BABU BANARASI DAS UNIVERSITY

School of Engineering

(School Code: 04)

Department of Computer Science and Engineering

(University Branch Code: 38)

Bachelor of Technology: Computer Science and Engineering (Cloud Computing and Machine Learning)

(in association with IBM)

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
Students need to select either GROUP 'A' or GROUP 'B'									
	NGP4101	General Proficiency				100		100	1
Total			3	1	0	140	60	200	5

GROUP 'A'

Course Category	Course Code	Code Title	Contact			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	NCCML4101	Introduction to Python Programming and	3	0	0	40	60	100	3
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	NCCML4151	Python Programming and Clean Coding	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			15	21	8	360	540	900	1

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
ESC	NCCML4102	Introduction to Java Programming	3	0	0	40	60	100	3
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
ESC	NCCML4152	Java Programming 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			14	3	8	360	540	900	21

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

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
Students need to select either GROUP 'A' or GROUP 'B'									
	NGP4201	General Proficiency				100		100	1
Total			3	1	0	140	60	200	5

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	NCCML4201	Introduction to Python Programming and Clean Coding	3	0	0	40	60	100	3
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	NCCML4251	Python Programming and Clean Coding 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			15	2	8	360	540	900	21

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
ESC	NCCML4202	Introduction to Java Programming	3	0	0	40	60	100	3
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
ESC	NCCML4252	Java Programming 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			14	3	8	360	540	900	21

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	NCS4301	Discrete Mathematics	3	0	0	40	60	100	3
PCC	NCCML4301	Fundamentals of Data Science	2	1	0	40	60	100	3
PCC	NCS4302	Operating Systems	3	1	0	40	60	100	4
PCC	NCS4305	C Programming	3	1	0	40	60	100	4
PCC	NCCML4351	Data Science Lab	0	0	2	40	60	100	1
PCC	NCS4355	C Programming Lab	0	0	2	40	60	100	1
CQAC	NCC4351	NSS/YOGA*	0	0	2	100	-	100	1
	NGP4301	General Proficiency	-	-	-	100	-	100	1
Total			**16**	**4**	**6**	**520**	**480**	**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	NCS4401	Database Management Systems	3	1	0	40	60	100	**4**
PCC	NCS4403	Data Structure Using 'C'	3	1	0	40	60	100	**4**
PCC	NCS4404	Big Data Analytics & Architecture	3	0	0	40	60	100	**3**
PCC	NCCML4401	DevOps	3	0	0	40	60	100	**3**
PCC	NCS4451	Database Management Systems Lab	0	0	2	40	60	100	**1**
PCC	NCCML4451	DevOps Lab	0	0	2	40	60	100	**1**
PCC	NCS4453	Data Structure Lab	0	0	2	40	60	100	**1**
CQAC	NVC4401	Indian Constitution*	1	0	0	40	60	100	**1**
	NGP4401	General Proficiency	-	-	-	100	-	100	**1**
* Compulsory Qualifying Audit Course									
Total			**17**	**3**	**6**	**500**	**600**	**1100**	**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	NCCML4501	Predictive Analytics	3	1	0	40	60	**100**	**4**
PCC	NCCML4502	Cloud Computing	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	NCCML4551	Predictive Analytics Lab	0	0	2	40	60	**100**	**1**
PCC	NCCML4552	Cloud Computing Lab	0	0	2	40	60	**100**	**1**
SPIC	NCCML4553	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			**16**	**2**	**6**	**520**	**480**	**1000**	**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**
PCC	NCCML4601	Machine Learning	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-I**	3	0	0	40	60	**100**	**3**
PCC	NCCML4651	Machine Learning Lab	0	0	2	40	60	**100**	**1**
PCC	NCS4652	Algorithms Lab	0	0	2	40	60	**100**	**1**
SPIC	NCCML4651	Seminar	0	0	2	100	0	**100**	**1**
SPIC	NCCCML4653	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	NCCML4701	Concepts of Deep Learning	3	1	0	40	60	**100**	**4**
PEC	-	**Professional Elective Course II**	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	NCCML4751	Deep Learning Lab	0	0	2	40	60	**100**	**1**
SPIC	NCCML4753	Major Project I	0	0	4	100	0	**100**	**2**
SPIC	NCCML4754	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	NCCML4801	Digital Image Processing	**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	NCCML4853	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
NPEC43811	Deployment of Private Cloud
NPEC43812	Cloud Native
NPEC43813	Evolutionary Algorithms
NPEC43814	Internet of Things

Course Code	Professional Elective Course II
NPEC43821	Network Security and Cryptography
NPEC43822	Cloud Security
NPEC43823	Robotics
NPEC43824	Fuzzy Logic

Course Code	Professional Elective Course III
NPEC43831	Artificial Neural Network
NPEC43832	Computer Vision
NPEC43833	Data Visualization and Statistics
NPEC43834	No SQL and MongoDB

Course Code	Professional Elective Course IV
NPEC43841	Essentials of Blockchain Technology
NPEC43842	Data Compression
NPEC43843	Bioinformatics
NPEC43844	Pattern Recognition

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(CCML)				
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(CCML)				
Year	I	**Semester**		I or II	
Course Name	Introduction to Python Programming and Clean Coding				
Code	NCCML4101/ NCCML4201				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Programming Skills	3	0	0	3
Course Objectives	**1.** To understand why Python is a useful scripting language for developers. **2.** To learn how to design and program Python applications **3.** To learn how to use lists, tuples, and dictionaries in Python programs **4.** To learn how to identify Python object types				
Course Outcomes					
CO1	Understand the Writing of loops and decision statements in Python.				
CO2	Analyze and Build package of Python modules for reusability.				
CO3	Evaluate the concepts of Data handling and use cases diagrams.				
CO4	Apply a prototype file systems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Clean Code** What is Bad Code? What is Clean Code? Purpose of Clean Code Thought of experienced programmers, Meaningful Names Intention Revealing Names, Make Meaningful Distinctions, Use Pronounceable Names Avoid Encodings and Mental Mappings, Difference between smart and professional programmer, Class and Method Names Function Size Matters, Blocks and Indenting, Do only one thing within a function, One level of abstraction per function, Use Descriptive Names, Function Arguments, Advantages of Having Less Arguments, Command Query Separation, Prefer Exceptions to Returning Error Codes, Extract Try/Catch Blocks, Error Handling Is One Thing	30 Hours	CO1
2	**Introduction to Python:** What is Python?, Advantages and disadvantages, Downloading and installing, Which version of Python, Running Python Scripts, Using the interpreter interactively, Using variables, String types: normal, raw and Unicode, String operators and expressions, Math operators and expressions, Writing to the screen, Reading from the keyboard, Indenting is significant, The if and elif statements, While Loops, Using List, Dictionaries, Using the for statement, Opening, reading and writing a text file, Using Pandas, the python data analysis library and data frames, Grouping, aggregating and applying, merging and joining, Dealing with syntax errors, Exceptions, Handling exceptions with try/except	30 Hours	CO2
3	**Data Handling and Use Cases:** RE Pattern Matching, Parsing Data, Introduction to Regression, Types of Regression, Use Cases, Exploratory data analysis, Correlation Matrix, Visualization using Matplotlib, Implementing linear regression **Advance Concepts:** Machine Learning – Algorithm, Algorithms – Random forest, Suppport vector Machine, Random Forest, Build your own model in python, Comparison between random forest and decision tree	30 Hours	CO3, CO4

Suggested Readings

1. Mark Lutz, Learning Python, O'Reilly Media, Edition: 5th
2. Johannes Ernesti & Peter Kaiser, Python 3, Rheinwerk Computing, Edition: 1st

Online Resources

1. https://archive.nptel.ac.in/courses/106/106/106106182/

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

Program	B. Tech CSE(CCML)				
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(CCML)				
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(CCML)				
Year	I	**Semester**	I or II		
Course Name	Python Programming and Clean Coding Lab				
Code	NCCML4151/NCCML4251				
Course Type	ESE	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basics of Python Programming	0	0	2	1
Course Objectives	**1.** To read and write simple Python programs. **2.** To develop Python programs with conditionals and loops. **3.** To define Python functions and to use Python data structures –- lists, tuples, dictionaries. **4.** To do input/output with files in Python.				
Course Outcomes					
CO1	Understand the concepts of Python Programming.				
CO2	Analyze the syntax and structures of Python Programming.				
CO3	Understanding the project based development.				
CO4	Apply the learning to get better understanding of Python Programming.				

Sr. No.	Course Contents	Mapped CO
1	Introduction to Python shell, running python script and declaring variables.	CO1
2	Programs to implement Control Statements (if, if-else, nested if-else, for loop, while loop, break statement, continue statement): a. Display table of number using for-loop statement. b. Find sum of Natural numbers from 1 to 10. c. Add digits of a number using while loop.	CO2
3	Programs to implement Functions, return statement, default argument, keyword arguments and scope of a variable in python.	CO1
4	Programs to implement various operations on Lists: a. Adding list b. Replicating list c. Deleting list d. List slicing e. Updating elements in list f. Appending elements g. Functions and methods in list	CO2
5	Programs to implement the concepts of File Handling: a. Read and write data from a file b. Illustrate append() mode c. Open the file in the read mode and use of for loop to print each line present in the file d. Show various ways to read and write data in a file e. Illustrate Append vs write mode	CO3
6	Programs to implement the functions of e library .	CO3
7	Program to introduce the basic functionalities of Matplotlib, the basic figure types and design them.	CO1
8	Write and perform the algorithm based on random forest.	CO4
9	Write and perform the algorithm based on super vector machine.	CO4
10	Write and perform the algorithm k-nearest neighbor algorithm.	CO4
11	**Project Statement** Desktop and games development project on python programming for students in a intermediate level python programming course	CO3,4

	are described. In these projects, students write their own programs to simulate various kinds of applications. Initially, beginners level programmed projects treat the basics of python using OOPS . Then this is followed by more advanced level projects using regular expression and various kind of Machine learning algorithm. The projects can be run on a typical laptop or desktop computer. Students will need to acquaint themselves with new tools and technologies while working on a python project. The more they learn about cutting-edge development tools, environments, libraries, the broader will be your scope for experimentation with their projects.	

