The objective of the experiment is to learn about morphological features of a word by analyzing it.	**CO1**
2	**Word Generation** The objective of the experiment is to generate word forms from root and suffix information.	**CO2**
3	**Morphology** Understanding the morphology of a word by the use of Add-Delete table	**CO3**
4	**N-Grams** The objective of this experiment is to learn to calculate bigrams from a given corpus and calculate probability of a sentence.	**CO4**
5	**N-Grams Smoothing** The objective of this experiment is to learn how to apply add-one smoothing on sparse bigram table.	**CO1**
6	**POS Tagging - Hidden Markov Model** The objective of the experiment is to calculate emission and transition matrix which will be helpful for tagging Parts of Speech using Hidden Markov Model.	**CO2**
7	**POS Tagging - Viterbi Decoding** The objective of this experiment is to find POS tags of words in a sentence using Viterbi decoding.	**CO3**
8	**Building POS Tagger** The objective of the experiment is to know the importance of context and size of training corpus in learning Parts of Speech	**CO4**

Online Resources

1. https://nlp-iiith.vlabs.ac.in/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**1**	**2**	**1**		**3**								**3**	**3**
CO2	**1**	**2**	**3**	**1**									**3**	**3**
CO3	**1**	**1**	**2**	**1**	**2**								**3**	**3**
CO4	**1**	**1**	**1**		**3**								**3**	**3**

Program	B. Tech CSE(AI)				
Year	IV	**Semester**	VIII		
Course Name	Concepts of Deep Learning				
Code	NAI4801				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of Machine Learning	3	0	0	3
Course Objectives	**1**. Provide basic concepts of deep learning and applications in various fields. **2.** This course emphasis is on analysing the fundamental issues to develop deep learning models and applied to solve complex engineering and social problems. **3**. Develop industry-oriented skills. **4.** Understand the data needs of deep learning.				
Course Outcomes					
CO1	To understand the basic concepts of deep learning.				
CO2	Applies basic principles of deep learning that are required to analyse large dataset and demonstrate the results in various formats.				
CO3	Analyse how to improve the learning quality of the model to make it more accurate.				
CO4	Evaluate current scope and limitations, and social impact of Deep learning				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**INTRODUCTION:** Definition of machine learning- Linear models and Nonlinear Models, introduction to machine learning algorithms, biological neuron, perceptron, Neural Nets: shallow network, training a network: back propagation, gradient descent loss functions, and - Neural networks as universal function approximates	30 Hours	CO1
2	**DEEP NETWORKS:** History of Deep Learning- Deep Learning Platforms. A Probabilistic Theory of Deep Learning Back propagation and regularization, normalization, Deep Boltzmann Machine, Hidden Markov model, Deep Networks Vs. Shallow Networks- Convolutional Networks- Auto Encoder and Generative Adversarial Networks (GAN), Semi- supervised Learning	30 Hours	CO2
3	**OPTIMIZATION ALGORITHMS AND GENERALIZATION**: Concept of Optimization, Optimization in deep learning– First Order, Second Order Methods, Stochastic Methods, Population Based Methods, Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience. CASE STUDY: Image net- Image Classification	30 Hours	CO3

Suggested Readings

1. Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View, 2015
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
4. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

Online Resources

1. https://nptel.ac.in/courses/106106184

2. https://nptel.ac.in/courses/106106201

Course Articulation Matrix														
PO-PSO	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	2	2	3							1	1	1
CO2	3	3	1	2	1							2	2	1
CO3	2	1	2	1	1								2	2
CO4	1	2	1	3	2							1	1	1

Program	B. Tech				
Year		**Semester**			
Course Name	Database Administration				
Code	OE43211				
Course Type	OE	**L**	**T**	**P**	**Credit**
Pre-Requisite	Oracle Database	3	1	0	4
Course Objectives	**1**.To Understand the concept of Database Management **2**. To introduce students to the basic database management administration concepts and practice on the Oracle environment. **3**.To explain what a database management system is as well as their components and models. **4**.To Create and understand the application of user roles, privileges, and the security of the database.				
Course Outcomes					
CO1	Understand the database approach and the file system approach. Explain what a database management system is as well as their components and models.				
CO2	Evaluate how relational algebra / relational calculus is used to construct queries for data definition commands and data manipulation commands in SQL.				
CO3	Apply the process of normalization and design normalized relations				
CO4	Analyze what tables, indexes, and views are as well as their importance and effect.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Design, model and install any database management systems by using Oracle database as sample. Plan, design, construct, control and manage database instances, database network environment	30 Hours	CO1
2	storage structures,usersecurity,database backup and recovery, database maintenance.Define and devise transaction management, concurrency control, crash recovery components	30 Hours	CO2
3	Examine and perform data base administration roles and operations by using Oracle database system as a sample.	30 Hours	CO3
4	Compare and contrast by examining the database systems and new trends in data storage, data retrieval and maintenance techniques.	30 Hours	CO4

Suggested Readings

1.Physical Database Design, Lightstone/Teorey/Nadeau,MorganKaufman,2007, Publisher: ELSEVIER
2.Database Design and Implementation, Edward Sciore,Wiley,2008
3.Databases and Transaction Processing, Lewis, Bernstein, Kifer, Addison Wesley, 2001

Online Resources

1. https://nptel.ac.in/courses/106105175

Course Articulation Matrix													
PO-PSO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**
CO1	**2**	**2**										**1**	**3**	**2**
CO2	**2**	**2**										**1**	**2**	**2**
CO3	**2**	**2**	**3**									**1**	**3**	**2**
CO4	**2**	**2**	**2**		**2**							**1**	**3**	**2**

Program	B. Tech				
Year		**Semester**			
Course Name	Computational Intelligence				
Code	OE43221				
Course Type	OE	**L**	**T**	**P**	**Credit**
Pre-Requisite	Statistics Artificial Intelligence	3	1	0	4
Course Objectives	**1.** To know the fundamentals of rule based systems and fuzzy expert systems. **2.** To acquire the knowledge of artificial neural networks. **3.** To understand the concepts of evolutionary computations. **4.** To expose the concepts of hybrid intelligent systems.				
Course Outcomes					
CO1	Understand the concepts of Computational Intelligence.				
CO2	Analyse the searching techniques used in problem solving.				
CO3	Evaluate the learning of models used in Computational Intelligence.				
CO4	Apply the Computational Intelligence techniques.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction** Introduction to Artificial Intelligence-Search-Heuristic Search-A* algorithm-Game Playing- Alpha-Beta Pruning-Expert systems-Inference-Rules-Forward Chaining and Backward Chaining- Genetic Algorithms. **Knowledge Representation And Reasoning** Proposition Logic, First Order Predicate Logic, Unification. Forward Chaining, Backward Chaining.	30 Hours	CO1
2	Resolution, Knowledge Representation, Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information, Prolog Programming. **Uncertainty** Non monotonic reasoning-Fuzzy Logic, Fuzzy rules, fuzzy inference, Temporal Logic, Temporal Reasoning, Neural Networks, Neuro-fuzzy Inference.	30 Hours	CO2
3	**Learning** Probability basics, Bayes Rule and its Applications, Bayesian Networks, Exact and Approximate Inference in Bayesian Networks, Hidden Markov Models, Forms of Learning, Supervised Learning, Learning Decision Trees, Regression and Classification with Linear Models, Artificial Neural Networks, Nonparametric Models, Support Vector Machines, Statistical Learning, Learning with Complete Data, Learning with Hidden Variables, The EM Algorithm, Reinforcement Learning.	30 Hours	CO3
4	**Intelligence And Applications** Natural language processing, Morphological Analysis, Syntax analysis, Semantic Analysis, Language Models, Information Retrieval, Information Extraction, Machine Translation, Machine Learning.	30 Hours	CO4

Suggested Readings

1. Andries P Engelbrecht, "Computational Intelligence: An Introduction", Wiley-Blackwell
2. Eberhart, "Computational Intelligence", Elsevier, First Edition
3. Amit Konar, "Computational Intelligence: Principles, Techniques and Applications", Springer

Online Resources

1. https://www.udemy.com/course/cipython/
2. https://nptel.ac.in/courses/106102220
3. https://nptel.ac.in/courses/106105077

Course Articulation Matrix													
PO-PSO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	**3**	**2**	**2**	**2**	**3**							**1**	**2**	**2**
CO2	**1**	**3**	**2**	**3**	**2**							**2**	**2**	**2**
CO3	**3**	**3**	**3**	**2**	**3**							**1**	**1**	**1**
CO4	**3**	**3**	**1**	**2**	**3**							**1**	**2**	**2**

Program					
Year	II	**Semester**		III	
Course Name	Programming with Python				
Code	NVC43241				
Course Type	VOC	**L**	**T**	**P**	**Credit**
Pre-Requisite	C Programming	2	0	0	2
Course Objectives	**1.** To have strong foundation on Python Programming. **2.** Develop analytical ability on different real world situations. **3.** Mapping and respective conversion of real world problems to Python Programs. **4.** Capability to work with large amount of data for analytical purpose Using Python.				
Course Outcomes					
CO1	Understand and write simple Python programs.				
CO2	Analysis of conditions in a problem and implement it in program.				
CO3	Design of Python blocks using functions and their evaluation using function call.				
CO4	Apply input/output with files in Python for secondary storage management and to apply OOPs concepts for analysis of real world problems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** The Programming Cycle for Python, Python IDE, Interacting with Python Programs, Elements of Python, Type Conversion. Basics: Expressions, Assignment Statement, Arithmetic Operators, Operator Precedence, Boolean Expression. **Conditionals:** Conditional statement in Python (if-else statement, its working and execution), Nested-if statement and elif statement in Python, Expression Evaluation & Float Representation.	30 Hours	CO1, CO2
2	**Loops:** Purpose and working of loops, While loop including its working, For Loop, Nested Loops, Break and Continue. **Function:** Parts of A Function, Execution of A Function, Keyword and Default Arguments, Scope Rules. **Strings:** Length of the string and perform Concatenation and Repeat operations in it. Indexing and Slicing of Strings.	30 Hours	CO3, CO4

Suggested Readings

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)

2.Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

3. John V Guttag ―Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press, 2013

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc20_cs70/preview

2. https://onlinecourses.nptel.ac.in/noc21_cs78/preview.

