BABU BANARASI DAS UNIVERSITY

School of Engineering
(School Code: 04)
Department of CSE
(University Branch Code: 38)

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

Evaluation Scheme

SEMESTER I									
Course Category.	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
C	BAS3101	Matrices and Calculus	3	1	0	40	60	**100**	**4**
C	BAS3102	Physics-I	2	1	0	40	60	**100**	**3**
Students need to select either GROUP 'A' or GROUP 'B'									
	GP3101	General Proficiency				100		**100**	**1**
Total			**5**	**2**	**0**	**180**	**120**	**300**	**8**

GROUP 'A'									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
F	BME3101	Engineering Mechanics	3	1	0	40	60	100	4
F	CCML3101	Introduction to Python Programming and Clean Coding	3	1	0	40	60	100	4
F	BEC3101	Basic Electronics Engineering	3	1	0	40	60	100	4
C	BAS3104	Environmental Studies	2	0	0	40	60	100	2
F	BME3151	Engineering Mechanics Lab	0	0	2	40	60	100	1
F	CCML3151	Python Programming and Clean Coding Lab	0	0	2	40	60	100	1
F	BME3152	Workshop Practice	0	1	2	40	60	100	2
C	BAS3152	Physics-I Lab	0	0	2	40	60	100	1
Total			**11**	**4**	**8**	**320**	**480**	**800**	**19**

GROUP 'B'									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
F	BEE3101	Basic Electrical Engineering	3	1	0	40	60	100	4
F	CCML3102	Introduction to Java Programming	3	1	0	40	60	100	4
C	BAS3103	Chemistry	3	1	0	40	60	100	4
C	BHS3101	Technical Communication	3	1	0	40	60	100	4
F	BEE3151	Basic Electrical Engineering Lab	0	0	2	40	60	100	1
F	CCML3152	Java Programming Lab	0	1	2	40	60	100	2
C	BAS3153	Chemistry Lab	0	0	2	40	60	100	1
Total			**12**	**5**	**6**	**280**	**420**	**700**	**20**

SEMESTER II									
Course Category.	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
C	BAS3201	Differential Equations and Fourier Analysis	3	1	0	40	60	**100**	**4**
C	BAS3202	Physics-II	2	1	0	40	60	**100**	**3**
Students need to select either GROUP 'A' or GROUP 'B'									
	GP3201	General Proficiency				100		**100**	**1**
Total			**5**	**2**	**0**	**180**	**120**	**300**	**8**

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

GROUP 'A'									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
F	BME3201	Engineering Mechanics	3	1	0	40	60	100	4
F	CCML3201	Introduction to Python Programming and Clean Coding	3	1	0	40	60	100	4
F	BEC3201	Basic Electronics Engineering	3	1	0	40	60	100	4
C	BAS3204	Environmental Studies	2	0	0	40	60	100	2
F	BME3251	Engineering Mechanics Lab	0	0	2	40	60	100	1
F	CCML3251	Python Programming and Clean Coding Lab	0	0	2	40	60	100	1
F	BME3252	Workshop Practice	0	1	2	40	60	100	2
C	BAS3252	Physics-I Lab	0	0	2	40	60	100	1
Total			**11**	**4**	**8**	**320**	**480**	**800**	**19**

GROUP 'B'									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
F	BEE3201	Basic Electrical Engineering	3	1	0	40	60	100	4
F	CCML3202	Introduction to Java Programming	3	1	0	40	60	100	4
C	BAS3203	Chemistry	3	1	0	40	60	100	4
C	BHS3201	Technical Communication	3	1	0	40	60	100	4
F	BEE3251	Basic Electrical Engineering Lab	0	0	2	40	60	100	1
F	CCML3252	Java Programming Lab	0	1	2	40	60	100	2
C	BAS3253	Chemistry Lab	0	0	2	40	60	100	1
Total			**12**	**5**	**6**	**280**	**420**	**700**	**20**

Babu Banarasi Das University
School of Engineering (School Code:04)
Department of Computer Science & Engineering
B. Tech CSE (CC&ML)
University Branch Code: 38

Evaluation Scheme

Credit Summary Chart:

Credit Summary Chart										
Course Category	**Semester**								**Total Credits**	**%age**
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
F	16/11	11/16	0	0	0	0	0	0	27/27	12.80
C	10/16	16/10	25	25	25	21	13	13	148/148	70.14
GE	0	0	0	0	0	4	8	8	20	9.48
OE	0	0	0	0	0	0	4	4	8	3.79
GP	1	1	1	1	1	1	1	1	8	3.79
Total	**27/28**	**28/27**	**26**	**26**	**26**	**26**	**26**	**26**	**211**	**100**