Online Resource:

1. https://python-iitk.vlabs.ac.in/

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*	*3*	*2*	*3*	*2*								*3*	*2*
CO2	*2*	*2*	*3*	*3*	*3*								*2*	*3*
CO3	*2*	*1*	*2*	*3*	*2*								*3*	*3*
CO4	3	2	2	3	2								2	2

Program	B. Tech CSE(CCML)				
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(CCML)				
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	30 Hours	CO3

	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, 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.		
	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 or II		
Course Name	Introduction to Java Programming				
Code	NCCML4102 / NCCML4202				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basics of any Programming Language.	3	0	0	3
Course Objectives	**1.** To provide an overview of an desktop application development and web application development using Java **2.** To introduce the tools and frameworks required to build Java Enterprise Applications. **3.** To teach the fundamental techniques and principles in achieving the concepts of Object Oriented Programming. **4.** To enable students to have skills that will help them to solve complex real-world problems regarding Web, Desktop and Enterprise Application Development.				
Course Outcomes					
CO1	Understand the vision of Object Oriented Programming from industry context.				
CO2	To apply Object Oriented Programming using Java using java I.D.E.				
CO3	Analyzing multithreading programming of Java Language to create more robust and fast applications.				
CO4	To evaluate the application of Web Server and Application Server and how to deploy Web Applications.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction** Introduction to object-oriented programming, Object concepts, Key principles of object-oriented programming. **Introduction To Uml And Java Programming Language Development project life cycle. Introduction to UML -Static UML Diagrams:** Class, Object, Component, Deployment - Dynamic UML Diagrams – Use Case, Sequence, Activity, State Chart. Introduction to the Java programming language. Introduction to the Java development and Productivity tools. Object-oriented programming: Java syntax basics - Part 1, Java syntax basics - Part 2.	30 Hours	CO1
2	**Concepts Of Core Java** Writing simple Java code using the IDE, Building classes, Debug applications, Inheritance, Design patterns and refactoring, Interfaces, Collections, Generics, Threads and synchronization, Utility classes, Exceptions and exception handling, I/O and serialization. **Introduction To Enterprise Application Development** JavaBeans, Introduction to Java EE Web Component, Overview of Servlets, Java EE Container Services	30 Hours	CO2 CO3

	Overview, Servlet API, Overview of Java Server Pages, Java Server Pages Specification and Syntax.		
3	**Enterprise Application Development Create and Edit HTML and JSPs, Debugging Web Applications,** Web Archive Deployment Descriptor, Session State Storage Issues, Cookie API, HttpSession: Management of Application Data, URL Rewriting, Best Practices for Session Management, JSP Expression Language, JSP Custom Tags, JSP Tag Files. Create and Edit Servlets, Filters, and Listeners, XDoclet and Annotations, Connecting to a database, Web Application Security, Java EE 12 Packaging and Deployment, Best Practices for Server, Side Application Development. **PROJECT**	30 Hours	CO4

Suggested Readings

1. Patrick Naughton and HerbertzSchildt, "Java-2: The Complete Reference", TMH, 1999.
2. Bill Vanners, "Inside Java Virtual Machine", TMH, 2nd Ed.
3. Rick Dranell, "HTML 4 unleashed", Techmedia Publication, 2000
4. Shelley Powers, "Dynamic Web Publishing", 2nd Ed., Techmedia, 1998.
5. Paul Dietel and Harvey Deitel, "Java How to Program", PHI, 8th Ed., 2010
6. E. Balaguruswamy, "Programming with Java: A Primer", TMH, 1998.

Online Resources

1. https://www.youtube.com/@IITKharagpurJuly-is9ie

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	2		1									1		
CO2	2	2	2	1	2							1	2	2
CO3	2			2										2
CO4	2	2	3	3	2							1	2	

Program	B Tech CSE(CCML)				
Year	I	**Semester**	I/II		
Course Name	Basic 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 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(CCML)				
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(CCML)				
Year	I	**Semester**		I or II	
Course Name	Java Programming Lab				
Code	NCCML4152/ NCCML4252				
Course Type	ESC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basics of Java Programming	0	0	2	1
Course Objectives	**1.** To understand the basic concepts and fundamentals of platform independent object oriented language. **2.** To demonstrate skills in writing programs using exception handling techniques and multithreading. **3.** To understand streams and efficient user interface design techniques.				
Course Outcomes					
CO1	Understand the syntax and semantics of java programming language and basic concepts of OOP.				
CO2	Develop reusable programs using the concepts of inheritance, polymorphism, interfaces and packages.				
CO3	Apply the concepts of Multithreading and Exception handling to develop efficient and error free codes.				
CO4	Analyze event driven GUI and web related applications which mimic the real word scenarios.				

S. No.	List of Experiments	Mapped CO
1	Write a program to create a class Student2 along with two method getData(),printData() to get the value through argument and display the data in printData. Create the two objects s1, s2 to declare and access the values from class STtest.	CO1
2	Write a program using parameterized constructor with two parameters id and name. While creating the objects obj1 and obj2 passed two arguments so that this constructor gets invoked after creation of obj1 and obj2.	CO1
3	Write a program in JAVA to demonstrate the method and constructor overloading	CO1
4	Write a java program in which you will declare two interface sum and Add inherits these interface through class A1 and display their content.	CO2
5	Write a java program in which you will declare an abstract class Vehicle inherits this class from two classes car and truck using the method engine in both display “car has good engine” and “truck has bad engine”.	CO2
6	Write a Java Program to finds addition of two matrices.	CO3
7	Write a program in java if number is less than 10 and greater than 50 it generate the exception out of range. Else it displays the square of number	CO3
8	Write a servlet to connect Java Web application to MySQLl/ DB2 Server	CO4
9	Create a Login form in html and validated it on Server Side using Servlet.	CO4
10	Create a J.S.P Application to view all data of MySQL/ DB2 table on Web Page.	CO4
11	**Project Statement**	CO2,3

	Airline Reservation System in Java This Java project is used to book seats for airlinesThere will be a database to store the number of vacant seats, fight details, arrival and departure times, cities, and rates for each flight. As a beginner level project, you can exclude the option of payment processing. But, there should be one dummy model of payment processing and also to cancel the booking. **Online Air Ticket Reservation System in Java** To book tickets for an Airplane from your own place. There will be a local server to host the database of the system. All the details regarding the bus, schedules, arrival and departure time, available seats, the rate will be mentioned and the user has to book the ticket according to his requirements. **Inventory Management System in Java** This is also a core Java project for beginners can be implemented as a minor project to test and implement skills in Java. This system will manage all the available stocks in a shop or any business organization. We can make purchases, sell and view the current stock. I3t keeps a track of manufacture, sale, purchase, orders, and delivery of the products by maintaining a database. You can search the product and it will show the status and details of the product on the screen.	

Online Resources

1. https://java-iitd.vlabs.ac.in/

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

Program	B. Tech CSE(CCML)				
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(CCML)				
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(CCML)				
Year	II	**Semester**	III		
Course Name	Fundamentals of Data Science				
Code	NCCML4301				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Python Programming	2	1	0	3
Course Objectives	**1.** To provide an overview of an exciting field of Predictive Analytics. To introduce the tools and frameworks required to build Java Enterprise Applications. **2.** To introduce the tools required For Predictive Analytics. **3.** Review and explore data to look at data distributions and to identify data problems, including missing values. **4.** To enable students to have skills that will help them to solve complex real-world problems in decision support.				
Course Outcomes					
CO1	Understand and critically apply the concepts and methods of Business analytics.				
CO2	Building and creating advanced analytical models that leverage historical data to uncover real-time insights to predict future events.				
CO3	To evaluate the Model on the basis of different Predictive Methods.				
CO4	Applying and analyzing how to use functions, deal with missing values, use advanced field operations, handle sequence data and improve efficiency.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Analytics Overview** Definition of business Analytics with real time examples, Predictive analytics: Transforming data into future insights, Analytics trends: Past, Present & Future, Towards a Predictive enterprise. **Ibm Spss Modeler & Data Mining** What are Data Mining applications? Strategy for data mining: CRISP-DM, Identify nodes and streams, The framework of a Data – mining project, Brief the unit of analysis, Explain the type of dialog box.	30 Hours	CO1
2	**Unit Of Analysis** Concepts of Unit of analysis (Distinct, Aggregate, SetToFlag), Integrate data, CLEM Expression, Role of Relationship between two fields, Identifying the modeling objective. **Advanced Data Preparation With IBM Spss Modeler** Functions to enrich data, Method to transform data, Cross-record functions, Sampling, Partitioning and sampling data, Improving Efficiency.	30 Hours	CO2

3	**Predictive Analytics With IBM Watson Studio** IBM Watson Studio, Watson studio Components, Data preparation, Watson Machine learning, Data Refinery, Watson Studio Neural Network Modeler, IBM Watson Studio jobs, Use case with AutoAI. **Project** Predicting using IBM SPSS Modeler & IBM Watson with real Case studies.	30 Hours	CO3, CO4

Suggested Readings

1. IBM Courseware
2. Predictive Analytics Mesmerizing & fascinating by ERIC SIEGEL

Online Resources

1. https://www.youtube.com/@introductiontodataanalytic5681

2. https://www.youtube.com/@nptel-nociitm9240

Course Articulation Matrix														
PO-PSO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	2	1	2	1	1							1	1	2
CO2	2	1	2	1	1							1	1	2
CO3	1	2	1	2	1							2	1	2
CO4	1	2	2	2	2							1	2	1

Program	B. Tech CSE(CCML)				
Year	II	Semester	III		
Course Name	Operating Systems				
Code	NCS4302				
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(CCML)				
Year	II	Semester	III		
Course Name	C Programming				
Code	NCS4305				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Fundamentals of computer	3	1	0	4
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** Programming Environment, Concept of algorithm, Strategy for designing Algorithms, Top-down development, Stepwise refinement, Flowchart, Programming Languages, Assembler, Compiler, Interpreter, Systematic Development of Programs, Program Writing and execution, Introduction to the design and implementation of correct efficient and maintainable programs, Structured Programming Concept, Number System and Conversion Methods, Introduction to C language, Identifiers, Keywords, Constants and Variables in C, Storage classes, Fundamental Data types in C, Integer	30 Hours	CO1

	types, short, long. Unsigned Character types, single and double precision floating point.		
2	**Storage Classes, Operators and Control Statements** Storage Classes in C: Automatic, register, static, extern, Operators and Expressions in C: Arithmetic, Relational, Logical, Assignment, Bitwise, Conditional, Increment and Decrement, Special Operators such as comma, sizeof etc. Type Conversion in C, Operator Precedence and Associativity, Mixed mode operations, Standard Input/output functions: printf(),scanf(), getch(), getchar(), getche() etc. Conditional and Control Statements: if statement, if-else statement, nested if- else statement, else if ladder, switch statements, restrictions on switch values, Use of break and default statement with switch. Looping or Iteration: Uses of while, for and do-while loops, nesting of loops, use of break and continue statements.	30 Hours	CO2
3	**Arrays, Structures and Functions** Array, notation and representation, using one dimensional, two dimensional and multi-dimensional arrays, Arrays of unknown and varying size, Searching and sorting in arrays. Strings: String declaration and initialization, String manipulation. Structures: Purpose and use of structures, declaring and assigning of structures, accessing structure elements, Array of structures, Arrays within structures. Union: Utility of unions, Union of structures. Function Declaration, function Definition, function call, Passing values between functions, Global and local variables and their scope, Call by value and call by reference	30 Hours	CO3
4	**Pointers, Preprocessors and File Handling** Pointers: Understanding Pointers, Declaration and initialization of pointer variables, Accessing the address of the variable, Pointer arithmetic, Pointers and arrays. Dynamic Memory Allocation, Stack, Linked list, Recursion, Pointers to functions, Declaration of a pointer to a function, Initialization of function pointers, Calling a function using a function pointer, Passing a function to another function, How to return a function pointer. Standard C library functions: Math functions, String handling functions, The C preprocessor: preprocessor directives, defining and calling macros, conditional compilation, passing values to the compiler. File Handling in C: Types of files, Defining, opening and closing of a file, Input/output operations on files, Multiple file handling in C.	30 Hours	CO4

Suggested Readings

1. Let Us C By Yashwant P. Kanetkar.
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
6. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson Addison-Wesley, 2006

Online Resources

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

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

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**
CO 1	**1**	**2**	**1**		**2**								**1**	**2**
CO 2	**2**	**3**	**1**	**1**									**2**	**2**
CO 3	**1**	**3**	**2**	**2**	**2**								**1**	**2**
CO 4	**1**	**1**	**2**	**1**	**1**								**1**	**1**