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	1	1	2	1	1							1	1	1
CO 2	1	2	2	2	1							2	2	2
CO 3	1	1	2	2	1							2	2	2
CO 4	1	2	2	2	1							2	2	2

Program					
Year	I	**Semester**		**II**	
Course Name	Artificial Intelligence				
Code	NVC43242				
Course Type	VOC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Data Structures & Algorithms, Fundamentals of Mathematics	2	0	0	2
Course Objectives	**1.** Understand the basics of the theory and practice of Artificial Intelligence as a discipline and about intelligent agents. **2.** The student will learn to apply knowledge representation techniques and problem solving strategies to common AI applications **3.** Study the concept behind genetic algorithm and its various operations. **4.** Learn the basic concept of fuzzy set theory.				
Course Outcomes					
CO1	Understand the evolution and various approaches of AI.				
CO2	Implementation of data stoarage,processing,visualization, and its use in regression, clustering etc.				
CO3	Analyze the concepts of neural networks.				
CO4	Apply the concepts of face, object, speech recognition and robots.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**An overview to AI** The evolution of AI to the present, various approaches to AI, what should all engineers know about AI? Other emerging technologies, AI and ethical concerns, Existing sets of principles for AI, AI in the Organization Structure. **Data & Algorithm** History of Data, Data storage and importance of and its acquisition, the stages of data processing, data visualization, regression, prediction & classification, clustering & recommender systems.	30 Hours	CO1, CO2
2	**Artificial Neural Networks** Deep learning, Recurrent Neural Networks, Convolutional Neural Networks, The Universal Approximation Theorem, Generative Adversarial Networks, Speech recognition, Natural language understanding, Natural language generation,Chatbots,Machine Translation. **Applications** Image and face recognition, Object recognition, Speech Recognition besides Computer Vision, Robots, Applications, Investments in AI and AI in start-ups, AI Strategy and Governance (agenda).	30 Hours	CO3, CO4

Suggested Readings

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009.
2. I. Bratko,-Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. M. Tim Jones,-Artificial Intelligence: A Systems Approach (Computer Science) ‖, Jones and Bartlett Publishers, Inc.; First Edition, 2008.

4. Nils J. Nilsson, ―The Quest for Artificial Intelligence‖, Cambridge University Press, 2009.
5. William F. Clocksin and Christopher S. Mellish,‖ Programming in Prolog: Using the ISO Standard‖, Fifth Edition, Springer, 2003.
6. Gerhard Weiss, ―Multi Agent Systems‖, Second Edition, MIT Press, 2013.
7. David L. Poole and Alan K. Mackworth,-Artificial Intelligence: Foundations of Computational Agents‖, Cambridge University Press, 2010.

Online Resources

1. https://nptel.ac.in/courses/109106184
2. https://onlinecourses.nptel.ac.in/noc22_cs83/preview

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**1**	**2**	**1**		**2**							**2**	**2**	**1**
CO2		**1**	**2**	**3**									**1**	
CO3	**2**		**2**	**2**	**1**							**1**	**1**	**2**
CO4	**1**		**2**	**1**	**1**							**1**	**1**	**2**

Program	-				
Year	II	**Semester**	IV		
Course Name	Cyber Crime and Computer Forensics				
Code	NVC43243				
Course Type	VOC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Knowledge of Cyber Laws	2	0	0	2
Course Objectives	1. Acquainting students with Cyber Crimes. 2. Providing the students the understanding of Issues in Internet Governance. 3. To understand the different aspects of computer forensic. 4. Making the student aware of Digital Evidences and working of various Agencies for investigation of cyber-crimes in India.				
Course Outcomes					
CO1	Understand the basic concept of cybercrime and computer forensics.				
CO2	Analyze the virus, cyber-attacks and hacking in cyber applications.				
CO3	Evaluate the different computer forensic tools and techniques.				
CO4	Apply different methods for digital evidence related to system security.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Definition of Cyber Crime:** Introduction of Cyber Crime, Nature and Scope of Cyber Crime, Types of Cyber Crime, Social Engineering, Categories of Cyber Crime, Property Cyber Crime. Introduction to internet crimes: hacking and cracking, credit card and ATM frauds, emerging digital crimes and modules. Introduction to Cyber Crime Investigation, Investigation Tools, Discovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery.	30 Hours	CO1, CO2
2	**Computer forensics analysis and Tools:** Introduction to Computer Forensics Forensic Software and Hardware, Analysis and Advanced Tools, Forensic Technology and Practices, Forensic Ballistics and Photography, Face, Iris and	30 Hours	CO3, CO4

	Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Network Forensics. **Email Security And Firewalls**: PGP ,S/MIME, Internet Firewalls for Trusted System- Roles of Firewalls, Firewall related terminology, Types of Firewalls, Firewall designs SET for E-Commerce Transactions.		

Suggested Readings

1. Angus M. Marshall, "Digital forensics: Digital evidence in criminal investigation", John – Wiley and Sons, 2008**.**

2. Bernadette H Schell, Clemens Martin, "Cybercrime", ABC – CLIO Inc, California, 2004. "Understanding Forensics in IT ", NIIT Ltd, 2005.

3. Nelson Phillips and EnfingerSteuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009**.**

Online Resources

1. https://onlinecourses.swayam2.ac.in/cec20_lb06

2. https://nptel.ac.in/courses/106106178

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2		1								1	2	
CO2	1	2	2	1								1	2	
CO3	2	1	2	2	2							2	2	2
CO4	1	1	1	2	2							2	2	2

Program	-				
Year	III	Semester		V	
Course Name	Meta-Verse and Virtual Reality				
Code	NVC43244				
Course Type	VOC	L	T	P	Credit
Pre-Requisite		2	0	0	2
Course Objectives	1. Understand how Augmented Reality/Virtual Reality (AR/VR) interfaces are used to interact in the Meta-verse. 2. To create AR/VR interfaces using free software tools. 3. Use AR/VR interfaces as part of a business solution to enable potential customers to interact with a company's products and services in the Meta-verse. 4. Understand how all these fit into the Meta-verse as a whole, so as to create viable business solutions in the Meta-verse.				
Course Outcomes					
CO1	Definition of the Meta-verse & the interplay between Web 3.0 and Block chain				
CO2	Use of NFTs in Meta-verse & Industries using the Meta-verse technology				
CO3	Describe how VR systems work and list the applications of VR.				
CO4	Explain the concepts of motion and tracking in VR systems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Introduction and class policies, What is the Meta-verse? Demo of the Meta-verse ,The Meta-verse vs. Web 3.0 AR/VR and the Meta-verse Applications of the Meta-verse advantages and Challenges of the Meta-verse Types of the Meta-verse Block chain and the Meta-verse Crypto currency and the Meta-verse NFTs and the Meta-verse	30 Hours	CO1, CO2
2	Introduction to Virtual Reality ,Representing the Virtual World ,The Geometry of Virtual Worlds & The Physiology of Human Vision, Visual Perception & Rendering ,Motion & Tracking	30 Hours	CO3, CO4

Suggested Readings

1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016.
2. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.

Online Resources:

1. https://elearn.nptel.ac.in/shop/iit-workshops/completed/metaverse/
2. https://archive.nptel.ac.in/courses/106/106/106106138/

Course Articulation Matrix														
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2	1	1							1	1	1
CO2	1	2	2	2	1							2	2	2
CO3	1	1	2	2	1							2	2	2
CO4	1	2	2	2	1							2	2	2

Program	B. Tech CSE (AI)				
Year	III	**Semester**		VI	
Course Name	Robotics and Intelligent Systems				
Code	NPEC43911				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Soft Computing	3	0	0	3
Course Objectives	**1.** To understand Robotics, Control and Intelligent Systems. **2.** Analyse necessary Approaches and Techniques to build working mechanisms of robots. **3.** Acquire skill in robot task planning for problem solving. **4.** To understand Robotics and Intelligent Systems modules				
Course Outcomes					
CO1	Understand robot manipulators and mobile robots.				
CO2	Analyse robot controllers by using appropriate methods.				
CO3	Design basic robot intelligent sensor systems including static system learning (kinematics) and dynamic learning; and intelligent course recognition.				
CO4	Apply skills in identifying areas in manufacturing where robotics can be deployed for enhancing productivity.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Robotics Systems:** Overview and Preliminaries, Biological Paradigms, Robotic Manipulators Sensors and Actuators, Low-Level Robot Control, Mobile Robots, Modelling Dynamic Systems Kinematics and Dynamics of Rigid Bodies, Continuous- and Discrete- time Dynamic Models, Linearization and Linear Response, Controller hardware/software systems, Sensor systems and integration.	30 Hours	CO1
2	**Intelligent Systems and Control:** General rule based expert systems- structure, characteristics, chaining inferences, conflict resolution, Fuzzy expert systems- fuzzy sets and their operations, linguistic variables, fuzzy rules, fuzzy inference, defuzzification, applications. **Neural Networks:** Learning processes, Single layer perceptron, Multilayer perceptron, Radial basis function neural networks, Self-organizing map neural networks Learning vector quantization neural networks.	30 Hours	CO2
3	**Evolutionary and genetic algorithms**- simulation of natural evolution, genetic algorithms, genetic operators, fitness function, applications. Simulation and control of dynamics systems- modeling using Simulink, PID controllers, implementation, fuzzy control, stability and performance evaluations. **Goal-Oriented Control:** Optimal Control, Robust, Adaptive, and Neural Control, Training Neural Networks, Task Planning and Multi-Agent Systems.	30 Hours	CO3, CO4