Discipline wise Credit Summary Chart										
Course Category	**Semester**								**Total Credits**	**%age**
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
Basic Sciences	10/12	12/10	4	3					**29**	13.74
Humanities and Socials Sciences	0/4	4/0	2	2	3	3			**14**	6.64
Engg. Sciences	16/11	11/16							**27**	12.79
Professional Subject Core			19	20	22	17	10	5	**93**	44.07
Professional Subject -General Elective						4	8	8	**20**	9.48
Professional Subject -Open Elective							4	4	**8**	3.80
GP + Project Work, Seminar and / or Internship in Industryor elsewhere.	1	1	1	1	1	2	4	9	**20**	9.48
Total	**27/28**	**28/27**	**26**	**26**	**26**	**26**	**26**	**26**	**211**	**100**

SEMESTER III									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
C	BHS3301/ BHS3302	Industrial Psychology / Industrial Sociology	2	0	0	40	60	**100**	**2**
C	BAS3301	Complex Analysis and Integral Transforms	3	1	0	40	60	**100**	**4**
C	BCS3301	Discrete Mathematics	3	1	0	40	60	**100**	**4**
C	CCML3301	Fundamentals of Data Science	2	1	0	40	60	**100**	**3**
C	BAI3302	AI in Mechanical Engineering Systems	3	1	0	40	60	**100**	**4**
C	BCS3305/ BCS3405	Computer Concepts & Programming in 'C'	3	1	0	40	60	**100**	**4**
C	BCS3351	UNIX & Shell Programming	0	0	2	40	60	**100**	**1**
C	CCML3351	Data Science Lab	0	0	2	40	60	**100**	**1**
C	BAI3352	AI in Mechanical Engineering Systems Lab	0	0	2	40	60	**100**	**1**
C	BCS3355/ BCS3455	'C' Programming Lab	0	0	2	40	60	**100**	**1**
	GP3301	General Proficiency	-	-	-	100	-	**100**	**1**
Total			**16**	**5**	**8**	**500**	**600**	**1100**	**26**

SEMESTER IV									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
C	BHS3402/ BHS3401	Industrial Sociology /Industrial Psychology	2	0	0	40	60	**100**	**2**
C	BAS3401	Statistical and Numerical Techniques	2	1	0	40	60	**100**	**3**
C	BCS3401	Database Management Systems	3	1	0	40	60	**100**	**4**
C	BCS3402	Operating System	3	1	0	40	60	**100**	**4**
C	BCS3403	Data Structure Using 'C'	3	1	0	40	60	**100**	**4**
C	CCML3401	DevOps	3	1	0	40	60	**100**	**4**
C	BCS3451	Database Management System Lab	0	0	2	40	60	**100**	**1**
C	CCML3451	DevOps Lab	0	0	2	40	60	**100**	**1**
C	BCS3453	Data Structure Lab	0	0	2	40	60	**100**	**1**
C	BCS3454	Numerical Techniques Lab	0	0	2	40	60	**100**	**1**
	GP3401	General Proficiency	-	-	-	100	-	**100**	**1**
Total			**16**	**5**	**8**	**500**	**600**	**1100**	**26**

SEMESTER V									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
C	BHS3501	Engineering & Managerial Economics	3	0	0	40	60	**100**	**3**
C	CCML3501	Predictive Analytics	3	1	0	40	60	**100**	**4**
C	CCML3502	Cloud Computing	3	1	0	40	60	**100**	**4**
C	BCS3503	Computer Networks	3	1	0	40	60	**100**	**4**
C	BCS3504	Automata Theory and Formal Languages	3	1	0	40	60	**100**	**4**
C	CCML3503	No SQL and MongoDB	2	1	0	40	60	**100**	**3**
C	CCML3551	Predictive Analytics Lab	0	0	2	40	60	**100**	**1**
C	CCML3552	Cloud Computing Lab	0	0	2	40	60	**100**	**1**
C	BCS3553	Computer Networks Lab	0	0	2	40	60	**100**	**1**
	GP3501	General Proficiency	-	-	-	100	-	**100**	**1**
Total			**17**	**5**	**6**	**460**	**540**	**1000**	**26**