Program	B. Tech. CSE(CCML)				
Year	II	**Semester**		III	
Course Name	Data Science Lab				
Code	NCCML4351				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Mathematics Python	0	0	2	1
Course Objectives	**1.** Building the fundamentals of data science. **2.** Imparting design thinking capability to build big-data **3.** Developing design skills of models for big data problems **4.** Gaining practical experience in programming tools for data sciences				
Course Outcomes					
CO1	Make use of the python libraries for data science				
CO2	Make use of the basic Statistical and Probability measures for data science. Lab Manual				
CO3	Perform descriptive analytics on the benchmark data sets.				
CO4	Perform correlation and regression analytics on standard data sets CS3361 Data Science Laboratory				

S. No.	List of Experiments	Mapped CO
1	Work with IBM SPSS Modeler.	CO1
2	Create a data-mining project to predict churn in telecommunications.	CO1
3	Understand the telecommunications data.	CO1
4	Set the unit of analysis for the telecommunications data.	CO2
5	Integrate telecommunications data	CO2
6	Predict churn in telecommunications and cluster customers into segments.	CO3
7	Use functions to cleanse and enrich telecommunications data	CO3
8	Improve efficiency with telecommunications data.	CO4
9	Analyzing data with Watson Studio.	CO4
10	Creating a machine learning model with IBM Watson Studio and the AutoAI tool	CO4
11	**Project Statement** • **Scenario:** A bank needs to reduce the risk that a loan is not paid back. • **Approach:** ➢ Use historical data to build a model for risk. ➢ Apply the model to customer or prospects who apply for a loan. A bank experiences problems with customers who do not pay back their loan, which costs the company a significant amount of money. To reduce the risk that loans are not paid back, the bank will use modeling techniques on its historical data to find groups of high-risk customers (high risk of not paying back the loan). If a model is found, then the bank will use that model to attach a risk score to those who apply for a loan. When the risk of not paying back the loan is too high, the loan will not be granted. The dataset includes demographic information and a field that indicates	CO2,3

	whether the customer has paid back the loan. Typically not all records will be used for modeling, but a sample will be drawn on which models are built. **A business case: A predictive model** ➢ Using one of the modeling techniques available in IBM SPSS Modeler, you can find patterns in the data. ➢ You can use the predictive model to attach a risk score to current customers or to those who apply for a loan. You can also have a decision rule in place to make a yes/no decision about whether an applicant will be granted the loan.	

Online Resources

1. https://www.iiitmk.ac.in/DAVirtalLab/#work

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

Program	B.Tech. CSE(CCML)				
Year	II	**Semester**		III	
Course Name	C Programming Lab				
Code	NCS4355				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of computer.	0	0	2	1
Course Objectives	**1.** To introduce students to the basic knowledge of programming fundamentals of C language. **2.** To impart writing skill of C programming to the students and solving problems. **3.** To impart the concepts like looping, array, functions, pointers, file, structure. **4.** Understand how to access and use library functions.				
Course Outcomes					
CO1	Understand and trace the execution of programs written in C language.				
CO2	Analyze the C code for a given algorithm..				
CO3	Evaluate Programs with pointers and arrays, perform pointer arithmetic, and use the pre-processor.				
CO4	Applying the basic concepts of pointer, file handling.				

S. No.	List of Experiments	Mapped CO
1	Creating simple C programs with debugging, compilation, execution.	CO1
2	C‘ programming on variables and expression assignment, simple arithmetic Loops, If-else, Case statements, break, continue, goto.	CO1
3	Implementing different operations on Single & Multidimensional arrays.	CO2
4	Implementing different String handling inbuilt and user defined functions.	CO2
5	Implementation of Functions, recursion, file handling in C.	CO2
6	Implementing different operations on Single & Multidimensional arrays.	CO3
7	Implement the Pointers, address operator, declaring pointers and operations on pointers in C.	CO3
8	Implement the Address of an array, structures, pointer to structure, dynamic memory allocation in C.	CO3
9	Implement the C program of 2‘s complement of a number.	CO4
10	Implement the pointers, address operator, declaring pointers and operations on pointers in C.	CO4

Online Resources

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

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	2									1	
CO 2	3	2	2	1									2	1
CO 3	3	3	3	2									1	2
CO 4	3	2	2	1									2	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(CCML)				
Year	II	**Semester**	IV		
Course Name	Database Management Systems				
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(CCML)				
Year	II	**Semester**	IV		
Course Name	Data Structure Using 'C'				
Code	NCS4403				
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(CCML)				
Year	II	**Semester**	IV		
Course Name	Big Data Analytics & Architecture				
Code	NCS4404				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Java, HADOOP frameworks, Clustering techniques, large data sets, PIG and HIVE	3	0	0	3
Course Objectives	**1.** Optimize business decisions and create competitive advantage with Big data analytics **2.** Understand several key big data technologies used for storage, analysis and manipulation of data. **3.** Recognize the key concepts of Hadoop framework, map reduce. **4.** To learn Basic methodologies of PIG and HIVE.				
Course Outcomes					
CO1	Understand what Big Data, importance and various sources of data. Describe the elements of big data-volume, variety, velocity and veracity.				
CO2	Analyse the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analytics				
CO3	Design of Algorithms to solve Data Intensive Problems using Map Reduce Paradigm				
CO4	Demonstrate and evaluate an ability to use frameworks like pig and hive to process Big Data and Analytics.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**ESSENTIALS OF BIG DATA AND ANALYTICS:** Data, Characteristics of data and Types of digital data, Sources of data, Working with unstructured data, Evolution and Definition of big data, Characteristics and Need of big data, Challenges of big data; Overview of business intelligence, Data science and Analytics, Meaning and Characteristics of big data analytics, Need of big data analytics, Classification of analytics, Challenges to big data analytics, Importance of big data analytics, Basic terminologies in big data environment.	30 Hours	CO1
2	**HADOOP :** Introducing Hadoop, Need of Hadoop, limitations of RDBMS, RDBMS versus Hadoop, Distributed computing challenges, History of Hadoop , Hadoop overview, Use case of Hadoop, Hadoop distributors, HDFS (Hadoop Distributed File System) , Processing data with Hadoop, Managing resources and applications with Hadoop YARN (Yet another Resource Negotiator), Interacting with Hadoop Ecosystem.	30 Hours	CO2

3	**MAPREDUCE PROGRAMMING:** Introduction , Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression, Real time applications using MapReduce, Data serialization and Working with common serialization formats, Big data serialization formats. **INTRODUCTION TO PIG and HIVE:** Introducing Pig: Pig architecture, Benefits, Installing Pig, Properties of Pig, Running Pig, Getting started with Pig Latin, Working with operators in Pig, Working with functions in Pig. Introducing Hive: Getting started with Hive, Hive Services, Data types in Hive, Built-in functions in Hive, Hive DDL	30 Hours	CO3, CO4

Suggested Readings

1. Seema Acharya, Subhashini Chellappan, ―Big Data and Analytics, Wiley Publications, 2 nd Edition,2014DT Editorial Services, ―Big Data, Dream Tech Press, 2 ndEdition, 2015.
2. Tom White, ―Hadoop: The Definitive Guide, O'Reilly, 3 rd Edition, 2012.
3. Black Book Big Data, dreamtech publications , 1st Edition, 2017.

E-Text Books

1. https://www.books.google.co.in/books?id=rkWPojgfeM8C&printsec=frontcover&dq=HIGH+PERFORMANCE+COMPUTING.
2. http://www.datameer.com/pdf/big-data-analytics-ebook.pdf?mkt_tok.

Online Resources

1. https://nptel.ac.in/courses/106104189

Course Articulation Matrix														
PO-PSO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	3	1		1								1	3	2
CO2	3	2		2								1	2	3
CO3	3	1	3	2	2							1	3	3
CO4	3		3	2	1								3	2

Program	B. Tech.CSE(CCML)				
Year	II	**Semester**	IV		
Course Name	DevOps				
Code	NCCML4401				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	To basic knowledge of certain basic programming languages such as Java, Perl and Python as it ensures the DevOps engineer.	3	0	0	3
Course Objectives	**1.** Understand the blooming in the techniques used in DevOps and their benefits. **2.** Understanding the lifecycle of a project, including alternative configurations and other project management models. **3.** Understand the benefit of automation in different stages of a project. **4.** Analyzing the philosophy and principles of DevOps.				
Course Outcomes					
CO1	Understand the concepts of DevOps in real life scenarios to improve the process.				
CO2	Analyze the implemented for swift completion of the tasks and increase productivity.				
CO3	Evaluate the concepts of DevOps and Design Thinking which are being followed by MNCs around the globe.				
CO4	Apply the concepts of DevOps and Design Thinking which are being followed by MNCs around the globe.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Design Thinking Methodology About Design Thinking** Intro to Design Thinking, Importance of Design thinking, History of Design Thinking, IBM Design Thinking Framework. **The Principles Guide Us** Introduction, Focus on User Outcomes, Relentless Reinvention, Diverse Empowered Teams. **The Loops Drive Us** Introduction, Empathy Map, As-Is Scenario, Big Idea Vignettes, Prioritization Grid, Need Statements, Ideation Activity, Storyboards.	30 Hours	CO1
2	**Agile Methodology Software Development Methodology** Definition of Project; Project vs Operations; Relationship between Project; Program and Portfolio; Features of Project; Measuring Project Success Phases of a Project. **Project Execution Methodologies** Waterfall Model; How does Waterfall work advantages - Disadvantages of Waterfall Model; V-Model; How does V-Model work; Advantages and Disadvantages of V-Model; Advantages-Disadvantages of Agile **Agile Deep Dive**	30 Hours	CO2

	Methodology Overview; Introduction to Agile Manifesto & Guiding Principles; Agile vs Waterfall; Agile Frameworks; Extreme Programming (XP); Rational Unified Process (RUP); Feature Driven Development (FDD); Test Driven Development (TDD); Scrum; Kanban		
3	**Scrum Deep Dive** Foundation of Scrum; Scrum Team; Roles in Scrum Team; Sprints; Definition of Ready **Scrum Artifacts** Product backlog; Sprint Backlog; Sprint Burndown; Impediments list **DevOps Devops Fundamentals** Introduction to DevOps; Agile Vs DevOps; DevOps Principles; Introduction to CI/CD; Hands-on GIT; Build Automation; Configuration Management; Continuous Deployment - Docker; Devops Use Case Introduction of a Use Case for CI/CD Pipeline; DevOps in Mobile Application; DevOps in Web Application; DevOps in Internet of Things Introduction to Devops on Cloud Introduction to IBM Cloud; DevOps on Cloud; Cloud Services (Toolchain and DevOps)	30 Hours	CO3,CO4

Suggested Readings

1. Agile Development and Methodologies – IBM Content
2. 'Running Lean' by Ash Maurya
3. Scrum: The Art of Doing Twice the Work in Half the Time' by Jeff Sutherland
4. The Phoenix Project: A Novel About IT, DevOps, and Helping Your Business Win' by Gene Kim, Kevin Behr and George Spafford
5. 'Essential Scrum: A Practical Guide to the Most Popular Agile Process' by Kenneth Rubin
6. Hands-on Devops by Sricharan Yadapalli – 2017
7. Design Thinking Methodology by Emrah Yayici - 2016

Online Resources

1.https://www.youtube.com/watch?v=GJQ36pIYbic&list=PL9ooVrP1hQOE5ZDJJsnEXZ2upwK7aTYiX

2. https://www.youtube.com/@nptel-speciallectureseries6651

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	2	2	2	1	3							2	2	2
CO2	3	2	3	3	2							3	2	2
CO3	2	3	3	3	2							3	3	2
CO4	2	3	3	3	2							2	2	1