Suggested Readings

1. M. Negnevitsky, Artificial Intelligence – A guide to intelligent systems Addison-Wesley, 2005.
2. M. Tarokh, Intelligent Systems and Control, Lectures
3. J. J. Craig, Introduction to Robotics, Addison Wesley Publishers, 2005.
4. Autonomous Robots, G. Bekey, MIT Press, 2005
5. Jones, Joseph L., Flynn, Anita, M., and Seiger, B.A., "Mobile Robots: Inspiration to Implementation", AK Peters, 1999
6. Schilling R. J., Fundamentals of Robotics: Analysis and Control, Prentice Hall, 2004
7. McKerrow P. J., Introduction to Robotics, Addison-Wesley.
8. Siegwart R. and Nourbakhsh I. R., Introduction to Autonomous Mobile Robots, The MIT Press, 2004.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc21_me76/preview

Course Articulation Matrix														
PO-PSO	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**1**	**2**	**1**	**3**	**1**							**2**	**2**	**1**
CO2	**1**	**2**	**2**	**1**	**1**							**1**	**1**	**1**
CO3	**2**	**2**	**1**	**1**	**3**							**1**	**2**	**2**
CO4	**1**	**2**	**2**	**1**	**2**							**2**	**2**	**1**

Program	B. Tech CSE(AI)				
Year	III	**Semester**	VI		
Course Name	Introduction to Unmanned Aerial Vehicle				
Code	NPEC43912				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Computer and Drone Basics	3	0	0	3
Course Objectives	**1.** Understand the parts and functions of UAV & Indian Aviation regulations of UAV. **2.** Explain the concepts of Aerodynamics, Propulsion & Structures of Model Aircrafts. **3.** Describe the working principle and components of UAV. **4.** Demonstrate the design process of UAV.				
Course Outcomes					
CO1	Understand the basic concepts of UAV.				
CO2	Analyze the application of sensors and actuators in UAV.				
CO3	Evaluate the loads acting on various types of UAVs				
CO4	Apply concept of performance and stability analysis of UAVs				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Basics Of Flight:** Different types of flight vehicles, Components and functions of an airplane Forces acting on Airplane Physical properties and structure of the atmosphere Aerodynamics, Air foil nomenclature, aerofoil characteristics, Angle of attack, Mach number, Lift and Drag, Propulsion and airplane structures. **Basic Review & Characteristics of UAV Types:** History, Classification and applications of UAVs, Unmanned Aircraft System (UAS), UAS composition, societal impact, future prospects. Types of Drones, Applications and Uses. Characteristics of Multi rotor vehicle, Fixed Wing vehicle, Flapping wing Vehicles and their applications, Defence.	30 Hours	CO1, CO2
2	**Introduction To Design And Selection Of UAV Aspects Of Airframe Design:** Conceptual design, preliminary design, detailed design, selection of UAV for particular requirement. Airframe configuration, Scale effects, packaging density, Aerodynamic design, Strength, stiffness and reliability requirements, flight and gust envelopes including manoeuvre loads, selection of power plants, Design for stealth PAYLOADS FOR UAV Classification of Payloads, camera, sensors, radars, various measuring devices classification of payload based on applications, Hyper spectral sensors, laser detection and range, synthetic aperture radar, thermal cameras, ultrasonic detectors, case study on payloads.	30 Hours	CO3
3	**Avionics Hardware & Communication Autopilot**, AGL-pressure sensors, servos, accelerometer, gyros, actuators, power supply, processor, integration, installation, configuration, and testing.	30 Hours	CO4

	UAV Navigation And Guidance System Navigation, Dead Reckoning, Inertial, Radio Navigation, Satellite, Waypoint Navigation, Dijkstra's Algorithm, A-star Algorithm, UAV Guidance, Types of guidance, UAV communication systems, Ground control station, Telemetry, UAS future.		

Suggested Readings

1. Andey Lennon " Basics of R/C model Aircraft design" Model airplane new publication
2. Randal W. Beard and Timothy W. McLain: Small Unmanned Aircraft: Theory and Practice, Princeton University Press,2012
3. Kimon P. Valavanis: Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy, Springer,2007

Online Resources

1. **https://nptel.ac.in/courses/101104073**

Course Articulation Matrix														
PO-PSO	**PO1**	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	1	1								2	2	1
CO2	2	2	2	2	2							2	2	2
CO3	2	2	2	2	2							2	2	2
CO4	2	2	2	2	2							2	2	2

Program	B. Tech CSE(AI)				
Year	III	**Semester**	VI		
Course Name	Sentiment Analysis				
Code	NPEC43913				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basics about Artificial Intelligence	3	0	0	3
Course Objectives	**1.** Discuss the various algorithms to perform opinion mining, subjectivity and emotion. **2.** Identify the sentiment of any document, web page or social networking site. **3.** Recognize aspect-based opinion summary and entity extraction. **4.** Underline the opinion summarization using various approaches.				
Course Outcomes					
CO1	Understand key issues involved in the study of semantic fields				
CO2	Analyse the meanings of an expression in a systematic manner				
CO3	Evaluate simple problems in semantic analysis				
CO4	Apply the basic goals of several different approaches to semantics.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction** Need for Sentiment Analysis, Problem of Sentiment Analysis, Subjectivity, Stance, Words to Discourse, Pragmatics, Natural Language Processing Issues, Opinion Definition, Sentiment Analysis Tasks, Opinion Summarization, Types of Opinion, Subjectivity and Emotion. **Document Sentiment Classification** Sentiment Classification Using Supervised Learning Unsupervised Learning Rating Prediction, Cross-Domain Sentiment Classification, Cross Language Sentiment Classification, Sentence Subjectivity And Classification Subjectivity Classification, Sentence Sentiment Classification, Conditional Sentences, Sarcastic Sentences Cross, Language Subjectivity and Sentiment Classification Discourse Information for Sentiment Classification	30 Hours	CO1, CO2
2	**Aspect Based Sentiment Analysis** Aspect sentiment classification, Basic rules of opinions and Compositional Semantics, Aspect Extraction, Identifying Resource usage aspect, Simultaneous Opinion Lexicon Expansion and Aspect Extraction, Grouping aspects into categories, Entity, Opinion Hold and Timing Extraction, Co reference Resolution and Word Sense Disambiguation Aspect and Entity Extraction, Sentiment Lexicon Generation, Corpus Based Approach, Dictionary Based Approach, Desirable and Undesirable Facts.	30 Hours	CO3

3	**Opinion Summarization &Tools for Sentiment Analysis** Aspect Based Opinion Summarization, Improvements to Aspect-Based Opinion Summarization, Contrastive view Summarization, Traditional Summarization, Analysis of Comparative Opinions, Identifying Comparative Sentences, Identifying Preferred Entities, Opinion Search and Retrieval, Opinion Spam Detection, Types of Spam Detection, Supervised and Unsupervised Approach, Group Spam Detection. Detecting Fake or Deceptive Opinions, Quality of Review, Quality as Regression Model, Other Methods, Case Study, and Sentiment Analysis Applications Tools for Sentiment Analysis.	30 Hours	CO4

Suggested Readings

1. Bo Pang and Lillian Lee, Opinion Mining and Sentiment Analysis: Now PublishersInc,2008.
2. Roy De Groot, Data mining for Tweet sentiment classification – Twitter sentiment,2009

Online Resources

1. https://nptel.ac.in/courses/106105158

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO 5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO1 2**	**PSO1**	**PSO2**
CO1	1	**2**	**1**	**2**	**1**								2	**1**
CO2	**1**	**2**		**3**	**1**								**2**	**2**
CO3	**1**	**2**	**3**	**1**	**2**								**1**	**1**
CO4	**1**	**1**	**1**	**1**	**2**								**2**	**1**

Program	B. Tech CSE				
Year	III	**Semester**		VI	
Course Name	Internet of Things				
Code	NPEC43914				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of AI and Computer Network	3	0	0	3
Course Objectives	**1.** Describe the IoT and Cloud architectures **2.** Determine the right sensors and communication protocols to use in a particular IoT system. **3.** Deploy Cloud Services using different cloud technologies. **4.** Implement cloud computing elements such virtual machines, web apps, mobile services, etc.				
Course Outcomes					
CO1	Understand general concepts of Internet of Things (IoT) (Understand) and Recognize various devices, sensors and applications.				
CO2	To analyse various M2M and IoT architectures.				
CO3	Apply design concept to IoT solutions.				
CO4	Evaluate design issues in IoT applications and Create IoT solutions using sensors, actuators and Devices.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to IoT**: Sensing, Actuation, Networking Basics, Communication Protocols, Sensor Networks, Machine-to-machine Communications, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Communication models & APIs.	30 Hours	CO1
2	**M2M to IoT**-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics. Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure forIoT. **M2M vs IoT An Architectural Overview**– Building architecture, Main design principles and needed capabilities, An IoT architecture outline, and standards considerations. Reference Architecture and Reference Model of IoT.	30 Hours	CO2, CO3
3	**IoT Reference Architecture**- Getting Familiar with IoT Architecture, Various architectural views of IoT such as Functional, Information, Operational and Deployment. Constraints affecting design in the IoT world- Introduction, Technical design Constraints. **Domain-specific applications of IoT**: Home automation, Industry applications, Surveillance applications, Other IoT applications, developing IoT solutions	30 Hours	CO4

Suggested Readings

1. Vijay Madisetti and Arsh deep Bahga, “Internet of Things (A Hands-on Approach)”, 1st Edition, VPT, 2014

2. Francis da Costa, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.
3. CunoPfister, Getting Started with the Internet of Things,OReillyMedia,2011, ISBN: 978-1-4493-9357

Online Resources

1. https://onlinecourses.nptel.ac.in/noc22_cs53

2. https://onlinecourses.swayam2.ac.in/arp19_ap52/preview

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO7**	**PO8**	**PO9**	**PO1 0**	**PO11**	**PO1 2**	**PSO1**	**PSO2**
CO1	**2**	**1**	**1**		**1**								**2**	**1**
CO2	**3**	**2**	**1**	**2**	**2**								**1**	**2**
CO3		**3**	**2**	**1**	**2**								**2**	**1**
CO4	**1**		**2**	**1**	**1**								**2**	**1**