SEMESTER VI									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
C	BHS3601	Industrial Management	3	0	0	40	60	**100**	**3**
C	CCML3601	Machine Learning	3	1	0	40	60	**100**	**4**
C	BCS3602	Design & Analysis of Algorithms	3	1	0	40	60	**100**	**4**
C	CCML3602	Cloud Security	2	1	0	40	60	**100**	**3**
C	BCS3604	Compiler Design	3	1	0	40	60	**100**	**4**
GE		**Generic Elective I**	3	1	0	40	60	**100**	**4**
C	CCML3651	Machine Learning Lab	0	0	2	40	60	**100**	**1**
C	BCS3652	Algorithms Lab	0	0	2	40	60	**100**	**1**
C	BCS3658	Seminar	0	0	2	100	0	**100**	**1**
	GP3601	General Proficiency	-	-	-	100	-	**100**	**1**
Total			**18**	**4**	**6**	**520**	**480**	**1000**	**26**

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	
C	CCML3701	Artificial Intelligence & Deep Learning	3	1	0	40	60	**100**	**4**
C	BCS3702	Network Security and Cryptography	3	0	0	40	60	**100**	**3**
GE		**Generic Elective II**	3	1	0	40	60	**100**	**4**
GE		**Generic Elective III**	3	1	0	40	60	**100**	**4**
OE		**Open Elective I***	-	-	-	40	60	**100**	**4**
C	CCML3751	Artificial Intelligence & Deep Learning Lab	0	0	2	40	60	**100**	**2**
C	BCS3752	Network Security Lab	0	0	2	40	60	**100**	**1**
C	BCS3759	Project I*	0	0	4	100	0	**100**	**2**
C	BCS3758	Industrial Training Evaluation	0	0	2	100	0	**100**	**1**
	GP3701	General Proficiency	-	-	-	100	-	**100**	**1**
Total			**12**	**3**	**10**	**580**	**420**	**1000**	**26**

*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	
C	BCS3801	Digital Image Processing	**3**	**0**	**0**	40	60	**100**	**3**
GE		**Generic Elective IV**	**3**	**1**	**0**	40	60	**100**	**4**
GE		**Generic Elective V**	**3**	**1**	**0**	40	60	**100**	**4**
OE		**Open Elective II****	**-**	**-**	**-**	40	60	**100**	**4**
C	BCS3851	Digital Image Processing Lab	**0**	**0**	**2**	40	60	**100**	**1**
C	BCS3859	Project II##	**0**	**0**	**16**	160	240	**400**	**9**
	GP3801	General Proficiency	**-**	**-**	**-**	100	-	**100**	**1**
Total			**9**	**2**	**18**	**460**	**540**	**1000**	**26**

**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 theresults.Finallyallprojectworkwillbepresentedinareporti.e.ProjectReport.

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:

F Foundation Course
C Core Course
GE Generic Elective
OE Open Elective

List of Generic Electives

Course Code	Generic Elective I
GE33811	Deployment of Private Cloud
GE33813	Soft Computing
GE33814	Evolutionary Algorithms
GE33812	Cloud Native
GE33815	Internet of Things

Course Code	Generic Elective II
GE33821	Big Data Analytics & Architecture
GE33825	System Modeling & Simulation
GE33822	Artificial Neural Network
GE33823	Natural Processing Language
GE33824	Big Data Security

Course Code	Generic Elective III
GE33831	Security Governance and Law
GE33833	Real Time Operating System
GE33834	Robotics
GE33835	Computer Vision
GE33832	Data Visualization and Statistics

Course Code	Generic Elective IV
GE33844	Data Mining and Ware Housing
GE33841	Fuzzy Logic
GE33842	IoT Application Development
GE33843	Optimization Techniques
GE33845	Augmented & Virtual Reality

Course Code	Generic Elective V
GE33852	Data Compression
GE33853	Distributed System
GE33854	Bioinformatics
GE33855	Pattern Recognition
GE33851	Essentials of Block Chain Technology

BAS 3101 Matrices and Calculus **Credits: 4**

Course Objective:

The general objective of the course is to introduce

1. the concepts of matrix algebra, methods of solving system of linear equations and determine eigen values and eigen vectors of a matrix;
2. the concepts of the eigen values and eigen vectors of Hermitian, Unitary and Normal matrices differ from those of general matrices;
3. the concepts of derivatives of functions (one and several variables) and their applications;
4. the concepts of multiple integration, Beta, Gamma functions and their applications;
5. the concepts of vector calculus to expose students to mathematical applications.