Program	B. Tech CSE(CCML)				
Year	II	Semester		IV	
Course Name	Database Management Systems 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(CCML)				
Year	II	**Semester**		IV	
Course Name	DevOps Lab				
Code	NCCML4451				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Programming Language.	0	0	2	1
Course Objectives	**1.** Understand the blooming in the techniques used in DevOps and their benefits. **2.** Understanding the lifecycle of a project, including alternative configurations and other project management models. **3.** Understand the benefit of automation in different stages of a project. **4.** Analyzing the philosophy and principles of DevOps.				
Course Outcomes					
CO1	Remember the importance of DevOps tools used in software development life cycle.				
CO2	Implemented the importance of Jenkins to Build, Deploy and TestSoftware Applications				
CO3	Perform the concepts of DevOps and Design Thinking which are being followed by MNCs around the globe.				
CO4	Analyze & Illustrate the Containerization of OS images anddeployment of applications over Docker				

S. No.	List of Experiments	Mapped CO
1	Designing a better way for cab booking from start to finish. Create a List of Stakeholders, Empathy Map and As-is Scenario Map	CO1
2	In Above case discussed in practical I, create Big Idea Vignettes, Prioritization grid and Need statements.	CO1
3	For the same case create story board**,** Hills	CO1
4	Create a To-be Scenario for the case discussed in Practical I	CO2
5	Installing Docker and Creating Docker Image	CO2
6	Pull and Push of docker images to and from docker repository.	CO3
7	Installation of Ubuntu on a virtual machine.	CO3
8	Installation of GIT and Creating GIT Repository.	CO4
9	Testing Using Junit	CO4
10	Setting up DevOps on IBM Cloud	CO4
11	**Project Statement** Deployment of an application on IBM Cloud. The environment provisioning automation task executes and begins posting activity events describing the progress of the execution. The activity postings are gathered by the continuous delivery process and presented to the user in a manner that is consumable to the development team. The task can be completed using JIRA also.	CO2,3

Online Resources

1. https://www.azuredevopslabs.com/

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

Program	B.Tech CSE(CCML)				
Year	II	Semester		IV	
Course Name	Data Structure Lab				
Code	NCS44 53				
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/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(CCML)				
Year	III	**Semester**	V		
Course Name	Predictive Analytics				
Code	NCCML4501				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of basic linear algebra, calculus, probability and statistics..	3	1	0	4
Course Objectives	**1.** To provide an overview of an exciting field of Predictive Analytics. **2.** To introduce the tools required For Predictive Analytics. **3.** Explore data to look at data distributions and to identify data Problems, including missing values. **4.** To enable students to have skills that will help them to solve complex Real-world problems in decision support.				
Course Outcomes					
CO1	Understand the data mining and its application.				
CO2	Analyze the concepts of unit of analysis and its objective.				
CO3	Evaluate the predictive analytics with IBM Watson studio.				
CO4	To understand and apply IBM SPSS Modeler in Data Mining, what kinds of data can be mined, what kinds of patterns can be mined.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**ANALYTICS OVERVIEW** Definition of business Analytics with real time examples, How Predictive analytics: Transforming data into future insights, Analytics trends: Past, Present & Future, Towards a Predictive enterprise. **IBM SPSS MODELER & DATA MINING** What are Data Mining applications? Strategy for data mining: CRISP-DM, Identify nodes and streams, The framework of a Data – mining project, Brief the unit of analysis, Explain the type of dialog box.	30 Hours	CO1

2	**UNIT OF ANALYSIS** Concepts of Unit of analysis (Distinct, Aggregate, SetToFlag), Integrate data, CLEM Expression, Role of Relationship between two fields, Identifying the modelling objective.	30 Hours	CO2
3	**PREDICTIVE ANALYTICS WITH IBM WATSON STUDIO** IBM Watson Studio, Watson studio Components, Data preparation, Watson Machine learning, Data Refinery, Watson Studio Neural Network Modeler, IBM Watson Studio jobs, Use case with AutoAI.	30 Hours	CO3
4	**PROJECT** Predicting using IBM SPSS Modeler & IBM Watson with real Case studies	30 Hours	CO4

Suggested Readings

1. IBM Courseware.
2. Predictive Analytics Mesmerizing & fascinating by ERIC SIEGEL.

Online Resources

1. https://nptel.ac.in/courses/110104086

2. https://archive.nptel.ac.in/courses/111/106/111106164/

Course Articulation Matrix

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

Program	B. Tech. CSE(CCML)				
Year	III	**Semester**	V		
Course Name	Cloud Computing				
Code	NCCML4502				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of Computer Network.	3	0	0	3
Course Objectives	**1.** Understand the vision of Cloud Computing from a global context. **2.** Analyzing architecture and implementation of APIs with services of IBM Cloud in Cloud Computing. **3.** To integrate the Node.js application with Watson services over IBM Cloud. **4.** Building and creating state of the art architecture in Kubernetes cluster.				
Course Outcomes					
CO1	To understand an overview of an exciting field of Cloud Computing.				
CO2	To analyze the tools requires building, deploying, runnin and managing applications on a cloud platform.				
CO3	To evaluate the cloud application development skills, such as Node.js, REST architecture, JSON, Cloud Foundry and DevOps services.				
CO4	Apply the skills of the students to solve complex real-world problems in decision support.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Cloud Computing and IBM Cloud** Definition with Real Time Examples, Introduction to cloud computing and its characteristics, Benefits of cloud, Models of Cloud, IBM Cloud resources, Cloud Foundary concepts **DevOps and REST API's with data services on IBM Cloud** What is DevOps? Capabilities of IBM Cloud Continuous Delivery, Architecture of REST, IBM Watson services, Databases types and capabilities, APIs interaction with Cloudant database	30 Hours	CO1
2	**Developing Cloud Application with Node.js** Introduction to JavaScript, Node.js modules, Synchronous and Asynchronous callback, Introduction to Express framework, Route handling, Middleware functions	30 Hours	CO2
3	**React and Introduction to Kubernetes** Introduction to React & its components, React deployment with IBM Cloud, Container orchestration (Kubernetes), Kubernetes building blocks: Pods, Deployment and Service, Building a Kubernetes cluster by using IBM Cloud, Deployment of an application to Kubernetes **Project** Research Activities on Cloud Computing with projects and research letters.	30 Hours	CO3, CO4

Suggested Readings

1. Cloud Computing, A Practical Approach - Anthony T. Velte, CISSP, CISA, is an award-winning author and cofounder of Velte Publishing, Inc. He is the coauthor, with Toby Velte
2. Cloud Application Development - Anubhav Hanjura
3. OpenStack Cloud Application Development - Scott Adkins, John Belamaric, Vincent Giersch, Denys Makogon, Jason Robinson
4. Cloud Computing Paperback- Temitayo Fagbola

Online Resources

1. https://nptel.ac.in/courses/106105167

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

Program	B. Tech CSE(IOTBC)				
Year	III	**Semester**	V		
Course Name	Computer Networks				
Code	NCS4503				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite		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; examples of a simple transport protocol. **Session layer:** Design issues; remote procedure call; examples **Presentation layer:** Design issues; data compression and	30 Hours	CO3 CO4

	encryption; network security and privacy. **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(CCML)					
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(CCML)				
Year	III	**Semester**	V		
Course Name	Predictive Analytics Lab				
Code	NCCML4551				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of Data mining	0	0	2	1
Course Objectives	**1.** Developing Predictive model and improving business outcomes. **2.** Exploring new data sources. **3.** Implementing predictive models. **4.** Evaluating model performance.				
Course Outcomes					
CO1	Implementation social media data using appropriate data/web mining techniques.				
CO2	Demonstrate Structured Data Extraction.				
CO3	Design a system to harvest information available on the web to build recommender systems.				
CO4	Implement the different components of a web page that can be used for mining.				

S. No.	List of Experiments	Mapped CO
1	Create a data-mining project to predict churn in telecommunications.	CO2
2	Demonstrate the Integration of telecommunications data Using IBM SPSS Modeler.	CO3
3	Demonstrate the Derive and reclassify fields for the tele-communications data.	CO1
4	Predict churn in telecommunications and cluster customers into segments.	CO2
5	Demonstrate linear regression analysis by predicting a target (amount of waste produced) as a function of several related inputs (amount of acreage put to different uses).	CO4
6	Predicting real use case using SVM Model.	CO3
7	Predicting real use case using Cox Regression.	CO3
8	Implementation of Model Bagging Using Neural Net.	CO4
9	Forecasting national broadband provider who wants to produce forecasts of user subscriptions in order to predict bandwidth usage.	CO3
10	Implementation of Error or Fraud Detection in Claims.	CO2
11	Predicting Credit Risk using Logistic Regression.	CO4

Online Resources

1. https://www.iiitmk.ac.in/DAVirtalLab/

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

Program	B. Tech. CSE(CCML)				
Year	III	**Semester**	V		
Course Name	Cloud Computing Lab				
Code	NCCML4552				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	NA	0	0	2	1
Course Objectives	**1.** Make students to aware about Cloud and how it is used in technological advancements? **2.** Make students to understand implementation for Cloud Computing, Programming? **3.** Make students to understand workflow process. What are the various areas of Cloud Computing where it can be implemented such as Big Data Analytics, Disaster Recovery and Test and Development, Cloud Backup, and solutions? **4.** Make students to understand about different cloud computing services.				
Course Outcomes					
CO1	To Create the appropriate cloud computing solutions and recommendations according to the applications used.				
CO2	Attempt to generate new ideas and innovations in cloud computing.				
CO3	To perform the underlying principle of cloud virtualization, cloud storage, data management and data visualization.				
CO4	Understand different cloud programming platforms and tools and attempt to generate new ideas and innovations in cloud computing.				

S. No.	List of Experiments	Mapped CO
1	Study the basic cloud architecture and represent it using a case study.	CO1
2	Enlist Major difference between SAAS PAAS & IAAS also submit research done on various companies in cloud business and the corresponding services provided by them, tag them under SAAS PAAS & IAAS.	CO1
3	Study and present a report on Jolly cloud.	CO1
4	Present a report on obstacles and vulnerabilities in cloud computing on generic level.	CO2
5	Present a report on Amazon cloud services.	CO2
6	Explain the process of migrating to cloud with a case study.	CO3
7	Present a report on google cloud and cloud services.	CO3
8	Enlist and explain legal issues involved in the cloud with the help of a case study.	CO4
9	Create a virtual machine on Amazon cloud services.	CO4
10	Perform SQL queries in Azure.	CO4
11	**Project Statement** ● Participants can build an application that stores the stocks that application users choose to follow in the database. A serverless function is configured to run every day at a specific time. ● Participants can use IBM Garage Method to guide in the enterprise adoption approach to cloud based solutions.	CO3,4

	● The IBM Garage method, used by IBM Services with clients around the world, emphasizes co-creation and frequent iteration. ● Participants can build and deploy a digital bank capable of managing users accounts, transactions, transfers, and bills	

Online Resources

1. https://www.gambitcomm.com/site/cloud-vlab.php?gclid=EAIaIQobChMI8KCPrqaV_wIVSoxLBR1UkgxoEAAYAyAAEgJKX_D_BwE