Program	B. Tech CSE(AI)				
Year	III	**Semester**	VI		
Course Name	Cyber Law and Security				
Code	NPEC43921				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of Computer Security	3	0	0	3
Course Objectives	1. To introduce the basics of information and web security and computer communication. 2. To familiarize students with Cyber Laws and Security policies and Cryptography. 3. To exhibit knowledge to secure corrupted systems, protect personal data, and secure computer networks in an Organization. 4. To monitoring and analyzing the nature of attacks through cyber/computer forensics software/tools.				
Course Outcomes					
CO1	Understand the information systems, its types, threats, security issues related to it and also about cyber security and risk associated to it.				
CO2	Analyze about Application security, Data security and types of security Threats in network.				
CO3	Understand the importance of secure information system and risk management issues indifferent applications.				
CO4	Understand modern copyright, patent law, skills of ethics, cyber-crime and IT ACT so that they can protect their inventions by making use of these Laws.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Introduction to information systems, Types of information Systems, Development of Information Systems, Introduction to information security, Need for Information security, Threats to Information Systems, Information Assurance, Cyber Security, and Security Risk Analysis. Classification of Threats and Assessing Damages Security in Mobile and Wireless Computing, Security Challenges in Mobile Devices, authentication Service Security, Security Implication for organizations. Application security (Database, E-mail and Internet), Data Security Considerations- Backups, Archival Storage and Disposal of Data.	30 Hours	CO1
2	Security Technology-Firewall and VPNs, Security Threats-Viruses, Worms, Trojan Horse, Bombs, Trapdoors, Spoofs, E-mail viruses, Macro viruses, Malicious Software, Network and Denial of Services Attacks, Security Threats to E-Commerce-Electronic Payment System, e- Cash, Credit/Debit Cards. Digital Signature, Public Key Cryptography. Developing Secure Information Systems, Application Development Security, Information Security Governance & Risk Management, Security Architecture & Design Security	30 Hours	CO2
3	Issues in Hardware, Data Storage & Downloadable Devices, Physical Security of IT Assets, Access Control, CCTV and intrusion Detection Systems, Backup Security Measures. Laws, Investigation and Ethics, Cyber Crime , Information	30 Hours	CO3, CO4

	Security and Law ,Types & overview of Cyber Crimes, Cyber Law, Issues in E-Business Management Overview of Indian IT Act, Ethical Issues in Intellectual property rights, Copy Right, Patents, Data privacy and protection, Domain Name, Software piracy, Plagiarism, Issues in ethical hacking.		

Suggested Readings

1. Godbole, *"* Information Systems Security*"*, Willey,2008
2. Merkov, Breithaupt, *"* Information Security*"*, Pearson Education,2014
3. Yadav, *"*Foundations of Information Technology*"*, New Age, Delhi, 2006
4. Schou, Shoemaker, *"* Information Assurance for the Enterprise*"*, Tata McGraw Hill, 2006

Online Resources

1. https://nptel.ac.in/courses/106106129
2. https://onlinecourses.swayam2.ac.in/nou19_cs08/preview

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	1									3	2	1
CO2	2	2	1	2	2							3	1	2
CO3	1	1	2	2	2							3	2	2
CO4	2	1	2	2	2							3	2	2

Program	B. Tech CSE(AI)				
Year	III	**Semester**	VI		
Course Name	Computer Vision				
Code	NPEC43922				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Machine Learning, Computer Graphics	3	0	0	3
Course Objectives	1. Acquire knowledge Image Processing **2**. Appling Filtering and edge detection **3.** Appling deep leering for recognition and feature detection on image and videos				
Course Outcomes					
CO1	Understanding basics of Image Processing and Photometric				
CO2	Understanding Image Filtering and edge detection.				
CO3	Understanding application of deep learning in image processing and recognition				
CO4	Understanding feature detection and motion.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	Introduction to image processing, Image formation: Geometric primitives and transformations, Photometric image formation, digital camera, Image processing: Point operators, More neighborhood operators, Fourier transforms, Pyramids and wavelets, Geometric transformations, Model fitting and optimization, Variational methods and regularization, Markov random fields	30 Hours	CO1
2	Linear Filtering: Filter Kernels, Linear Filter Experiments, Linear Convolution Filtering, Selecting a Region-of-Interest, Adding Noise to Image, Mean Filtering, Median Filtering, Rank Order Filtering, Normal Distribution Filtering, Edges, Lines, Corners, Gaussian Kernel and Voronoï Meshes, Linear Function, Edge Detection, Double Precision Laplacian Filter, Enhancing Digital Image Edges, Gaussian Kernel, Gaussian Filter, Image Gradient Approach to Isolating Image Edges	30 Hours	CO2
3	Deep Learning: Supervised learning, Unsupervised learning, Deep neural networks, Convolutional neural networks, More complex models Recognition: Instance recognition, Image classification, Object detection, Semantic segmentation, Pose estimation, Video understanding, Vision and language Feature detection and matching: Edges and contours, Contour tracking, Lines and vanishing points, Segmentation Motion estimation: Translational alignment, Parametric motion, Optical flow, Layered motion Computational photography, High dynamic range imaging, Super-resolution, denoising, and blur removal,	30 Hours	CO3, CO4

	Image matting and compositing, Video matting, Texture analysis and synthesis		

Suggested Readings

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", 2nd Edition, September 30, 2022 Springer
2. James F James F. Peters, "Foundations of Computer Vision, Computational Geometry, Visual Image, Structures and Object Shape Detection", 124, Springer
3. E. R. Davies, "Computer and Machine Vision: Theory, Algorithms, Practicalities", Fourth Edition, 2012, Elsevier
4. Ramesh Jain, Rangachar Kasturi, Brian G. Schunck,"MACHINE VISION", McGraw-Hill, Inc., ISBN 0-07-032018-7, 1995

Online Resources

1. https://onlinecourses.nptel.ac.in/noc21_ee23/preview

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO 5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO1 2**	**PSO1**	**PSO2**
CO1	**3**	**3**	**3**	**3**	**2**							**2**	**3**	**3**
CO2	**3**	**3**	**3**	**3**	**3**							**2**	**2**	**3**
CO3	**3**	**3**	**3**	**3**	**3**							**2**	**3**	**3**
CO4	**3**	**3**	**3**	**3**	**2**							**2**	**3**	**3**

Program	B. Tech CSE(AI)				
Year	III	**Semester**	VI		
Course Name	Recommender Systems				
Code	NPEC43923				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	AI and Machine Learning.	3	0	0	3
Course Objectives	**1.** Students learn about the basic concepts of recommender systems. **2.** To learn personalization algorithms, evaluation tools, and user experiences. **3.** To develop the concepts of Content-based Recommender Systems. **4.** Students study a Comprehensive Survey of Neighbourhood-based Recommendation Methods.				
Course Outcomes					
CO1	Understand the basic concepts behind recommender systems.				
CO2	Analyze the Content-based Recommender Systems and Knowledge-based recommendation system.				
CO3	Evaluate the variety of approaches for recommender systems.				
CO4	Analyze the different approaches towards the recommender system.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Introduction to Recommender Systems, Recommender Systems Function, Applications of recommendation systems, Issues with Recommender system, Data and Knowledge Sources, Recommendation Techniques, Recommender Systems and Human Computer Interaction, Recommender Systems as a Multi-Disciplinary Field, Application and Evaluation. **Data Mining Methods for Recommender Systems, Collaborative Filtering:** Data Preprocessing, Classification: Nearest Neighbors, Decision Trees, Rule-based Classifiers, Bayesian Classifiers, Artificial Neural Networks, Support Vector Machines, Ensembles of Classifiers.	30 Hours	CO1
2	**Cluster Analysis:** k-Means, Alternatives to k-means. User-based nearest neighbor recommendation, Item-based nearest neighbor recommendation, Model based and pre-processing based approaches, Attacks on collaborative recommender systems. **Content-based Recommender Systems, Knowledge based recommendation:** Basics of Content-based Recommender Systems. High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, Obtaining item features from tags, Representing item profiles, Methods for learning user profiles, Similarity based retrieval, Classification algorithms. Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders.	30 Hours	CO2, CO3

3	**Hybrid approaches, Evaluating Recommender System Recommender Systems and communities:** Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta-level, Limitations of hybridization strategies. Introduction, General properties of evaluation research, Evaluation designs, Evaluation on historical datasets, Error metrics, Decision-Support metrics, User-Centred metrics. Communities, collaboration and recommender systems in personalized web search, Social tagging recommender systems, Trust and recommendations, Group recommender systems.	30 Hours	CO4

Suggested Readings

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press (2011), 1.
2. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer (2011), 1.
3. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1.

Online Resources

1. **https://nptel.ac.in/courses/110101145**

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2		2	1								2	2	2
CO2	2	2	2	2	1							2	2	2
CO3	2	2	2	2	2							2	1	1
CO4	2	2	1	2	2							2	2	1

Program	B. Tech CSE(AI)				
Year	III	**Semester**	VI		
Course Name	Block Chain Technology				
Code	NPEC43924				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Distributed Systems, Computer Networking, Cryptography.	3	0	0	3
Course Objectives	**1.** Student to be able to design, build, and deploy smart contracts and distributed applications. **2.** Students should be able to understand different types of Decentralized applications developed using block chain technology. **3.** Describe the basic bit coin and block chain application. **4.** To study about crypto currencies and their functions.				
Course Outcomes					
CO1	Understand about the distributed database and function.				
CO2	Analyse the basic concepts and structural aspects of block chain and application.				
CO3	To Understand the distributed consensus and Nakamoto consensus.				
CO4	Explain the fundamental characteristics of Crypto currency and bit coin.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Basics:** Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.	30 Hours	CO1
2	**Blockchain:** Introduction, Advantage over conventional distributed database, Block chain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Block chain application, Soft & Hard Fork, Private and Public block chain **Distributed Consensus:** Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.	30 Hours	CO2, CO3
3	**Crypto currency:** History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin Crypto currency **Regulation:** Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. **Applications:** Internet of Things, Medical Record Management System, Domain Name Service and future of Block chain.	30 Hours	CO4

Suggested Readings

1. Andreas M. Antonopoulos, Mastering Bitcoin: Unlocking Digital Crypto currencies, "O'Reilly Media, Inc.", 03-Dec-2014 - Business & Economics.
2. Dr. Gavin Wood, “ETHEREUM: A Secure Decentralized Transaction Ledger,”Yellow paper.2014.
3. Antony Lewis, The Basics of Bitcoins and Block chains: An Introduction to Crypto currencies and the Technology that Powers Them(Cryptography, Crypto Trading, Digital Assets, NFT) Paperback – April 13,2021
4. Joseph J. Bambara, Paul R. Allen, Block Chain: A Practical Guide to Developing Business, Law And Technology.