Learning Outcomes:

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

1. demonstrate ability to manipulate matrices, to find rank and to solve the system of linear equations;
2. find eigen values and eigenvectors and use them in diagonalization problems and other applications;
3. find nth derivative by using Leibnitz theorem;
4. apply partial derivatives to study extrema & expansion of functions of two variables;
5. evaluate double integrals by changing variables , changing order and triple integration to find the area and volume of given region;
6. calculate line integrals along piecewise smooth paths, interpret such quantities as work done by a force;
7. solve double and triple integrations and apply it to calculate line, surface and volume integrals;
8. apply Green's theorem to evaluate line integrals along simple closed contours on the plane, Stoke's theorem to give physical interpretation of the curl of a vector field and Divergence theorem to give physical interpretation of the divergence of a vector field.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Matrices** Type of Matrices, Elementary row and column transformation, Rank of matrix, Linear dependence, Consistency of linear system of equations and their solution, Characteristic equation, Caley-Hamiltion theorem, Eigen values and eigen vectors, Application of matrices to engineering problems.	30	1
II	**Differential Calculus** Leibnitz theorem, Partial differentiation, Euler's theorem, Expansion of function of several variables. Jacobian, Extrema of functions of several variables. Lagranges method of multipliers (Simple applications).	30	1

III	**Multiple Integrals** Double and triple integrals, Change of order, Change of variables, Beta and Gamma functions, Applications to area and volume, Dirichlet integral and applications.	30	1
IV	**Vector Calculus** Point function, Gradient, Divergence and Curl of a vector and their physical interpretations, Line, Surface and Volume integrals, Green's, Stoke's and Gauss divergence theorems (without proof) and applications.	30	1

Recommended Books:

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.
2. Peter V. O'Neil, Advanced Engineering Mathematics, Thomson (Cengage) Learning, 2007.
3. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill Publishing Company Ltd., 2008.
4. R. K. Jain & S. R. K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House, 2002.
5. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2005.

SYLLABUS

BAS-3102 ENGINEERING PHYSICS I

Course Objective:

The main objectives of the course are

1. To provide knowledge and develop an understanding of principles and processes of wave optics, optical communication and fundamentals of special theory of relativity.
2. To develop the basic skills to apply knowledge by the topics covered in the course to engineering problems.

Learning Outcome:

At the end of the course students shall be able

1. To apply knowledge of wave optics.
2. To design and conduct experiments.
3. To identify and solve the problems in different field of engineering & technology.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Wave Optics:** Interference: Interference of light, Biprism experiment, Displacement of fringes, Interference in thin film, Wedge shaped film, Newton's rings. Diffraction: Single slit and N-slit, Diffraction grating, Grating spectra, Dispersive power of grating, Rayleigh criterion and resolving power of grating. Polarisation: Double refraction, Nicolprism, Production and detection of plane, circularly and elliptically polarised light, Optical activity and Fresnel's theory of optical activity, Specific rotation and Polarimeter.	30	1
II	**Laser and Fibre Optics**: Laser: Spontaneous and stimulated emission of radiation, Einstein coefficient, Population inversion & pumping, Construction and working of ruby & He-Ne Laser, Applications of Laser, Holography. Fundamental idea about optical fibre, Propagation mechanism & communication in optical fibre, Types of optical fibre, Acceptance angle and acceptance cone, Numerical aperture	30	1

	and V-number, Attenuation ,Signal loss in optical fibre, Dispersion in optical fibre.		
III	**Special theory of Relativity:** Inertial & non inertial frames, Concept of ether, Michelson and Morley Experiment, Einstein's basic postulate of special theory of relativity, Lorentz transformation equations, length contraction, Time dilation, Mass variation, relativistic velocity addition theorem, Mass-energy Equivalence relation.	30	1

References:

1. Concepts of Modern Physics, Aurther Beiser , Mc-Graw Hill
2. Introduction of Special theory of relativity, Robert Resnick, Wiely
3. Optics, Ajay Ghatak, TataMc-Graw Hill
4. Optical fibre and Laser, Anuradha De, New Age
5. Fundamental of Physics, Resnick, Halliday & Walker, Wiely
6. Optics, Jenkin and White, Tata Mc-Graw Hill

(Dr. Karunesh Tiwari)
Convener

(Prof. Rajeev Manohar)
External Expert

(Dr. Nitin Jain)
Nominee

(Dr. Neelam Yadav)
Member

ENGINEERING MECHANICS (BME3101/BME3201)

Course Objective:

1. A working knowledge of statics with emphasis on force equilibrium and free body diagrams.
2. To calculate the reactive forces and analyse the structures.
3. To know the geometric properties of the different shapes & to learn energy and momentum methods.
4. Provides an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems, and an understanding of the mechanical behavior of materials under various load conditions.