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

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(CCML)				
Year	III	**Semester**	VI		
Course Name	Machine Learning				
Code	NCCML4601				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of Python	3	0	0	3
Course Objectives	**1.** Understand the vision of Machine Learning and R Programming from a global context. **2.** Have a good understanding of the fundamentals of R Programming. Have an overview of the operators, variables, different data structures, understanding of the two main control structures: decisions and loops and functions etc. **3.** Design effective data visualizations in order to provide new insights into a research question or communicate information to the viewer. **4.** Supervised, Unsupervised Machine Learning and relation of statistical modelling to machine learning, Learn to use optimization techniques to find the minimum error in your machine learning model, learn various machine learning algorithms like KNN, Decision Trees, SVM, Clustering in detail.				
Course Outcomes					
CO1	To understand an overview of an exciting field of Machine Learning and R Programming				
CO2	To evaluate the tools required to manage and analyze machine learning like RStudio				
CO3	To analyze the fundamental techniques and principles in achieving Machine Learning using R with scalability and streaming capability.				
CO4	Apply the skills that will help the students to solve complex real-world problems in decision support.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to Machine learning and R:** Concept and history of ML, types of machine learning. Supervised and unsupervised machine learning, Applications of ML. Introduction and History of R Programming. **R Programming:** Variables and data types, data structures, Control Statements: If, else, if. Else if and switch statement, loops: for loop, while loop, repeat loop, break and next statement, Functions and string: Function, user defined function, Apply family. Data processing: Read data from different format, csv files, Excel files, Xml, json and web scraping from database	30 Hours	CO1
2	**Data Visualization and Basics of Statistics:** Scatter plot, Line chart ,Bar Chart ,Pie Chart ,Histogram, Heat Map Basic Statistical concepts: Measure of center tendency- mean, median and mode, Measure of variability – Variance, Standard deviation and Interquartile range, data distribution Hypothesis testing : Null and alternate hypothesis, statistical test, z-tests, t test, critical reason,	30 Hours	CO2, CO3

	critical value one tail and two tail test, Type 1 and type 2 error. **Supervised machine learning:** Regression and classification analysis, Algorithms – Linear Regression, Logistic Regression, Support Vector Machine, KNN, Naïve Bayes		
3	Decision Tree and Random Forest. Model evaluation techniques – MAE, MSE, RMSE, MPE, MAPE, R- squared and Adjusted R-Square. Confusion Matrix, Accuracy, Precision, Recall, F-Score and AUC-ROC curve. **Unsupervised Learning Techniques:** Clustering, K-Means Clustering, Hierarchical Clustering, Agglomerative clustering, Divisive Clustering, Linkage Method, Density-Based Clustering, PCA, Distance Matrices, Euclidean Distance, Manhattan Distance, Minkowiski. **Project:** Research Activities on Machine Learning with projects and research letters.	30 Hours	CO3, CO4

Suggested Readings

1. Brett Lantz. Machine Learning with R. 3rd ed. ISBN-13: 978-1788295864.
2. R for Data Science: Import, Tidy, Transform, Visualize, and Model Data 1st Edition. By Hadley Wickham. ISBN-13: 978-1491910399
3. Hands-On Programming with R: Write Your Own Functions and Simulations by Garrett Grolemund. ISBN-13: 978-1449359010
4. Analytics: Data Science, Data Analysis and Predictive Analytics for Business" by Daniel Covington.
5. Machine Learning for Big Data: Hands-On for Developers and Technical Professionals" by Jason Bell.

Online Resources

1. https://www.youtube.com/@nptel-nociitm9240

2. https://www.youtube.com/@machinelearning-balaramanr9557

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**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	2	2	1	1								2	3	
CO2	2	2	1	3								2	3	
CO3	2	2	1	3								2	2	3
CO4	2	2	1	3								2	3	3

Program	B. Tech CSE(CCML)				
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.** Analyse 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	Analyse 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(CCML)				
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(CCML)				
Year	III	**Semester**	VI		
Course Name	Machine Learning Lab				
Code	NCCML4651				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of any Programming Language	0	0	2	1
Course Objectives	**1.** Learn the Concepts of Machine Learning. **2.** Learn different Machine Learning Algorithms. **3.** Evaluate learning of different Algorithms. **4.** Be able to apply the learning to solve real-world problems.				
Course Outcomes					
CO1	Understand complexity of Machine Learning algorithms and their limitations.				
CO2	Analyze modern notions in data analysis-oriented computing.				
CO3	Evaluate and be able to perform experiments in Machine Learning using real-world data.				
CO4	Applying common Machine Learning algorithms in practice and implementing their own.				

Sr. No.	Course Contents	Mapped CO
1	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.	CO1
2	For a given set of training data examples stored in a .CSV file, implement and demonstrate the CandidateElimination algorithm to output a description of the set of all hypotheses consistent with the training examples.	CO1
3	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	CO2
4	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.	CO2
5	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	CO3
6	Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.	CO3
7	Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.	CO3
8	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using kMeans algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.	CO4
9	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem. 10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data	CO3

	points. Select appropriate data set for your experiment and draw graphs.	
10	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.	CO4

Online Resources

1. https://www.v-labs.ai/

2. https://ieeexplore.ieee.org/document/8884288

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

Program	B. Tech CSE(CCML)				
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(CCML)				
Year	IV	**Semester**		VII	
Course Name	Concepts of Deep Learning				
Code	NCCML4701				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of Machine Learning	3	1	0	4
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,CO 4

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. NPTEL: Deep Learning - YouTube

2. https://youtu.be/njKP3FqW3Sk

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 CSE(CCML)				
Year	IV	**Semester**	VII		
Course Name	Deep Learning Lab				
Code	NCCML4751				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic of Python Programming	0	0	2	1
Course Objectives	**1.** Implement the various deep learning algorithms in Python. **2.** Learn to work with different deep learning frameworks like Keras, Tensor flow, PyTorch, Caffe etc.				
Course Outcomes					
CO1	To carry out fundamental and applied research using deep learning mechanisms				
CO2	To identify innovative research directions in Artificial Intelligence, Machine Learning and Deep Learning				
CO3	To provide quality education and practical skills to faculty and students in Deep Learning, leading to quality publications and innovative models.				
CO4	Understand Deep Learning tools.				

S. No.	List of Experiments	Mapped CO
1	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.	**CO1**
2	Build a Logistic Regression model that answers the question: *"*what sorts of people were more likely to survive?*"* using passenger data (ie name, age, gender, socio-economic class, etc). in Titanic dataset	**CO2**
3	Build a model to digit recognition of MNIST dataset using Support Vector Machine. Also print the confusion matrix.	**CO1**
4	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	**CO2**
5	Construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set.	**CO3**
6	Write a program to classify retinal damage from OCT Scan dataset using a pre- trained VGG16 Model	**CO4**
7	Write a program to visualization of each species of iris dataset using Liner Regression Model.	**CO2**
8	Build a CNN Model to identify Image from the CIFAR-10 Dataset. Calculate the accuracy, precision, and recall for your data set.	**CO3**
9	Construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set.	**CO4**
10	Consider the *"*airline-passengers.csv *"*dataset. Write a program to implement LSTM (Short Long-term Memory) Network, the task is to predict the number of international airline passengers in units of 1,000. The data ranges from January 1949 to December 1960, or 12 years, with 144 observations.	**CO2**
11	**Project Statement** **Project Title – Stock Market Prediction** Stock price prediction is one among the complex machine learning problems. It depends on a large number of factors which contribute to changes in the supply	**CO3,4**

	and demand. This paper presents the technical analysis of the various strategies proposed in the past, for predicting the price of a stock, and evaluation of a novel approach for the same. Stock prices are represented as time series data and neural networks are trained to learn the patterns from trends. Along with the numerical analysis of the stock trend, this research also considers the textual analysis of it by analyzing the public sentiment from online news sources and blogs. Utilizing both this information, a merged hybrid model is built which can predict the stock trend more accurately	

Online Resources

1. https://vlab.spit.ac.in/ai/

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**		**3**								**1**	**1**
CO2	**1**	**2**	**3**	**1**									**1**	**1**
CO3	**1**	**1**	**2**	**1**	**2**								**1**	**2**
CO4	**1**	**1**	**1**		**3**								**1**	

Program	B. Tech.CSE(CCML)				
Year	IV	**Semester**	VIII		
Course Name	Digital Image Processing				
Code	NCCML4801				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic Programming Skills	3	0	0	3
Course Objectives	**1.** Cover the basic theory and algorithms that are widely used in digital image processing. **2.** Expose students to current technologies and issues that are specific to image processing systems. **3.** Develop hands-on experience in using computers to process images.				
Course Outcomes					
CO1	Understand image formation and the role human visual system plays in perception of gray and color image data.				
CO2	Be able to conduct independent study and analysis of image processing problems and techniques.				
CO3	Evaluate and Learn the signal processing algorithms and techniques in image enhancement and image restoration.				
CO4	Acquire an appreciation for the image processing issues and techniques and be able to apply these techniques to real world problems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction & Fundamentals Introduction:** Motivation and Perspective, Applications, Components of Image Processing System. Fundamentals: Element of Visual Perception, A Simple Image Model, Sampling and Quantization; Image Enhancement in Spatial Domain Introduction; Basic Gray Level Functions: Piecewise-Linear Transformation Functions-Contrast Stretching; Histogram Specification: Histogram Equalization, Local Enhancement, Enhancement using Arithmetic/Logic Operations-Image Subtraction, Image Averaging; Basics of Spatial Filtering: Smoothing - Mean filter, Ordered Statistic Filter; Sharpening – The Laplacian.	30 Hours	CO1
2	**Introduction & Fundamentals Introduction: Motivation and Perspective, Applications, Components of Image Processing System. Fundamentals:** Element of Visual Perception, A Simple Image Model, Sampling and Quantization; Image Enhancement in Spatial Domain Introduction; Basic Gray Level Functions: Piecewise-Linear Transformation Functions-Contrast Stretching; Histogram Specification: Histogram Equalization, Local Enhancement, Enhancement using Arithmetic/Logic Operations-Image Subtraction, Image Averaging; Basics of Spatial Filtering: Smoothing - Mean filter, Ordered Statistic Filter; Sharpening – The Laplacian; 30 Hours 1 II Image Enhancement in Frequency Domain Fourier Transform and the Frequency Domain & Image Restoration Basis of Filtering in Frequency Domain: Filters, Low- pass, High-pass, Correspondence Between Filtering in Spatial and Frequency Domain, Smoothing Frequency Domain Filters-Gaussian Lowpass Filters; Sharpening Frequency Domain Filters-Gaussian	30 Hours	CO2

	Highpass Filters; Homomorphic Filtering. Image Restoration: A Model of Restoration Process, Noise Models, Restoration in the presence of Noise only-Spatial Filtering-Mean Filters: Arithmetic Mean filter, Geometric Mean Filter, Order Statistic Filters – Median Filter, Max and Min filters; Periodic Noise Reduction by Frequency Domain Filtering-Bandpass Filters; Minimum Mean-square Error Restoration.		
3	**Colour & Morphological Image Processing & Registration Color Fundamentals:** Color Models-Converting Colors to different models; Color Transformation, Smoothing and Sharpening, Color Segmentation. Morphological Image Processing: Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, Morphological Algorithms- Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening. Registration: Introduction, Geometric Transformation-Plane to Plane transformation; Mapping, Stereo Imaging-Algorithms to Establish Correspondence; Algorithms to Recover Depth. **Segmentation & Object Recognition Segmentation:** Introduction, Region Extraction, Pixel- Based Approach, Multi-level Thresholding, Local Thresholding, Region-based Approach, Edge and Line Detection-Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking and Edge Following, Edge Elements. Feature Extraction Representation: Topological Attributes, Geometric Attributes. Description: Boundary-based Description, Region-based Description, Relationship. Object Recognition: Deterministic Methods, Clustering, Statistical Classification, Syntactic Recognition, Tree Search, Graph Matching.	30 Hours	CO3, CO4

Suggested Readings

1. Rafael C. Gonzalvez and Richard E. Woods, "Digital Image Processing" 2nd Edition, Pearson Education. **2.** R.J. Schalkoff, "Digital Image Processing and Computer Vision", John Wiley and Sons, NY.