Online Resources

1. **https://onlinecourses.nptel.ac.in/noc22_cs44/preview**
2. **https://nptel.ac.in/courses/106104220**

Course Articulation Matrix														
PO-PSO	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2		2	2	1							2	2	2
CO2	2	1	1	1	2							2	2	2
CO3	2	2	2	1	1							2	3	3
CO4	2	2	2	1	2							2	3	3

Program	B. Tech CSE (AI)				
Year	IV	**Semester**	VII		
Course Name	System Modelling & Simulation				
Code	NPEC43931				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basics about Simulation	3	0	0	3
Course Objectives	**1.** Introduce computer simulation technologies and techniques. **2.** Provides the foundations for the student to understand computer simulation. **3.** Implement and test a variety of simulation. **4.** Learning Useful statistical models.				
Course Outcomes					
CO1	Understand the basic concepts of Simulation.				
CO2	Analyse the Useful statistical models.				
CO3	Evaluate Input Modeling and Data Collection.				
CO4	Apply Model Building and Verification, Validation.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Introduction and Overview of Simulation; Advantages and Disadvantages of Simulation, Application areas, Steps in a Simulation Study, What is System, System Components, System Environment; Model of a system, Types of Models. Concepts in Discrete-Event Simulation: The Event Scheduling / Time-Advance Algorithm, World Views, Manual simulation Using Event Scheduling, List processing. Simulation in Java, Simulation in GPSS; Simulation in Spread sheet.	30 Hours	CO1, CO2
2	Useful statistical models discrete distributions; Continuous distributions; Poisson process; Empirical distributions, Queuing Models: Characteristics of queuing systems, Queuing notation; Long-run measures of performance of queuing systems; Networks of queues, Rough-cut modelling.	30 Hours	CO3
3	Input Modelling: Data Collection; Identifying the distribution with data, Parameter estimation, Goodness of Fit Tests, Fitting a non-stationary Poisson process, Selecting input models without data, Multivariate and Time-Series input models. Measures of performance and their estimation, Output analysis for terminating simulations; Output analysis for steady-state simulations. Model building, verification and validation; Verification of simulation models; Calibration and validation of models, optimization via Simulation	30 Hours	CO4

Suggested Readings

1. Zeigler B.P. Praehofer. H. and Kim I.G. "Theory of modeling andsimulation", 2nd Edition. Academic press2000

2. Shannon, R. E., "System Simulation: the Art and Science", Prentice Hall Inc. 1990

Online Resources

1. https://onlinecourses.nptel.ac.in/noc21_me25/preview

Course Articulation Matrix														
PO-PSO	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1		**1**	**2**	**1**								**2**	**1**
CO2	**1**	**2**		**3**	**1**								**2**	**2**
CO3	**1**	**2**	**3**		**2**								**1**	**2**
CO4	**1**	**1**	**1**	**1**									**1**	**2**

Program	B. Tech CSE (AI)				
Year	IV	**Semester**	VII		
Course Name	Embedded System Design				
Code	NPEC43932				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Simulation Techniques	3	0	0	3
Course Objectives	**1.** To impart fundamental concepts in the area of Embedded Systems. **2.** To impart the design of an embedded system. **3.** To impart the partition of a system to hardware and software parts efficiently. **4.** To impart the Hardware/software Co-design concepts.				
Course Outcomes					
CO1	Understand the general process of embedded system development.				
CO2	Analyse important embedded system terminology.				
CO3	Evaluate embedded system product conceptualization methods.				
CO4	Apply common aspects of embedded system development.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Embedded System** Embedded systems, applications and purpose of embedded systems, processor embedded into a system, embedded hardware units and devices in a system, Characteristics and quality attributes of embedded systems. **Embedded System Design Process and system architecture** Requirements, Specifications, Architecture Design, Designing of Components, System Integration, Challenges in Embedded System Design. Instruction Set Architecture i.e., CISC and RISC instruction set architecture, Basic Embedded. Processor/Microcontroller Architecture with examples, Memory System Architecture (Caches, Virtual Memory	30 Hours	CO1, CO2
2	**Programming Embedded Systems** Structure of embedded program, infinite loop, compiling, linking and locating, downloading and debugging. Memory map, i/o map, interrupt map, processor family, external peripherals, memory - RAM, ROM, types of RAM and ROM, memory testing, CRC, Flash memory. Control and Status Registers, Device Driver, Timer Driver-Watchdog Timers, Embedded Operating System, Real-Time Characteristics, Selection Process.	30 Hours	CO3
3	**Concept of Real time Operating Systems:** Real-time Memory Management, Example Real-time OS, Types of RTOS, Basic design using RTOS, Micro/OS-II and Vx works, windows CE, OSEK, real-time Linux functions, case study: digital camera hardware and software architecture, embedded systems in automobile, embedded system for a smart card, mobile phone software for key inputs.	30 Hours	CO4

Suggested Readings

1. Embedded Systems Design by Steve Heath, II edition, Newnes publications, 2002.
2. Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers by Tammy Noergaard, Elsevier,2005.
3. Embedded Systems Architecture Programming and Design by Raj Kamal, II edition, Tata MC Graw-Hill,2011.
4. Designing Embedded Systems with PIC Microcontrollers: principles and applications by Tim Wilmshurst, Elsevier,2009.
5. Embedded Systems, Rajkamal, TataMcGraw-Hill, 2003

Online Resources

1. https://onlinecourses.nptel.ac.in/noc23_cs54/preview

Course Articulation Matrix														
PO-PSO	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	**1**	**2**	**2**	**1**								**2**	**3**
CO2	**2**	**1**	**2**	**1**	**2**								**2**	**2**
CO3	**2**	**2**	**1**	**1**	**2**								**3**	**3**
CO4	**1**	**1**	**2**	**1**	**2**								**3**	**3**

Program	B. Tech CSE(AI)				
Year	IV	**Semester**		VII	
Course Name	Evolutionary Multi-objective Optimization				
Code	NPEC43933				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Fundamentals of AI	3	0	0	3
Course Objectives	1. To develop the understanding of evolutionary algorithms and multi-objective evolutionary optimization algorithms. 2. To develop the understanding of genetic computing. 3. To learn the application of evolutionary algorithms for solving optimization problems. 4. To explain the details of evolutionary algorithms such as GA and other related algorithms.				
Course Outcomes					
CO1	Understand evolutionary algorithms.				
CO2	Analyse and develop understanding of genetic computing.				
CO3	Design evolutionary algorithms for solving optimization problems.				
CO4	Applying genetic algorithm to Optimization Multi-objectives				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Evolutionary Computation** - Biological and artificial evolution, Evolutionary computation and AI, Different historical branches of EC, e.g., GAs, EP, ES, GP, etc., A simple evolutionary algorithm. Evolutionary strategies- Evolution in continuous variables. Transformations, Search Operators, Selection Schemes and mutation	30Hours	CO1
2	**Genetic Algorithms** - Representation, operators, and standard algorithm. The building block hypothesis and the schema theorem. Genetic Programming - Trees as individuals, Major steps of genetic programming, e.g., functional and terminal sets, initialisation, crossover, mutation, fitness evaluation, etc. Search operators on trees, Automatically defined functions, Issues in genetic programming, e.g., bloat, scalability, etc., Examples	30Hours	CO2
3	Multi-objective optimization and their combination with multi-criteria decision-making techniques. Classical methods for treating multi-objective problems, advanced methods based on Pareto-optimality. Evolutionary techniques for optimization problems with and without constraints. NSGA-II, SPEA-2, and MO-CMA-ES. Methods to compare algorithms including test functions and measures to analyze the obtained approximated Pareto-optimal set and front. Methods to cope with limitations to handle the dimensionality of the Pareto-front. Multi-criteria decision-making approaches.	30Hours	CO3, CO4

Suggested Readings

1. Ashish M. Gujarathi, B. V. Babu," Evolutionary Computation: Techniques and Applications",CRC Press 2016.
2. X. Yao (ed)," Evolutionary Computation: Theory and Applications", World Scientific Publ. Co., Singapore, 1999
3. Dan Simon, "Evolutionary Optimization Algorithms", Wiley, 2013

Online Resources

1. https://nptel.ac.in/courses/112103301

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO 5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO1 2**	**PSO1**	**PSO2**
CO1	**1**	**3**	**1**		**3**								**3**	**3**
CO2	**1**	**2**	**2**	**1**									**3**	**3**
CO3	**2**	**1**	**3**	**1**	**2**								**3**	**3**
CO4	**1**	**2**	**1**		**3**								**3**	**3**