Learning Outcome:

At the end of the course student should be able to:

1. Solve the engineering problems in case of equilibrium and non- equilibrium conditions & solve the problems involving dry friction.
2. Calculate the reaction forces and forces in members of statically determinate structures.
3. Determine the centroid, centre of gravity and moment of inertia of various surfaces and solids &calculate the forces acting on the rigid body, structures using varying principles.
4. To find out the stress, strain and elastic properties of different bodies.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Two-Dimensional Force Systems:** Basic concepts, Laws of motion, Principle of Transmissibility of forces, Transfer of a force to parallel position. Resultant of a force system, Simple Resultant of Two dimensional concurrent Force systems and Non-concurrent Force systems, Distributed force system, free body diagrams, Equilibrium and Equations of Equilibrium, Applications of two dimensional force system. **Friction:** Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction, Equilibrium of bodies involving dry friction, Belt friction, Application of friction.	30	1

II	**Beam:** Introduction, Shear force and Bending Moment, Differential equations for shear force & bending moment, Shear force and Bending Moment Diagrams for Statically Determinate Beams. **Trusses:** Introduction, Simple Truss and Solution of Simple Truss, Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members	30	1
III	**Centroid and Moment of Inertia:** Introduction, Centroid of plane, curve, area, volume and composite bodies, Moment of inertia of plane area,Parallel Axes Theorem & Perpendicular axes theorem, Moment of inertia of composite bodies. **Kinematics and Kinetics:** Linear motion, Instantaneous center, D'Alembert principle, Rotation of rigid bodies. Impulse and momentum principle, Work and energy principle.	30	1
IV	**Simple Stress and Strain:** Definition of stress, stress tensor, normal and shear stresses in axially loaded members, Stress-strain relationship, Stress-strain diagram for uniaxial loading of ductile and brittle materials, Hooke's law, Poisson's ratio, shear stress, shear strain, modulus of rigidity, Relationship between elastic constants. One Dimensional Loading of members of varying cross-sections, Temperature Stresses,Strain energy.	30	1

Reference Books:

1. Engineering Mechanics by Irving H. Shames. Prentice-Hall.
2. Engineering Mechanics: Principles of Statics and Dynamics by R. C. Hibbler. Pearson Press.
3. Engineering Mechanics: by Shanes and Rao. Pearson Education.
4. Engineering Mechanics by S.S. Bhavikatti, K.G. Rajashekarappa. New Age Publications.
5. A textbook of Engineering Mechanics by Dr. R.K. Bansal, Laxmi Publications.
6. Mechanics of Solids by Abdul Mubeen, Pearson Education Asia.
7. Mechanics of Materials by E.P. Popov, Prentice Hall of India Private Limited.

CCML3101 Introduction to Python Programming and Clean Coding

Course Objective:

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
5. To learn how to use indexing and slicing to access data in Python programs
6. To define the structure and components of a Python program

Learning Outcome:

After completing the course, the students should be able to:

1. Write loops and decision statements in Python
2. Write functions and pass arguments in Python
3. Build and package Python modules for reusability
4. Read and write files in Python
5. Design object-oriented programs with Python classes
6. Data handling and use cases diagrams
7. Design and Implement a prototype file systems

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**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	1
II	**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	30	1

	errors, Exceptions, Handling exceptions with try/except		
III	**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	30	1
IV	**Advance Concepts:** Machine Learning - Algorithm Algorithms – Random forest Super vector Machine Random Forest Build your own model in python Comparison between random forest and decision tree	30	1

Text/Reference Books:

1. J. Peterson, A. Silberschatz, and P. Galvin, "Operating System Concepts", Addison Wesley. 2012
2. A. V. Aho, R. Sethi, and J. D. Ullman, "Compilers: Principles, Techniques and Tools", Addison-Wesley. 2013
3. R. El. Masri and S. B. Navathe, "Fundamentals of Data Base Systems", Benjamin Cummings. 2013

BEC3101/BEC3201 BASIC ELECTRONICS ENGINEERING

Course Objective:

This course provides

1. Comprehensive idea about basic electronics devices like Diodes, BJT, JFET, MOSFET, Operational Amplifier.
2. Fundamental principles of Electronic instruments like CRO and digital multi-meter.
3. Fundamental principle of communication.