3. A.K. Jain, "Fundamentals of Digital Image Processing", Published by Prentice Hall, Upper Saddle River, NJ.

Online Resources

1. https://nptel.ac.in/courses/117105135

2. https://nptel.ac.in/courses/117105079

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

CO 4	*3*	*1*	*1*	*1*	*1*							*3*	*2*

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**	**PSO1**	**PSO2**
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(CCML)				
Year	III	**Semester**	VI		
Course Name	Deployment of Private Cloud				
Code	NPEC43811				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of computer network.	3	0	0	3
Course Objectives	**1.** To understand Cloud concepts, introduction to IBM cloud Compare the advantages and disadvantages of various cloud computing platforms. **2.** To learn introductory concepts of trade-offs between deploying applications in the cloud and over the local infrastructure. **3.** This course will provide an overview regarding the performance, scalability, and availability of the underlying cloud technologies and software. **4.** Learners will be able to understand how to work on containerization concept using Docker as a Tool and will work on Kubernetes.				
Course Outcomes					
CO1	Understand the cloud concepts.				
CO2	To understand the implementation of cloud computing Science.				
CO3	To evaluate the application of cloud deployment with its phases.				
CO4	Applying and analyzing architecture with data management over cloud platforms.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Open Shift** Introduction to OpenShift,Three kinds of Platform, advantages of using OpenShift, OpenShift architecture, OpenShift components,benefits of OpenShift, **Core Concepts** Understand containers and images, pods and services,Builds and streams,Routes & Templates,Deployments,Storage concepts,OpenShift networking concepts **Installation of OpenShift platform** The servers for installation,Steps to install and configure an OpenShift cluster, post-installation step.	30 Hours	CO1
2	**Configuration of OpenShift platform** change log in identity provider,Create and manage users and accounts,Deploy an OpenShift router,Deploy an internal registry **Use of web interface** Fork a sample repository,Create projects and applications,Verify if the application us running,Configuring automated builds,code change and manually rebuild image. **Use of command line interface** Create projects and applications,Verify if the application us running,Configuring automated builds,code change and manually rebuild images	30 Hours	CO2, CO3
3	**Creating custom container images** Custom docker image creation approaches(Understand basics of a docker file,Design considerations for a custom docker file,Building custom images using a docker file) **Controlling access to OpenShift resources**	30 Hours	CO3, CO4

	access control on OpenShift resources,secrets and their application, security policies and their application **Allocation persistent storage** Understand persistent storage concepts such as PVs and PVCs,Implement persistent storage for use by the application,persistence is configured for internal registry **Managing application deployments** manage the applications deployed on OpenShift(Understand pod replicas and how to scale them, control pod scheduling,Manage image, image streams, templates)		

Suggested Readings

1. Ajay Kumar, “Microsevices Architecture”, Self published, 2018, 1st Edition.

2. Sam Newman, “Building Microservices”, O'Reilly Media Inc, 2014, 1st Edition.

Online Resource

1. https://archive.nptel.ac.in/courses/106/105/106105223/

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

Program	B.Tech.CSE(CCML)				
Year	III	**Semester**		VI	
Course Name	Cloud Native				
Code	NPEC43812				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Knowledge of Hybrid Cloud	3	0	0	3
Course Objectives	**1.** Describe the characteristics of cloud-native applications. **2.** Understand hybrid cloud concepts and benefits. **3.** Explain application modernization with hybrid cloud. **4.** The course will explain the concepts and use of container technology and containerized applications.				
Course Outcomes					
CO1	Understand the vision of Cloud native application development from a global context.				
CO2	Analyzing RedHat OpenShift architecture and APIs with application development.				
CO3	To evaluate the application of DevOps with Redhat OpenShift architecture in Industrial Automation.				
CO4	Applying research activities based on application development with Redhat OpenShift.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Hybrid Clouds** Definition of Cloud native applications, Understand concepts of hybrid cloud and its connectivity, Understand application modernization with hybrid cloud, Concept of security architecture in hybrid cloud, Definition of Multi-Cloud **Foundations of Cloud Native Application Development** Understand twelve-factor app methodology, Linux containers, Introduction to Microservices architecture and its integration Architecture of IBM Kubernetes Service, Virtual machines and Containers isolation, Rapid security patching by using container image layering, DevOps. **Architecture overview of IBM Kubernetes Service (IKS)** Technical architecture of Kubernetes Container Platform, Pods, Role of master nodes, and worker nodes, Role of scheduler, Services and Routes with working, Persistent storage and list its benefits with Kubernetes, external routing into Kubernetes applications and the router‘s role, Internal routing within Kubernetes, Workflow of a pod deployment in Kubernetes.	30 Hours	CO1, CO2
2	**Introduction to Red Hat OpenShift on IBM Cloud** Introduction Red Hat OpenShift on IBM Cloud architecture, Key features of Red Hat OpenShift, Understand namespaces, users, and resource quota limits, application creation and autoscalling processes. **Configuring applications on Red Hat OpenShift** Understand application configuration concepts,Role of volumes in cloud native application development, Concept of persistent volumes, What are environment variables, Concept of secrets, what are ConfigMap,	30 Hours	CO2, CO3

	Articulate downward API, **DevOps for Red Hat OpenShift applications on IBM Cloud**Challenges of application integration, Features of continuous integration (CI) and its best practices, Understand workflows, their benefits, and their tools, Introduction to DevOps Practices, Continues Delivery, Understand deployment pipeline process, Explain DevSecOps and why it is important, Understand toolchains on IBM Cloud		
3	**Continuous integration/continuous deployment (CI/CD) and pipelines with OpenShift** Understand the concepts of DevOps and CI/CD, Process of application deployment, Role of deployment configurations, Red Hat OpenShift on IBM Cloud deployment options, Red Hat OpenShift on IBM Cloud deployment options, Scaling application and trigger new deployment, Understand CI/CD workflow and how it is implemented with Red Hat OpenShift on IBM Cloud, benefits of CI/CD and its best practices, Concept of a delivery pipeline, concept of an image stream. **Bringing it all together on Red Hat OpenShift** Review logs and events by using Red Hat OpenShift built-in logging and monitoring, Understand metric dashboards by using Red Hat OpenShift built-in metrics dashboards, Integration of application with Cloudant, Integrate the Red Hat OpenShift cluster with the IBM Cloud Log Analysis service. **Projects** Research Activities with Cloud native application development	30 Hours	CO4

Suggested Readings

1. Deploying to OpenShift: A Guide for Busy Developers Book by Graham Dumpleton
2. Cloud Native Patterns: Designing Change-tolerant Book by Cornelia Davis
3. Programming Kubernetes: Developing Cloud-Native Applications Book by Michael
4. Hausenblas and Stefan Schimanski (Software engineer)

Online Resources

1. Cloud Native Applications Architecture Design Best Practices | Udemy

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

4														

Program	B. Tech. CSE(CCML)				
Year	III	**Semester**	VI		
Course Name	Evolutionary Algorithms				
Code	NPEC43813				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Mathematics	3	0	0	3
Course Objectives	**1.** How to solve hard problems without using complex mathematical formulations **2.** Design algorithms that are robust yet easy to program **3.** To solve optimization related problems efficiently. **4.** To learn to formulate a given problem as an optimization problem and apply EAs				
Course Outcomes					
CO1	Understand a given problem amenable for evolutionary optimization/search				
CO2	Apply appropriate evolutionary algorithms for a given problem				
CO3	Analyze the state-of-the-art evolutionary computation research literature				
CO4	Evaluate suitable evolutionary algorithms for a real world application				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Introduction to Evolutionary Computation, Biological Background: Principles of Darwinian natural selection, Historical Development of EC, Genetic Algorithms, Genetic Programming, Evolutionary Strategies and Evolutionary Programming, Features of Evolutionary Computation, Advantages of Evolutionary Computation Applications of Evolutionary Computation.	30 Hours	CO1
2	**Genetic Algorithms:** Overview of Conventional Optimization and Search Techniques, Simple Genetic Algorithm, terminology: Individual, Genes, Fitness, Population, Encoding, Breeding, Termination, Comparison with Other Optimization , Techniques GA in search, optimization, and machine learning. Case Study of Travelling Salesman Problem	30 Hours	CO2
3	**Evolutionary Strategies:** Introduction, Comparison with GA & GP Operators: Gaussian Mutation Operator and Intermediate Recombination Operator. Application of ES for Image Enhancement Foundations of Evolutionary Algorithms , Schemas and the two-armed bandit problem, Advantages and disadvantages of evolutionary algorithms over alternative methods. Co-evolutionary Algorithms: Cooperative co-evolution, Competitive co-evolution, Swarm intelligence and ant colony optimization.	30 Hours	CO3, CO4

Suggested Readings

1. Sivanandam, Deepa “Introduction to Genetic Algorithm”, Springer.

2. Melanie Mitchell: “An Introduction to Genetic Algorithm”, Prentice Hall of India.

3. D. E. Goldberg, "Genetic Algorithms in Search, Optimisation and Machine Learning", Addison-Wesley.

4. Zbigniew Michalewics, "Genetic Algorithms + Data Structures = Evolution Programs", Springer Verlag, 1997.

5. Goldberg, "Genetic Algorithms", Pearson Eduction.

6. T. Back, D. B. Fogel and Michalewicz, "Evolutionary Computation1: Basic Algorithms and Operators", 2000.

Online Resources

1. https://www.youtube.com/@npteliitguwahati8283

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

Program	B. Tech CSE(CCML)				
Year	III	**Semester**		VI	
Course Name	Internet of Things				
Code	NPEC43814				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic knowledge of 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**	**2**	**2**
CO2	**3**	**2**	**1**	**2**	**2**							**2**	**1**	**2**
CO3		**3**	**2**	**1**	**2**							**2**	**2**	**2**
CO4	**1**		**2**	**1**	**1**							**2**	**2**	**2**

Program	B. Tech CSE(CCML)				
Year	IV	**Semester**	VII		
Course Name	Network Security and Cryptography				
Code	NPEC43821				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Security Services and Mechanism	3	0	0	3
Course Objectives	**1.** Have a fundamental understanding of the objectives of cryptography and network security **2.** Getting familiar with the cryptographic techniques that provide information and network security. **3.** To know the different types of algorithms of exchanging information in a secret way. **4.** To know the possible threats which can break the secure communication.				
Course Outcomes					
CO1	Understanding cryptography and network security concepts and applications.				
CO2	Apply security principals to system design and Real time Scenarios.				
CO3	To evaluate the application of security with Digital signature.				
CO4	Analysis of network traffic and security threats.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Cryptography and Symmetric Ciphers** Security Attacks: Security Services and mechanism; Classical encryption techniques: Substitution ciphers and Transposition ciphers, Steganography, Cryptanalysis; Modern Block Ciphers: Stream and Block Cipher, Block Cipher Principles, Block Cipher Modes of Operations; Shannon‘s theory of Confusion and Diffusion; Fiestal structure; Data encryption standard(DES); Strength of DES; Idea of differential cryptanalysis; Triple DES; Symmetric Key Distribution; Finite Fields: Introduction to groups, rings and fields, Modular Arithmetic, Euclidean Algorithm, Finite Fields of the form GF(p).	30 Hours	CO1
2	**Basics of Number Theory and Publickey Cryptography** Introduction to Number Theory: Prime and Relative Prime Numbers, Fermat‘s and Euler‘s theorem, Testing for Primality, Chinese Remainder theorem, Discrete Logarithms; Public Key Cryptography: Principles of Public-Key Cryptography, RSA Algorithm, Security of RSA; Key Management: Deffie-Hellman Key Exchange.	30 Hours	CO2
3	**Hash Functions and Digital Signatures** Message Authentication; Hash Functions; Secure Hash Functions; Security of Hash functions and MACs; Digital Signatures; Digital Signature Standards (DSS); Proof of digital signature algorithm; Advanced Encryption Standard (AES) encryption and decryption. **Network and System Security** Authentication Applications: Kerberos, X.509 Certificates; Electronic Mail Security: Pretty Good Privacy, S/MIME; IP	30 Hours	CO3,CO 4

	Security: IP Security Architecture, Authentication Header, Encapsulating security payloads, Combining Security Associations; Web Security: Secure Socket Layer and Transport Layer Security, Secure Electronic transaction; Intruder; Viruses; Firewalls.		