Program	B. Tech CSE (AI)				
Year	IV	**Semester**		VII	
Course Name	Bioinformatics				
Code	NPEC43934				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	0	0	3
Course Objectives	**1**. Understanding methods and software tools for understanding biological data. **2.** To analyze fundamentals of evolution, molecular biology, and molecular evolution. **3**. To understand DNA, RNA important molecules, protein data, etc. their structure, replication and transcription. **4.**To Evaluate the biological databases which help in analyzing biological data and their interpretation.				
Course Outcomes					
CO1	To understand the basic concept of Bioinformatics and its significance in Biological data analysis				
CO2	To Analyse properties of bio informatical databases, perform text- and sequence-based searches.				
CO3	To Apply the major steps in pair wise and multiple sequence alignment by dynamic programming.				
CO4	To Evaluate different types of Biological databases.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction** Bioinformatics objectives and overviews, Interdisciplinary nature of Bioinformatics, Data integration, Data analysis, Major Bioinformatics databases and tools. Metadata: Summary & reference systems, finding new type of data online. Molecular Biology and Bioinformatics: Systems approach in biology, Central dogma of molecular biology, problems in molecular approach and the bioinformatics approach, Overview of the bioinformatics applications	30 Hours	CO1
2	**The Information Molecules and Information Flow** Basic chemistry of nucleic acids, Structure of DNA, Structure of RNA, DNA Replication, -Transcription, -Translation, Genes-the functional elements in DNA, Analyzing DNA,DNA sequencing. Proteins: Amino acids, Protein structure, Secondary, Tertiary and Quaternary structure, Protein folding and function, Nucleic acid-Protein interaction; Perl: Perl Basics, Perl applications for bioinformatics- Boiler, Linux Operating System, Understanding and Using Biological Databases, Java clients, CORBA, Introduction to biostatics	30 Hours	CO2
3	**Nucleotide sequence data** Genome, Genomic sequencing, expressed sequence tags, gene expression, transcription factor binding sites and single nucleotide polymorphism. Computational representations of molecular biological data storage techniques: databases (flat, relational and object oriented), and controlled vocabularies,	30 Hours	CO3, CO4

	general data retrieval techniques: indices, Boolean search, fuzzy search and neighboring, application to biological data warehouses. **Biological data types and their special requirements** Sequences, macromolecular structures, chemical compounds, generic variability and its connection to clinical data, representation of patterns and relationships: alignments, regular expressions, hierarchies and graphical models.		

Suggested Readings

1. O'Reilly, " Developing Bio informatics computer skills", Indian Edition's Publication,2019
2. Rastogi, Mendiratta, Rastogi, "Bioinformatics concepts, skills & Applications", CBS Publishers,2020
3. "Bioinformatics", Addison Wesley,2021

Online Resources

1. https://nptel.ac.in/courses/102103044
2. https://nptel.ac.in/courses/102106065

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO1 2**	**PSO1**	**PSO2**
CO1	**2**	**2**	**1**		**2**								**2**	**1**
CO2	**1**	**2**	**3**	**2**	**2**							**1**	**1**	**2**
CO3	**2**		**3**	**3**	**2**							**2**	**2**	**3**
CO4	**1**	**1**	**2**	**2**	**2**							**2**	**2**	**2**

Program	B. Tech CSE (AI)				
Year	IV	**Semester**	VIII		
Course Name	Cloud Computing				
Code	NPEC43941				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of network	3	0	0	3
Course Objectives	**1.** To understand the concepts of Cloud Computing. **2.** To learn Cloud Computing Architecture. **3.** To learn Taxonomy of Virtualization Techniques. **4.** To acquire knowledge on Cloud Deployment models.				
Course Outcomes					
CO1	Understand the concept of virtualization and how this has enabled the development of Cloud Computing.				
CO2	To analyze fundamentals of cloud, cloud Architectures and types of services in cloud.				
CO3	To evaluate and Understand scaling, cloud security and disaster management				
CO4	To apply to explore some important cloud computing driven commercial systems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Origins of Cloud computing, Cloud components, Evolution of Cloud Computing, Characteristics of Cloud Computing, Underlying Principles of Parallel and Distributed Computing, driving factors towards cloud, Architecture, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services, Service Models: IaaS, PaaS, SaaS, NaaS, Cloud Clients, Comparing cloud providers with traditional IT service providers.	30 Hours	CO1
2	Introduction, Cloud Reference Model, Architecture, Infrastructure Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges, Cloud Interoperability and Standards, Scalability and Fault Tolerance. Cloud deployment model: Public clouds, Private clouds, Community clouds, Hybrid clouds, advantages of Cloud computing.Inter Cloud Resource Management, Resource Provisioning and Resource Provisioning Methods Global Exchange of Cloud Resources, Security Overview, Cloud Security Challenges, Software-as-a-Service Security, Security Governance, Virtual Machine Security, IAM, Security Standards.	30 Hours	CO2
3	Hadoop, MapReduce, Virtual Box, Google App Engine, Programming Environment for Google App Engine, Open Stack, Federation in the Cloud, Four Levels of Federation, Federated Services and Applications, Future of Federation. Scientific Applications: Health care, Geoscience and Biology. Business and Consumer Applications- CRM and ERP, Social Networking, Media Applications and Multiplayer Online Gaming.	30 Hours	CO3,CO 4

Suggested Readings

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers,2012.
2. Ritting house, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security, CRC Press,2017
3. George Reese Cloud Application Architectures, First Edition, O"Reilly Media 2009.
4. Cloud Computing 2nd Edition by Dr. Kumar Saurabh from Wiley India 2012.
5. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
6. Cloud computing for dummies- Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper, Wiley Publishing, Inc,2010

Online Resources

1. https://onlinecourses.nptel.ac.in/noc21_cs14/preview

2. https://archive.nptel.ac.in/courses/106/105/106105167

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO 7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**2**	**1**		**1**								**2**	**2**
CO2	**2**	**3**	**2**	**2**								**2**	**3**	**3**
CO3	**1**	**2**	**1**	**1**	**2**							**1**	**3**	**3**
CO4	**2**	**1**	**3**	**1**									**3**	**3**

Program	B.Tech. CSE(AI)				
Year	IV	**Semester**		VIII	
Course Name	Data Mining and Ware Housing				
Code	NPEC43942				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	DBMS	3	0	0	3
Course Objectives	**1.** To introduce the concept of data mining with in detail coverage of basic tasks, metrics, issues, and implication. **2.** Understand and implement classical models and algorithms in data warehouses and data mining **3.** To introduce the concept of data warehousing with special emphasis on architecture and design. **4.** Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.				
Course Outcomes					
CO1	Understand the functionality of the various data mining and data warehousing components.				
CO2	To analyze Appreciate the strengths and limitations of various data mining and data warehousing models.				
CO3	To evaluate andExplain the analysing techniques of various data. Describe different methodologies used in data mining and data warehousing.				
CO4	To apply Compare different approaches of data warehouse and data mining with various technologies.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Data Mining:** Introduction, What is Data Mining, Definition, KDD, Challenges, Data Mining Tasks, Data Preprocessing- Data Cleaning, Missing Data, Dimensionality Reduction, Feature Subset Selection, Discretization and Binarization, Data Transformation; Measures of similarity and dissimilarity-Basics.	30Hours	CO1
2	**Data Warehouse and OLAP technology:** Introduction to Data Warehouse, Differences between operational database systems and data Warehouse, Data Warehouse characteristics, Data Warehouse Architecture and its components, Extraction-Transformation-Loading, Logica (Multi-Dimensional), Data Modelling, Schema Design, star and snow-Flake Schema, Fact Constellation, Fact Table, Fully Addictive, Semi-Addictive, Non-Additive Measures; Factless-Facts, Dimension Table characteristics; Factless-Facts, Dimension Table characteristics; OLAP cube,OLAP Operations, OLAP Server Architecture- ROLAP, MOLAP and HOLAP.	30Hours	CO2
3	**Association Rules:** Problem Definition, Frequent Item Set Generation, The APRIORI Principle, Support and Confidence Measures, Association Rule Generation, APRIORI Algorithm, The Partition Algorithms, FP- Growth Algorithms, Compact Representation of Frequent Item Set-Maximal Frequent Item Set. **Classification and prediction:** What is Classification	30Hours	CO3, CO4

	&Prediction , Issues regarding Classification and prediction, Decision tree, Bayesian Classification,Classification by Back propagation, Multilayer feed-forward Neura Network, Back propagation Algorithm, Classification methods ,K nearest neighbor classifiers, Genetic Algorithm, Cluster Analysis ,Data types in cluster analysis, Categories of clustering methods, Partitioning methods, Hierarchical Clustering-,CURE and Chameleon, Density Based Methods-DBSCAN, OPTICS, Grid Based Methods-STING,CLIQUE.		

Suggested Readings

1. Data Mining-Concepts and Techniques- Jiawei Han, Micheline Kamber,Morgan Kaufmann Publishers, Elsevier, 2 Edition,2006.
2. Introduction to Data Mining, Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Pearson Education,2016
3. Data Mining Techniques, Arun K Pujari, 3rd Edition, Universities Press,2013
4. Data Ware Housing Fundamentals, PualrajPonnaiah, Wiley StudentEdition,2010
5. The Data Ware House Life Cycle Toolkit- Ralph Kimball, Wiley StudentEdition,2008

Online Resources

1. https://onlinecourses.swayam2.ac.in/cec19_cs01/preview
2. https://nptel.ac.in/courses/106105174

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO7**	**PO8**	**PO9**	**PO1 0**	**PO11**	**PO1 2**	**PSO1**	**PSO2**
CO1	3	1	2	1	2								2	2
CO2	1	3	2	2	1								1	2
CO3		3	2	1	2								2	2
CO4	2		2	1	2								2	3

Program	B. Tech CSE(AI)				
Year	IV	**Semester**		VIII	
Course Name	Introduction to Drones				
Code	NPEC43943				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of sensors	3	0	0	3
Course Objectives	1. To develop an overall understanding of UAS history, UAS types, and civilian small UAS applications 2. To develop a firm understanding of UAS operational safety and rule-compliance requirements 3. To understand basic UAS elements 4. To obtain a basic knowledge of UAS aerodynamics and flight dynamics				
Course Outcomes					
CO1	To be able to understand typical civilian low-cost UAS systems.				
CO2	To analyze and comply FAA regulations on small UAS operations.				
CO3	To evaluate integrate of typical mission sensors in typical civilian low cost UAS systems.				
CO4	To be able to apply to create UAS related engineering practice/service or to join UAS work force.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamentals of Flights:-** Introductions , Understanding geospatial technology, UAS platform overview, UAS flight demo, FAA regulations, UAS safety , Flight checklists, Roles and responsibilities of personnel involved in flight operations, Different types of flight vehicles, Components and functions of an airplane, Forces acting on Airplane, Physical properties and structure of the atmosphere, Aerodynamics, Airfoil nomenclature, aero foil characteristics, Angle of attack, Mach number, Lift and Drag - Propulsion and air plane structures.	30Hours	CO1
2	**Unmanned Aerial Vehicle:-**Difference between aircraft and UAV, Parts and functions of Fixed, Rotorcraft and flapping wing UAV-various History of UAV's, Types of Drones, Applications and Uses. Characteristics of Multi rotor vehicle, Fixed Wing vehicle, Flapping wing Vehicles and their applications, Defence, Civil, Environmental monitoring (physical, chemical and biological).	30Hours	CO2
3	**Payloads For UAV:-**Payloads, Classification of Payloads, camera, sensors, radars, various measuring devices ,classification of payload based on applications , Hyper spectral sensors ,laser detection and range , synthetic aperture radar, thermal cameras ,ultra sonic detectors ,case study on pay loads. **Launch and Recovery:-**Launching systems, UAV Launch Methods for Fixed, Wing Vehicles, Vertical Takeoff and Landing UAV Launch, Recovery systems. **UAV Navigation And Guidance Systems:-** Navigation, Dead Reckoning, Inertial, Radio Navigation,	30Hours	CO3, CO4

	Satellite, Way point Navigation. Dijkstra's Algorithm, A-star Algorithm, UAV Guidance, Types of guidance, UAV communication systems, and Ground control station, Telemetry, UAS future.		