Learning Outcome:

At the end of the course students will be able to gain knowledge about the

1. Fundamentals of electronic devices like Diodes, BJT, JFET, MOSFET, Operational Amplifier and Electronic instruments like CRO and digital multi-meter.
2. Number system, Boolean algebra, logic gates, Kaurnaugh map
3. Basics of communication systems.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**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, Breakdown Mechanism: Zener & Avalanche breakdown, Zener Diode and its application, LED, LCD, and Solar Cell.	30 Hours	1
II	**TRANSISTORS** Construction of Bipolar Junction Transistor: PNP and NPN, Working of Transistor, BJT configurations: CE, CB and CC, Input & Output characteristics of CB & CE configuration, Biasing: Fixed bias, Emitter bias, Potential divider bias, Comparison of biasing circuits. JFET: Basic construction and characteristics, Concept of pinch off, maximum drain saturation current, Input and transfer characteristics, Biasing: Self bias and fixed bias. MOSFET- Depletion and Enhancement type MOSFET- construction, operation and characteristics.	30 Hours	1
III	**DIGITAL ELECTRONICS AND COMMUNICATION SYSTEM** Number System, Complements, Boolean Algebra: Basic	30 Hours	1

	Theorems and De Morgan Theorems. Standard logic gates. Universal Logic Gates. Implementation of Boolean function using Basic gates and Universal gates. Reduction of Boolean function using K-Map upto4variables. Block Diagram of Communication System, Electromagnetic spectrum, Need for Modulation, Basic Definitions AM,FM,PM		
IV	**OPERATIONAL AMPLIFIER AND APPLICATIONS:** Introduction to OP-AMP, Characteristics of ideal OP-AMP. 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 oscillation and Barkhausen criterion.	30 Hours	1

Text Books:

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

Reference Books:

1. Jacob Millman, Christos C. Halkias, Integrated Electronics: Analog and Digital Circuits and Systems (McGraw-Hill electrical and electronic engineering series).
2. William D. Cooper, Albert D.Hefrick, Modern Electronic instrumentation and measurement technique 5th edition Prentice Hall Of India, New Delhi 1997.
3. Ramakant Gaikwad .Op –Amp's & linear Integrated Circuits, 4th edition, Prentice Hall of India, New Delhi 2002.
4. Albert Paul Malvino, Donald P Leach . Digital Principle & Application 4th edition, Tata McGraw –Hill Edition , New Delhi -1991.

BAS 3104/BAS3204: ENVIRONMENTAL STUDIES

Course Objectives: The main objectives of the course are:

1. To create awareness and improve knowledge about environment.
2. To conserve natural resources through sustainable use.
3. To prevent, control of pollution and protect environment.
4. To developed skill and participation in environment protection activities.

Learning outcome: After the completion of the course, students are expected to better understanding of:

- Environments and related issues.
- Develop skill to solve many inter related problems of socio-economic nature and ecology.
- Able to conserve natural resources and sustainable use.
- Able to protect environment.

Course Contents:

Modules	Course Topics	Total Hours	Credit	Lecture/ week		
				L	T	P
1.	**Environment** Environment: Definition, Principles and Scope of Environmental Studies, Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere, Ecosystems, structure and function of ecosystem, Types of ecosystem, energy flow in an ecosystem, Food chain and food web, ecological pyramids, Prey-Predator interaction, Population dynamics of Prey and Predator. Material cycle: Definition and importance, Nitrogen and carbon cycle Environmental Impact Assessment (EIA): Definition and Concept, Elements of EIA, Prediction of impacts and its methodology, Sustainable Development. **Natural resource and its conservation** Natural resources: Renewable & non-renewable natural resources, drinking water quality, water borne and water induced diseases, arsenic and fluoride problem in drinking water, deforestation, impact of overexploitation mineral resources. Energy resources: Conventional and non-conventional energy sources, solar energy, hydro-power energy, Hydrogen-energy, wind energy, geothermal energy, biomass energy, nuclear energy, fossil fuels.	30	1	2	0	0

2.	**Environmental Pollution** Environmental pollution: Definition, pollutants, sources, causes, effects and control measures of air, water, and soil pollutions. Noise: Sources of noise pollution, measurement of noise, Noise exposure levels and standards. Impact of noise on human health. Noise control and abatement measures. Waste water and its treatment. Eutrophication and Biomagnifications. Solid waste management: solid waste source, characterization, effects and control measures of urban and industrial waste. **Current Environmental Issues** Current environmental Issues: Population growth, logistic curve equation. Climate change, global warming, acid rain, ozone layer depletion. Water Crises-Conservation of water, Rain water harvesting. Biodiversity and its conservation: Natural disaster and its management. Nuclear hazards Environment protection: Legal aspects of environment protection, Environment Protection Act, Air(Prevention and Control of Pollution)Act, Water(Prevention and control of Pollution)Act, Role of NGOs in environment protection. Environmental Education and Awareness.	30	1	2	0	0

Text Books:

1. Environmental Biology- Agarwal, K.C.2001, Nidi Publ. Ltd. Bikaner.
2. Basics of Environment and Ecology- A. Kaushik and C.P. Kaushik, Second Edition, 2014, New Age International(p) Ltd.