Suggested Readings

1. William Stallings, ―Cryptography and Network Security: Principals and Practice‖, Pearson Education.
2. Behrouz A. Frouzan: ―Cryptography and Network Security‖, Tata McGraw- Hill
3. Bruce Schiener, ―Applied Cryptography‖. John Wiley & Sons

Online Resources

1. http://swayam.gov.in/
2. https://nptel.ac.in/

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

Program	B.Tech. CSE(CCML)				
Year	IV	**Semester**		VII	
Course Name	Cloud Security				
Code	NPEC43822				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basics of Cloud Computing	3	0	0	3
Course Objectives	**1.** Understand the vision of Cloud and its security. **2.** To understand the implementation of Forensic Science. **3.** Applying and analyzing architecture with data management over cloud platforms. **4.** To evaluate the application of cloud security with its phases.				
Course Outcomes					
CO1	To understand Cloud concepts, introduction to IBM cloud, ISO 27017-Cloud Security, PCI DSS Controls, Flips Levels.				
CO2	To analyze concepts of Cloud Data Life Cycle (CSUSAD).				
CO3	Evaluate an overview regarding Management plan implementation & Cloud Forensics.				
CO4	Apply how to work on containerization concept using Docker as a Tool and will work on Kubernetes.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Security in cloud model** Cloud Security Model, Cloud Broker Services, Introduction to IBM Cloud, Network Perimeter, What is Encryption, Cloud Foundary, Cryptographic Erasure, ISO 27017-Cloud Security 11114, NIST DP 800-53, PCI DSS Controls, FIPS Levels. **Enterprise Cloud management** Management plan implementation, What is Forensic Science, Evidence Management, OECD Privacy Principles, eDiscovery, GDPR's Key Points, Gap Analysis, ISO 27001: 2013 Domains, Risk Terminology, The CSA STAR components, Supply Chain Risk.	30 Hours	CO1, CO2
2	**Cloud Data Life Cycle (CSUSAD) & DLP(data Loss Prevention** Key data function: Access Process and Store, Data functions mapping to the data life cycle, Controls, Data dispersion in cloud storage, Erasure Coding, Threat to storage types, Database encryption, Gateway encryption, Key storage in cloud Containerization Data De-identification/anonymization, Tokenization, DLP(data Loss Prevention), Data Discovery, DRM(digital rights management), Crypto-shredding, Chain of Custody, Software-Defined Networking(SDN), Data centre design standards, ENISA, Data protection risk, Risk assessment/Analysis, Automation of Controls, iSCSI.	30 Hours	CO3
3	**Audit Mechanism & Application Security** Key regulations for CSP facilities ,IAM ,VPC, Understanding of Cloud environment, BCDR planning factors, Business impact analysis (BIA), Design phase, API types, Phases and Methodologies, Cross-site scripting, Security misconfiguration , Threat Modelling, Software	30 Hours	CO4

	Supply-chain (API) management, ISO/IEC 27034-1IAM on Cloud Federated Identity management, SAML,WS federation, OAuth2.0, OpenID Connect, Reduced Sign-on (RSO), Database activity Monitor, Application Virtualization, Cloud Secure Development Life Cycle, Open Web Application Security Project (OWASP), VLANs, Distributed Resource Scheduling(DRS), Patch Management, Performance Monitoring, Intrusion Detection System		

Suggested Readings

1. Ronald L. Krutz and Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing
2. John R. Vacca, Cloud Computing Security.
3. Building the Infrastructure for Cloud Security: A Solutions View Book by Enrique Castro-Leon and Raghuram Yeluri
4. Cybersecurity for Executives in the Age of Cloud Book by Teri Radichel

Online Resources

1. https://www.youtube.com/@cloudcomputing351

2. https://www.youtube.com/@MrKeerthikiran

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

Program	B.Tech. CSE-CCML				
Year	IV	Semester		VII	
Course Name	Robotics				
Code	NPEC43823				
Course Type	PEC	L	T	P	Credit
Pre-Requisite	Basic Knowledge of Robot.	3	0	0	3
Course Objectives	**1.** This course provides an introduction to the mechanics of robots and spatial mechanics and motion planning. **2.** The theoretical focus is on kinematics and dynamics of robotic manipulators and control design for non-linear mechanical systems. **3.** Laboratory practice to learn simple robot programming. **4.** This course will also expose students to some of the contemporary happenings in robotics, including current robotics research, applications, robot contests and robot web surfing.				
Course Outcomes					
CO1	Understand basic mathematic manipulations of spatial coordinate representation and transformation.				
CO2	Analyze history, concept development and key components of robotics technologies.				
CO3	Evaluate basic robot forward and inverse kinematics problems.				
CO4	Apply basic robotic dynamics, path planning and control problems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction** Definition, Classification of Robots, geometric classification and control classification. Robot Elements: Drive system, control system, sensors, end effectors, gripper actuators and gripper design.	30 Hours	CO1
2	**Robot Coordinate Systems and Manipulator Kinematics** Robot Coordinate Systems and Manipulator Kinematics: Robot co-ordinate system representation, transformation, homogenous transform and its inverse, relating the robot to its world. Manipulators Kinematics, parameters of links and joints, kinematic chains, dynamics of kinematic chains, trajectory planning and control, advanced techniques of kinematics and dynamics of mechanical systems, parallel actuated and closed loop manipulators.	30 Hours	CO2
3	**Robot Control** Robot Control: Fundamental principles, classification, position, path velocity and force control systems, computed torque control, adaptive control, Seroo system for robot control, and introduction to robot vision, Robot Programming: Level of robot programming, language based programming, task level programming, robot programming synthesis, robot programming for welding, machine tools, material handling, assembly operations, collision free motion planning. **Applications** Applications: Application of robot in welding, machine tools, material handling, and assembly operations parts sorting and parts inspection.	30 Hours	CO3, CO4

Suggested Readings

1. Coifet Chirroza, “An Introduction to Robot Technology” Kogan Page.

2. Y. Koren “Robotics for Engineers” Mcgraw Hill.

3. K. S. Fu, R.C. Gonzalez Y& CSG Lee, “Robotics” McGraw Hill.

4. J.J. Craig, “Robotics” Addison-Wesley.

5. Grover, Mitchell Weiss, Nagel Octrey, “Industrial Robots” Mcgraw Hill.

6. Asfahl, “Robots & Manufacturing Automation” Wily Eastern.

Online Resources

1. https://www.youtube.com/@nptel-nociitm9240

2. https://www.youtube.com/@IITKharagpurJuly-is9ie

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	2		1	2									3	3
CO2	2	2		2									3	
CO3	2	2	2										1	2
CO4	3	2	3	1									2	2

Program	B. Tech CSE (CCML)				
Year	IV	**Semester**		VII	
Course Name	Fuzzy Logic				
Code	NPEC43824				
Course Type	PCC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Fundamentals of AI	3	0	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 (CCML)				
Year	IV	**Semester**	VII		
Course Name	Artificial Neural Network				
Code	NPEC43831				
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(CCML)				
Year	IV	**Semester**	VII		
Course Name	Computer Vision				
Code	NPEC43832				
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(CCML)				
Year	IV	**Semester**	VII		
Course Name	Data Visualization and Statistics				
Code	NPEC43833				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Python Programming	3	0	0	3
Course Objectives	**1.** To learn different statistical methods for Data visualization **2.** To learn basics of Watson Studio R and Python. **3.** To learn about packages Numpy, pandas and matplotlib **4.** To learn the functionalities and usages of Seaborn..				
Course Outcomes					
CO1	understand the visualization pipeline with its relationship to other data analysis pipelines				
CO2	Implement and evaluate data to IU-supported research storage for both short- and long-term preservation in order to comply with data management mandates.				
CO3	Acquire and Apply data visualization tools on various data sets.				
CO4	Properly document and organize data and visualizations in order to prepare them for reuse.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction of Statistics:** Introduction to Statistics, Difference between inferential statistics and descriptive statistics, Inferential Statistics-Drawing Inferences from Data, Random Variables, Normal Probability Distribution, Sampling, Sample Statistics and Sampling Distributions. R overview and Installation-Overview and About R, R and R studio Installation, Descriptive Data analysis using R, Description of basic functions used to describe data in R..	30 Hours	CO1
2	**Data Visualization with Watson Studio:** Introduction to data visualization, Adding data to data refinery, Visualization of Data on Watson Studio, Data manipulation packages, Data visualization with R.	30 Hours	CO2
3	**Data Visualization with Python:** Introduction to Python, installation, Introduction to Jupyter Notebook, Python scripting basics, Numpy and Pandas, Matplotlib overview, Basic plots using matplotlib, Specialized Visualization Tools using Matplotlib, Advanced Visualization Tools	30 Hours	CO3, CO4

	using MatplotlibWaffle Charts, Word Clouds. **Seaborn Overview:** Introduction to seaborn, Seaborn functionalities and usage, Spatial Visualizations and Analysis in Python with Folium, Distribution, Categorical Plots, Matrix Plots ,Regression Plots , Choropleth Maps, Grids, Style and Colors, Case Study.		