Suggested Readings

1. Andey Lennon "Basics of R/C model Aircraft design" Model airplane news publication, 2016.
2. Theory, Design, and Applications of Unmanned Aerial Vehicles- by A. R. Jha Ph.D. (Author), 2016.
3. Unmanned Aerial Vehicles- Editors: Valavanis, K., Vachtsevanos, George J. (Eds.), 2014.
4. Jane's Unmanned Aerial Vehicles and Targets -by Kenneth Munson (Editor), 2010.

Online Resources

1. https://nptel.ac.in/courses/101104073

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO 5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO1 2**	**PSO1**	**PSO2**
CO1	**3**	**2**	**1**	**2**	**2**								**2**	**1**
CO2		**3**	**2**	**1**	**1**								**1**	**2**
CO3	**1**	**1**	**2**	**1**	**2**								**1**	**1**
CO4	**2**	**2**	**1**	**3**	**1**								**2**	**2**

Program	B. Tech CSE(AI)				
Year	IV	**Semester**	VIII		
Course Name	Computer Forensics				
Code	NPEC43944				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of operating system	3	0	0	3
Course Objectives	**1.** To know computer forensics and its issues, resources to forensics the data. **2.** To understand the file logs, event file logs, working of the files system. **3.** To understand the importance of identification of evidence with their impact, file recovery process. **4.** To understand the application of various computer forensics techniques in different areas.				
Course Outcomes					
CO1	To Understand proper documentation over the forensics analysis process.				
CO2	To analyze the representation and organization of data and metadata in modern computers.				
CO3	To evaluate working process of Windows and Linux file systems and its application.				
CO4	To apply tool recover deleted files, extract hidden data, and also create disk images.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction toComputer Forensics**: Computer Forensics, history of computer forensics, Types of Computer Forensics Technology, resources required to develop computer forensics, Computer Investigation. **Computer Forensics System**: Window and artefact Window File system system-File allocation, File allocation table, Registry, Event logs, Executable Window, prefetch file. Linux Systems and artefacts Linux Systems: Linux File Systems, File System Layer, Metadata Layer, Data Unit Layer, Journal Tools, Deleted Data, Linux Logical Volume Manager, Linux Boot Process and Services, Linux System Organization and Artefacts, Partitioning, File system Hierarchy	30 Hours	CO1, CO2
2	**Computer Forensics Analysis:** Evidence Identification, Data Seizure, Replication and avoiding of evidence, Digital image verification and authentication, Reconstruction of Past Evidence- fighting against macro threats, Information safety, Network Forensics and investigating logs, network Intrusion and crime, Network Traffic investigation, Tactics of military-terrorist and private company; Forensics Identification and Analysis of surveillance Devices.	30 Hours	CO3
3	**Computer Forensics Technology:** Need of evaluation Tools, Operation performed by Techniques, Types of Computer Forensics Techniques- Software techniques, Command Line techniques, Unix/Linux Techniques, GUI based techniques, Hardware based Techniques- Forensics Workstation, Write Blocker,	30 Hours	CO4

	Comparison of Techniques; Cyber Forensics techniques and Case study.		

Suggested Readings

1. Cory Altheide, Harlan Carvey, Digital Forensics with Open Source Tools, Syngress imprint of Elsevier.
2. Bill Nelson, Amelia Phillips, Christopher Steuart, "Guide to Computer Forensics and Investigations", Fourth Edition, Course Technology.
3. MariE-Helen Maras, "Computer Forensics: Cyber criminals, Laws, and Evidence", Jones & Bartlett Learning; 2nd Edition,2014.

Online Resources

1. https://onlinecourses.swayam2.ac.in/cec20_lb06/preview

2. https://nptel.ac.in/courses/106106178

Course Articulation Matrix														
PO-PSO	**PO1**	**PO 2**	**PO3**	**PO4**	**PO 5**	**PO6**	**PO7**	**PO8**	**PO 9**	**PO10**	**PO11**	**PO1 2**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	1	1									2	1
CO2	1	3	1		2									2	1
CO3	2	1	2	1	2									1	2
CO4	1	2	3	2	1									1	2

Program	**B.Tech**				
Year	**IV**	**Semester**		**VIII**	
Course Name	**Disaster Management**				
Code	**OE33101**				
Course Type	Theory	**L**	**T**	**P**	**Credit**
Pre-Requisite	Environmental Studies, Chemistry	**4**	**0**	**0**	**4**
Course Objectives	**1.** Study about basic concept of environmental chemistry. **2.** Learn about the various parameters of water and wastewater. **3.** How to examine microbial contamination of water. **4.** Study about the different – phases of microbial growth.				
Course Outcomes					
CO1	**1.** Introduction to the basic principles of environmental chemistry.				
CO2	**2.** Detailed knowledge of different parameter of water and wastewater.				
CO3	**3.** To know the thermodynamics microbial system.				
CO4	**4.** Know the aerobic and anaerobic process involved in the water and Wastewater.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction** Concept of Environmental Hazards, Environmental stress & Environmental Disasters. Types of Environmental hazards & Disasters: Natural hazards and Disasters, Volcanic Hazards/ Disasters, - Causes and distribution of Volcanoes, - Hazardous effects of volcanic eruptions, - Environmental impacts of volcanic eruptions, Earthquake Hazards/ disasters, - Causes of Earthquakes, - Distribution of earthquakes, - Flood control measures (Human adjustment, perception & mitigation), Droughts: - Impacts of droughts, - Drought hazards in India, - Drought control measures.	30 hrs.	CO1
2	**Mechanics & forms of Soil Erosion** Factors & causes of Soil Erosion, Conservation measures of Soil Erosion, Chemical hazards/ disasters-- Release of toxic chemicals, nuclear explosion, Sedimentation processes, - Global Sedimentation problems, Regional Sedimentation problems, Sedimentation & Environmental problems, Corrective measures of 23 Erosion & Sedimentation, Biological hazards / disasters, Population Explosion	30 hrs.	CO2
3	**Stages** Pre- disaster stage (preparedness)- Preparing hazard zonation maps, Predictability/ forecasting & warning, Preparing disaster preparedness plan, Land use zoning, Pre-disaster stage (mitigation) Disaster resistant house construction, Population reduction in vulnerable areas, Awareness . Emergency Stage:- Rescue training for search & operation at national & regional level, Immediate relief, and Assessment surveys. Post Disaster	30 hrs.	CO3

	stage, Rehabilitation- Political Administrative Aspect		
4	**Relief Measures** Provision of Immediate relief measures to disaster affected people, Prediction of Hazards & Disasters, Measures of adjustment to natural hazards Mitigation discuss the work of following Institution, Meteorological observatory, Seismological observatory, Hydrology Laboratory, Industrial Safety inspectorate, Institution of urban & regional planners, Chambers of Architects, Engineering Council, National Standards Committee, Integrated Planning Contingency management Preparedness Education on disasters, Community involvement, The adjustment of Human Population to Natural hazards & disasters	30 hrs.	CO4

Suggested Readings

1. Singh. Savinder, "Environmental Geography", Prayag Pustak Bhawan.
2. Sharma V.K., "(Ed) Disaster Management", IIPA Publication New Delhi.

Online Resources

1. https://nptel.ac.in/courses/124107010

2. https://www.youtube.com/watch?v=Eh8dAmiJ-fo

Course Articulation Matrix														
PO-PSO	**PO1**	**PO 2**	**PO3**	**PO4**	**PO 5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO2**
CO1	**3**	**2**		**2**		**2**	**2**					**2**		
CO2	**3**	**2**		**2**		**2**	**2**					**2**		
CO3	**3**	**2**		**2**		**2**	**2**					**2**		
CO4	**3**	**2**		**2**		**2**	**2**					**2**		

Program	B.Tech				
Year	IV	**Semester**	VII		
Course Name	NON-CONVENTIONAL ENERGY RESOURCES				
Code	OE43302				
Course Type	OE	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of Engineering	3	1	0	4
Course Objectives	1. To develop a strong foundation in the field of Non-Conventional energy resources. 2. The subject gives the knowledge about different forms of Non-Conventional energy.				
Course Outcomes					
CO1	To understand about Non-Conventional energy resources.				
CO2	Evaluate solar energy, make use of it, and understand the principals involved in gathering solar energy and converting it into electricity.				
CO3	Study the components, kinds, and performance of the wind energy conversion system to gain an understanding of the topics involved.				
CO4	To understand about examples of ocean energy and describe the practical ways to use it.				