Suggested Readings:

1. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd.,Ahmedabad-380013.India
2. Brunner R.C., Marine Pollution, Clanderson Pross Oxford (TB)
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T.2001, Environmental Encyclopedia, Jaico Publ, House , Mumbai,1196p.
4. De A.K., Environmental Chemistry, Wiley Eastern Ltd. Down to Earth, Centre for Science and Environment (R).

ENGINEERING MECHANICS LAB (BME3151/BME3251)

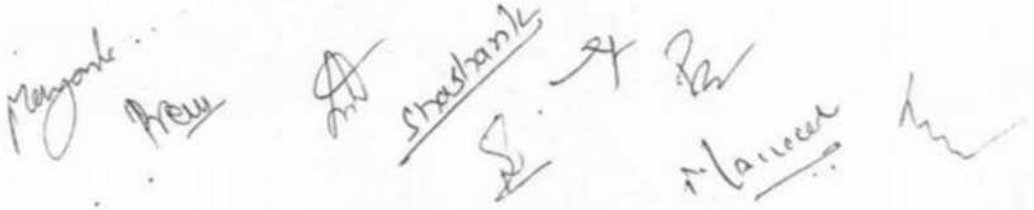
1. To conduct the tensile test and determine the ultimate tensile strength, percentage elongation for a steel specimen.
2. To determine the compression test and determine the ultimate compressive strength for a Specimen.
3. To conduct the Impact-tests (Izod/Charpy) on Impact-testing machine to find the toughness.
4. To determine the hardness of the given specimen using Vickers/Brinell/Rockwell hardness testing machine.
5. Friction experiment(s) on inclined plane and/or on screw-jack.
6. Worm & worm-wheel experiment for load lifting.
7. Belt-Pulley experiment.
8. Bending of simply-supported and cantilever beams for theoretical & experimental deflection.
9. Torsion of rod/wire experiment.
10. Experiment on Trusses.
11. Statics experiment on equilibrium.
12. Experiment on Moment of Inertia.

Note:

1. At least ten experiments are to be performed in the semester.

2. At least eight experiments should be performed from the above list.

Remaining two experiments may either be performed from the above list or designed & set by the concern faculty as per the scope of the syllabus.



CCML3151 Python Programming and Clean Coding Lab

List of Programs

1. Introduction to Python shell, running python script and declaring variables.

2. Programs to implement Control Statements (if, if-else, nested if-else, for loop, while loop, break statement, continue statement):

1. Display table of number using for-loop statement.
2. Find sum of Natural numbers from 1 to 10.
3. Add digits of a number using while loop.

3. Programs to implement Functions, return statement, default argument, keyword arguments and scope of a variable in python.

4. Programs to implement various operations on Lists:

1. Adding list
2. Replicating list
3. Deleting list

4. List slicing
5. Updating elements in list
6. Appending elements
7. Functions and methods in list

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

6. Programs to implement the functions of e library .
7. Program to introduces the basic functionalities of Matplotlib, the basic figure types and design them.
8. Write or perform the algorithm based on random forest.
9. Write and perform the algorithm based on super vector machine.
10. Write and perform the algorithm k-nearest neighbor algorithm.

Project Statement

Desktop and games development project on python programming for students in a intermediate level python programming course 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.

WORKSHOP PRACTICE (BME3152/BME3252)

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.
2. **Fitting Bench Working Shop:** Study of tools & operations, Simple exercises involving fitting work, make perfect male-female joint, Use of drills/taps idea.
3. **Black Smithy Shop:** Study of tools & operations, Simple exercises base on black smithy operations such as upsetting, drawing down, punching, bending, fullering & swaging.
4. **Welding Shop:** Study of tools & operations of Gas welding & Arc welding, Simple butt and Lap welded joints, Oxy-acetylene flame cutting.
5. **Sheet-metal Shop:** Study of equipment & operations, Making Funnel complete with 'soldering', Fabrication of tool-box, tray, electric panel box etc.
6. **Machine Shop:** Study of machine tools and operations, Plane turning, Step turning. Taper turning, Threading, grinding of turning equipment.
7. **Foundry Shop:** Study of tools & operations, Pattern making, Mould making with the use of a core, Method of material pouring and Casting.

Note:

1. At least ten experiments are to be performed in the semester.
2. At least eight experiments should be performed from the above list.

Remaining two experiments may either be performed from the above list or designed & set by the concern faculty as per the scope of the syllabus

BAS-3151*BAS-3252 PHYSICS PRACTICALS**

Course Objective:

The main objectives of the course are

1. To learn some basic principles of physics that help students to understand how the world around them works.
2. To realize fundamental concepts of physics and how it can be applied to other field i.e. engineering.
3. To apply scientific knowledge systematically.