Suggested Readings

1. IBM Courseware

2. R Graphics Essentials for Great Data Visualization by Alboukadel Kassambara

3. Core Python Programming -Second Edition, R. Nageswara Rao, Dreamtech Press.

4. The Visual Display of Quantitative Information (2nd Edition). E. Tufte. Graphics Press, 2001.

5. Envisioning Information, E. Tufte. Graphics Press, 1990.

Online Resources

1 https://www.youtube.com/@IITMadrasBSDegreeProgramme

2. https://www.youtube.com/@nptel-nociitm9240

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

Program	B.Tech. CSE(CCML)				
Year	IV	**Semester**	VII		
Course Name	No SQL and MongoDB				
Code	NPEC43834				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Basic of Business Analytics	3	0	0	3
Course Objectives	**1.** Understand and critically apply the concepts and methods of Business analytics. **2.** To understand and apply IBM SPSS Modeler in Data Mining, what kinds of data can be mined, what kinds of patterns can be mined. **3.** Applying and analyzing how to use functions, deal with missing values, use advanced field operations, handle sequence data and improve efficiency. **4.** To evaluate the Model on the basis of different Predictive Methods.				
Course Outcomes					
CO1	To understand an overview of an exciting field of Predictive Analytics.				
CO2	To analyze the tools required For Predictive Analytics.				
CO3	Evaluate data to look at data distributions and to identify data problems, including missing values.				
CO4	Apply students to have skills that will help them to solve complex real-world problems in decision support.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Overview of NoSQL** Introduction to NoSQL,CAP Theorem, different data models,Pros & Cons of using NoSQL **Comparison between SQL and NoSQL** Document Databases (Example of Document databases) Introduction to MongoDB , Why MongoDB? What isMongoDB? Document and Collections Data Model Design (Embedded Data Models and Normalized Data Models) MongoDB Use Cases	30 Hours	CO1
2	**Basic MongoDB Operations** Data Types in Mongo Shell Inserting and saving documents Batch Insert Removing Documents Updating Documents Update top level field Update an embedded field Update multiple documents Replace a document Commands Limitations in querying data Query for All Documents in a Collection, Query by a Top Level Field	30 Hours	CO2
3	**Advanced MongoDB** Batch Processing Data Aggregation Indexing Replication via Replica Sets Query by a Field in an Embedded Document Query by a Field in an Array Specify Conditions with Operators Combine Condition **Advanced MongoDB OPERATIONS** Auto-Sharding, Shard Keys Horizontal Scalability MongoDB-Java/Python DevOps on Cloud; Cloud Services (Toolchain and DevOps) **Project** Research Activities on Data with projects & research letters.	30 Hours	CO3, CO4

Suggested Readings

1. Steve Hoberman, “Data Modelling for MongoDB”, First Edition,Technics Publication, 2014, ISBN 9781935504702.
2. Daniel Perkins, “MongoDB, Third Edition, CreateSpace Independent Publishing Platform, 2016, ISBN 152396300
3. Shakuntala Gupta Edward, “Practical MongoDB ”, Second edition, Apress Publications, 2016, ISBN 1484206487.
4. David Hows, “The definitive guide to MongoDB”, 2nd edition, Apress Publication, 2009, 8132230485.

Online Resources

1. https://www.youtube.com/@GiraffeAcademy

2. https://www.youtube.com/@AnInsightfulTechie

Course Articulation Matrix														
PO-PSO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	3		1	1								1	1	
CO 2	2	3		2								1	1	
CO 3	2			3								1	1	1
CO 4	2		3	1	2							1	1	1

Program	B. Tech CSE(CCML)				
Year	IV	**Semester**		VIII	
Course Name	Bioinformatics				
Code	NPEC43843				
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
2. Rastogi, Mendiratta, Rastogi, "Bioinformatics concepts, skills & Applications", CBS Publishers
3. "Bioinformatics", Addison Wesley

Online Resources

1. https://nptel.ac.in/courses/102103044
2. https://nptel.ac.in/courses/102106065
3. https://onlinecourses.swayam2.ac.in

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(CCML)				
Year	IV	**Semester**	VIII		
Course Name	Data Compression				
Code	NPEC43842				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Multimedia	3	0	0	3
Course Objectives	**1.** To provide students with contemporary knowledge in Data Compression and Coding. **2.** To equip students with skills to analyze and evaluate different Data Compression and Coding methods. **3.** Student knows basic algorithms used in lossless and lossy compression. **4.** Student knows basic mathematical models used in lossless and lossy compression.				
Course Outcomes					
CO1	Apply fundamental ideas of the lossless data compression in multimedia.				
CO2	Implement and evaluate mathematical theory and algorithms.				
CO3	Analyze fundamental ideas of quantization and transform coding.				
CO4	Understand how lossless and lossy compression algorithms can be used for solving scientific and engineering problems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction** Compression Techniques: Lossless and Lossy Compression, Measures of performance, Modeling and Coding; Mathematical Preliminaries for Lossless compression: A brief introduction to information theory; Models: Physical models, Probability models, Markov models, Composite source model; Coding: Uniquely decodable codes, Prefix codes.	30 Hours	CO1
2	**Huffman and Arithmetic Coding** Huffman coding algorithm: Minimum variance Huffman codes; Adaptive Huffman coding: Update procedure, Encoding procedure, Decoding procedure; Golomb codes, Rice codes, Tunstall codes Applications of Huffman coding: Lossless image compression, Text compression and Audio Compression Arithmetic Coding: Introduction, Coding a Sequence,	30 Hours	CO2

	Generating a Tag, Deciphering a Tag, Comparison of Huffman and Arithmetic Coding, Applications.		
3	**Dictionary Coding and Context Based Compression** Dictionary Techniques: Introduction, Static Dictionary: Diagram Coding; Adaptive Dictionary: The LZ77 Approach, The LZ78 Approach, Applications: File Compression-UNIX compress, Image Compression-Graphics Interchange Format (GIF) and Portable Network Graphics (PNG), Compression over modems-V.42 bits. Context Based Compression: Introduction, Prediction with Partial Match (ppm)-The basic algorithm, The ESCAPE SYMBOL, Length of context, The Exclusion Principle; The Burrows Wheeler Transform: Move-to-front coding, Dynamic Markov Compression. Lossless image compression: Introduction, CALIC, JPEG-LS, Multi-resolution Approaches, Facsimile Encoding.	30 Hours	CO3, CO4

Suggested Readings

1. David Salomon, “Data Compression”, Springer Publication, 4th Edition.
2. Khalid Sayood, “Introduction to Data Compression”, Morgan Kaufmann Series, 3rd Edition

Online Resources

1. https://www.youtube.com/watch?v=5wRPin4oxCo
2. https://www.coursera.org/lecture/digital/on-video-compression-standards-LluJC

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

Program	B. Tech CSE(CCML)				
Year	IV	**Semester**	VIII		
Course Name	Essentials Of Block chain Technology				
Code	NPEC43841				
Course Type	PEC	**L**	**T**	**P**	**Credit**
Pre-Requisite	Understanding of computer science, information technology, and information security.	3	0	0	3
Course Objectives	**1.** Blockchain technology and key concepts like cryptography and cryptocurrency concepts. **2.** Gain a deep insight into Bitcoin, its network, and how Bitcoin t transactions are validated by miners. **3**. Interpret the prospects of Blockchain and assess how Blockchain can improve your business standards. **4.** Deploy your private Blockchain on the web where you can visually see your chains & send transactions between nodes.				
Course Outcomes					
CO1	Understand how blockchain solutions are transforming the industry landscape.				
CO2	Analyze a deeper understanding of blockchain technical topics such as consensus, cryptography, privacy, and security.				
CO3	Evaluate hands-on expertise using popular blockchain open-source technology, including Hyperledger Fabric.				
CO4	Apply a permissioned blockchain.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Blockchain Prerequisites and Introduction to Blockchain** Introduction to HTML 5 and Javascript Programming, Concept of callback, promises and Async/Await, NodeJS-Server-side Javascript, Docker essentials, Containers Orchestration, Implementations Creating, and Deploying Docker containers, Introduction to Blockchain. **Blockchain in detail** Understand the business context behind blockchain and the problems that blockchain aims to solve, Distinguish between blockchain for business and other blockchain implementations.	30 Hours	CO1
2	**Blockchain Status** Enumerate the broad categories of blockchain solutions, and Understand the state of the blockchain industry in 2019, in terms of technologies, topics, and communities, See how today's blockchain implementations vary, Look at the indicators that point to 30 Hours 1 blockchain's future. **Linux Foundation Hyperledger and Blockchain Use-Cases** Understand the background behind the Linux Foundation Hyperledger project, Enumerate and compare the different Hyperledger projects, Introduce Hyperledger Fabric, Learn about some successful blockchain projects, Evaluate good vs. bad blockchain ideas, Assess the business value	30 Hours	CO2
3	**Blockchain Developer Part 1:-** Blockchain principles and their use in the enterprise,	30 Hours	CO3, CO4

	Blockchain infrastructure and applications Identify participants, assets, transactions in a business network, Hyperledger Fabric, Blockchain solution architecture, Peers, smart contracts, channels, world state. **Blockchain Developer Part 2:-** Consensus, ordering service and transaction endorsement, Chaincode structure, lifecycle, and deployment approaches., Blockchain deployment with Docker and Kubernetes, Blockchain security on Hyperledger Fabric PROJECT Research Activities on Blockchain network		

Suggested Readings

1. IBM Courseware

2. Implementing Blockchain solutions using Hyperledger

Online Resources

1. https://nptel.ac.in/courses/106105184

Course Articulation Matrix														
PO - PSO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	2		3								2	2	2
CO 2	2	2	2	2								2	3	2
CO 3	2	1		1								2	2	1
CO 4	2	2	3	2								2	2	2

Program	B. Tech CSE(IOTBC)					
Year	III	**Semester**	VI			
Course Name	Pattern Recognition					
Code	NPEC43844					
Course Type	PEC	**L**	**T**	**P**	**Credit**	
Pre-Requisite	Probability, Linear algebra, ML, Python	3	0	0	3	
Course Objectives	**1.** Learn the fundamental concepts and applications of pattern recognition. **2.** Understand the fundamental concepts of Pattern Recognition. **3.** Evaluate the learning of the Models. **4.** Develop some applications of pattern recognition.					
Course Outcomes						
CO1	Understand the fundamental pattern recognition and machine learning theories.					
CO2	Analyze certain important pattern recognition techniques.					
CO3	Evaluate systems and algorithms for pattern recognition (signal classification), with focus on sequences of patterns.					
CO4	Applying the pattern recognition theories to applications of interest.					

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Introduction to Pattern Recognition, Basics of pattern recognition, Design principles of pattern recognition system, Learning and adaptation, Pattern recognition approaches, Mathematical foundations – Linear algebra, Probability Theory, Expectation, mean and covariance, Normal distribution, multivariate normal densities, Chi squared test.	30 Hours	CO1
2	**Statistical Pattern Recognition**: Bayesian Decision Theory, Classifiers, Normal density, Discriminant functions. **Parameter Estimation Methods:** Maximum-Likelihood estimation, Bayesian Parameter estimation, Dimension reduction methods, Principal Component Analysis (PCA),Fisher Linear discriminate analysis, Expectation-maximization (EM),Hidden Markov Models (HMM),Gaussian mixture models.	30 Hours	CO2
3	**Nonparametric Techniques and Unsupervised Learning:** Density Estimation, Parzen Windows, K-Nearest Neighbor Estimation, Nearest Neighbor Rule, Fuzzy classification, Clustering, Criterion functions for clustering, Clustering Techniques, Iterative square - error partitioned clustering – K means, Agglomerative hierarchical clustering, Cluster validation.	30 Hours	CO3, CO4

Suggested Readings

1.Richard O. Duda, Peter E. Hart and David G. Stork, “Pattern Classification”, 2nd Edition, John Wiley, 2006.

2. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2009.

3.S. Theodoridis and K. Koutroumbas, “Pattern Recognition”, 4th Edition, Academic Press, 2009.

Online Resources

1. https://nptel.ac.in/courses/106106046
2. https://nptel.ac.in/courses/106108057
3. https://nptel.ac.in/courses/117106100
4. https://nptel.ac.in/courses/117108048

Course Articulation Matrix														
PO-PSO	**PO1**	**PO 2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO 7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	**3**	**1**		**1**								**1**	**3**	**2**
CO2	**3**	**2**		**2**								**1**	**2**	**2**
CO3	**3**	**1**	**3**	**2**	**2**							**1**	**3**	**2**
CO4	**3**		**3**	**2**	**1**								**3**	**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 (CSE)				
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		