Module	Course Contents	Contact Hrs.	Mapped CO
I	**Introduction:** Indian and global energy sources, Energy exploited, Energy planning, Introduction to various sources of energy, Solar thermal, Photovoltaic, Water power, wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy. Solar radiations: Extra-terrestrial radiation, Spectral distribution, Solar constant, Solar radiations on earth, Measurement of solar radiations, Solar radiation geometry, flux on a plane surface, latitude, declination angle, surface azimuth angle, hour angle, Zenith angle, solar altitude angle expression for angle between incident beam and the normal to a plane surface (no derivation), Local apparent time, Apparent motion of sun, Day length.	30 Hours	CO1
II	**Solar energy:** Solar thermal power and its conversion, Solar collectors, Flat plat, Concentric collectors, Cylindrical collectors, Thermal analysis of solar collectors. Solar energy storage, Different systems, solar pond. Applications, Water heating, Space heating & cooling, Solar distillation, solar pumping, solar cooking, Greenhouses, Solar power plants. **Biogas:** Photosynthesis, Bio gas production Aerobic and anaerobic bio-conversion process, Raw materials, Properties of bio gas, Transportation of bio gas, bio gas plant technology & status, Community biogas plants, Problems involved in bio gas production, Bio gas applications, Biomass conversion techniques, Energy plantation, Fuel	30 Hours	CO2

	properties.		
III	**Wind energy:** Properties of wind, Availability of wind energy in India, wind Velocity, win machine fundamentals, Types of wind machines and their characteristics, Horizontal and Vertical axis wind mills, Elementary design principles, Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Selection of a wind mill, Economic issues, Recent development. **Electrochemical effects and fuel cells:** Revisable cells, Ideal fuel cells, other types of fuel cells, Efficiency of cells, Thermions systems. **Tidal power:** Tides and waves as sources of energy, Fundamentals of tidal power, Use of tidal energy Limitations of tidal energy conversion systems. **Hydrogen Energy:** Properties of hydrogen in respect of its use as source of renewable energy, Sources of hydrogen, Production of hydrogen, Storage and transportation, Problems with hydrogen as fuel.	30 Hours	CO3
IV	**Thermoelectric systems:** Kelvin relations, power generation, Properties of thermoelectric materials, Fusion Plasma generators. **Geothermal energy:** Hot springs, Steam ejection, Principal of working, types of geothermal station with schematic representation, Site selection for geothermal power plants. Advanced concepts Problems associated with geothermal conversion. **Ocean energy:** Principal of ocean thermal energy conversion, Power plants based on ocean energy, problems associated with ocean thermal energy conversion systems.	30 Hours	CO4

Suggested Readings

1. 'Renewable energy sources and conversion technology' by Bansal Keemann, Meliss," Tata McGraw Hill.
2. 'Non-Conventional energy Sources' by Rai G.D, Khanna Publishers.
3. 'Non-conventional Energy' by Ashok V. Desai, New Age International Publishers Ltd.

Online Resources

1. NPTEL (SWAYAM)
   https://archive.nptel.ac.in/courses/121/106/121106014/

2. IEEE Papers

A. Ashwin Kumar, "A study on renewable energy resources in India," *2010 International Conference on Environmental Engineering and Applications*, Singapore, 2010, pp. 49-53, doi: 10.1109/ICEEA.2010.5596088.

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**3**	**2**	**3**	**2**	**3**							**2**	**2**
CO2	**3**	**3**	**2**	**3**	**3**	**3**							**1**	**2**
CO3	**2**	**2**	**3**	**2**	**3**	**2**							**2**	**1**
CO4	**3**	**2**	**3**	**2**	**3**	**2**							**2**	**1**

Program	B. Tech				
Year	IV	**Semester**	VIII		
Course Name	Quality Management				
Code	OE43501				
Course Type	OE	**L**	**T**	**P**	**Credit**
Pre-Requisite	Intermediate School Education	3	1	0	4
Course Objectives	1. To have knowledge of Quality concept & Quality Management. 2. To be aware about the importance Quality Management. 3. To have knowledge about Control charts. 4. To have knowledge of ISO 9000 series.				
Course Outcomes					
CO1	Know the importance of Quality Management Tools and their applications.				
CO2	Increase the productivity and efficiency of organization with the help of Quality Management Tools.				
CO3	Can develop new types Quality Management Techniques.				
CO4	Apply Taguchi method & JIT method for various applications.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Quality Concepts:** Evolution of Quality control, Concept change, TQM Modern concept, Quality concept in design, Review off design, Evolution of prototype. **Control on Purchased Product:** Procurement of various products, Evaluation of supplies, Capacity verification, Development of sources, Procurement procedure. **Manufacturing Quality:** Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims.	30 Hours	CO1
2	**Quality Management:** Organization structure and design, Quality function, Decentralization, Designing and fitting organization for different types products, Economics of quality value and contribution, Quality cost, Optimizing quality cost. **Human Factor in Quality:** Attitude of top management, Co-operation, of groups, Operators attitude, responsibility, Causes of operator's error and corrective methods.	30 Hours	CO2
3	**Control Charts:** Theory of control charts, Measurement range, Construction and analysis of R charts, Process capability study, Use of control charts. **Attributes of Control Charts:** Defects, Construction and analysis off-chart, Improvement by control chart, Variable sample size, Construction and analysis of C-chart.	30 Hours	CO3
4	**Defects Diagnosis and Prevention:** Defect study, Identification and analysis of defects,	30 Hours	CO4

	Corrective measure, Factors affecting reliability, MTTF, Calculation of reliability, Building reliability in the product, Evaluation of reliability, Interpretation of test results, Reliability control, Maintainability, Zero defects, quality circle. **IS0-9000anditsconceptofQualityManagement:** ISO9000series, Taguchi method, JIT in some details		

Suggested Readings

1. Concurrent Engineering Kusiak John Wiley.

2. Concurrent Engineering Menon Chapman & hall.

3. Quality Control & Reliability Analysis – Bijendra Singh, Khanna Publications

Online Resources

1. https://archive.nptel.ac.in/courses/110/104/110104080/

2. https://nptel.ac.in/courses/110104085

Course Articulation Matrix

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1		2	2				1		2	2			
CO2	2	2	1	3	2				2	1	2	2			
CO3	2	3	1	1	3						1	2			
CO4	3	3	3	3	3				1		1	2			

Program	**B. Tech**				
Year	**IV**	**Semester**		**VIII**	
Course Name	**Concepts of Climate Smart Agriculture**				
Code	OE43102				
Course Type	Theory	**L**	**T**	**P**	**Credit**
Pre-Requisite	Environmental Studies, Disaster Management	**3**	**1**	**0**	**4**
Course Objectives	1. To give knowledge about meteorology, atmosphere, and climate smart agriculture. 2. To give knowledge about soil formation and its physicochemical properties. 3. To know about climate change and its possible impacts. 4. To know about climate challenges and water management.				
Course Outcomes					
CO1	1. To know about meteorology, atmosphere, and climate smart agriculture.				
CO2	2. To understand soil formation and its physicochemical properties.				
CO3	3. To know climate change and its possible impacts.				
CO4	4. To know challenges due to climate change and water management.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Climate relations** Meteorology and atmosphere, structure and composition of atmosphere, atmospheric inputs (acid rain, dust), water-soil-plant relations, pollution in the environment and its effects on human, plant and soil, climate smart agriculture and greenhouse gases.	30 hrs.	CO1
2	**Soil formation and its physicochemical properties** Soil forming rocks and minerals, their classification and composition, important soil physical properties; and their importance; soil particle distribution; soil organic matter – its composition and decomposition, effect on soil fertility; soil reaction – acid, saline and sodic soils. Soil nutrients, Influence of physicochemical properties of soil on plant health. Effects of macro and micro nutrients on plant growth.	30 hrs.	CO2
3	**Climate change and its possible impacts** Historical examples of crop failure, reasons, and its social consequences, need and strategy of development of climate smart crop, successful examples of climate smart crops, effects of climate on crops, crop growth and development in relation to environmental stress -water and temperature stress, nutrient stress and resistance mechanism.	30 hrs.	CO3
4	**Challenges due to climate change and water management** Challenges arising out of climate change and case studies (e.g., cultivating Durum wheat in Ethiopia and its mitigation). Advances of crop water management for climate smart crop production, examples of case studies. Rain water harvesting, organic farming, and use of high-quality varieties of crops.	30 hrs.	CO4

Suggested Readings

1. Manohar, K.R. and Iga Thinathane. C. Green House Technology and Management, B.S.Publications, Hyderabad.
2. Benkeblia Noureddine (Ed) (2020) Climate Change and Crop Production: Foundations for Agroecosystem Resilience; CRC Press
3. Hebbar, KB, Naresh Kumar, S. and Chowdappa, P. (2017). Impact of Climate Change on Plantation Crops (Eds). P 260. Astrel International –Daya Publishing House, New Delhi, India, ISBN: 9789351248330.
4. Brady, N. E., The Nature and Properties of Soils, MacMillan Publishing Co., INC., 1984.
5. Bohn, H. L., McNeal, B. L., O'Connor, G. A., Soil Chemistry, John Wiley and Sons, New York, 1979.
6. M.M. Rai, Principles of Soil Science, 4th ed., Macmillan India Limited, Delhi, 2002.
7. Henry D. Foth and Boyd G. Ellis, Soil Fertility, 2nd edition, Lewis Publishers, New York, 1997.

Online Resources

1. L. Molley, The Chemical Nature of Soils. In: Soils, Ontario Forestry Association, 2011, Available: http://www.ontarioenvirothon.on.ca/files/soil/soil_Chapter4.pdf
2. U.M. Sainju, R. Dris and B. Singh, Mineral Nutrition of Tomato, 2003, Available: www.aseanfood.info/Articles/11019991.pdf.
3. Making climate-smart agriculture work for the poor (www.worldagroforestry.org/publication/making-climate-smart-agriculture-work-poor
4.

Course Articulation Matrix														
PO-PSO	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2		2	2					2		
CO2	3	2	2	2		2	2					2		
CO3	3	2	2	2		2	2					2		
CO4	3	2	2	2		2	2					2		