Learning Outcome:

At the end of the end of the course students be able to

1. Tackle experimental problems in physics.
2. Use mathematics to describe the physical world.
3 Plan, execute, analyse and report experiments.
4. Compare results critically with prediction from theory.

The student shall perform ten experiments in the laboratory by choosing at least four experiments from each group

GROUP-A

Practical	Topics	Total Hours	Credits
1.	To determine the wavelength of monochromatic light by Newton's rings.	30	1
2.	To determine the wavelength of monochromatic light with the help of Fresnel's biprism		
3.	To determine the focal length of two lenses by nodal slide and locate the position of cardinal points.		
4.	To determine the specific rotation of cane sugar solution using Bi-quartz polarimeter.		
5.	To determine the wavelength of various spectral lines using plane transmission grating		
6.	To study the polarization of light by simple reflection using laser.		
7.	Measurement of wavelength of a laser (He-Ne) light using single slit diffraction.		

*BAS3152
**PHYSICS-I LAB
As per Evaluation Scheme, SOE

GROUP-B

Practical	Topics	Total Hours	Credits
8	To determine the specific resistance of the material of given wire using Carey Foster's bridge	30	1
9	To determine the variation of magnetic field along the axis of a current carrying coil and then to estimate the radius of the coil.		
10	To verify Stefan's Law by electrical method		
11	To calibrate the given ammeter and voltmeter		
12	To study the Hall Effect and determine Hall coefficient, carrier density and mobility of a given semiconductor material using Hall-effect set up.		
13	To determine energy band gap of a given semiconductor material.		
14	To study the characteristics of zener diode		
15	To determine electrochemical equivalent of copper using Tangent or Helmholtz galvanometer		
16	To draw hysteresis curve of a given sample of ferromagnetic material and from this to determine magnetic susceptibility and permeability of the given specimen.		
17	To determine the ballistic constant of a ballistic galvanometer		
18	To determine the value of a planck's constant by a photocell.		
19	To determine the coefficient of viscosity of a liquid.		
20.	Measurement of fiber attenuation and aperture of fiber		

(Dr. Karunesh Tiwari)
Convener

(Prof. Rajeev Manohar)
External Expert

(Dr. Nitin Jain)
Nominee

(Dr. Neelam Yadav)
Member

BABU BANARASI DAS UNIVERSITY, LUCKNOW

School of Engineering

Department of Electrical Engineering

Bachelor of Technology

SEMESTER – I / II

BEE3101/BEE3201 BASIC ELECTRICAL ENGINEERING

Course Objective:

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.

Learning Outcome:

At the end of the course students will be able.

1. To understand basic theorem of electrical engineering.
2. To understand basic electrical engineering.
3. To understand the basic concepts of magnetic, AC & DC circuits.
4. To explain the working principle, construction, applications of DC & AC machines & measuring instruments.
5. To gain knowledge about the fundamentals of electric components, devices.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**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	1
II	**A. C. Circuits:** A.C. voltage and currents, average and r.m.s. values, Form factor and peak factor, Phasor	30 Hours	1

	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.		
III	**Measuring Instruments & Electromagnetic and Transformer:** Types of instruments, construction, working principles & applications, PMMC, MI, Single phase dynamometer, Ammeter, Voltmeter, Wattmeter, Induction type Energy meter, Use of shunt and multiplier. Magnetic circuit concept, B-H curves characteristics of magnetic materials, Practical magnetic circuits. Magnetic circuits with D.C. and A.C. excitation, Hysteresis and eddy current losses, Magnetic force. Self and mutual inductances, Faraday`s laws, Lenz`s Law, 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.	30 Hours	1
IV	**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	1

Text &Reference books:

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. 'Electric Technology, by H.Cotton, CBS Publishers and Distributors.
4. 'Basic Electrical Technology' by A.E.Fitzgerald, McGraw Hill Publication.
5. 'Basic Electrical Technology' by Kothari and I.J. Nagrath, Tata McGraw Hill.
6. 'Basic Electrical Technology' by S.N.Singh, PHI Publication.

CCML3102 Introduction to Java Programming

Course Outcome:

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.
5. To study, understand and implement each unit according to National Education Policy 2020.

Learning Outcome:

At the end of the course, the student should be able to:

1. Understand the vision of Object Oriented Programming from industry context. The CLO has been achieved accordingly in Unit 1.
2. To understand and apply Object Oriented Programming using Java using java I.D.E. The CLO has been achieved accordingly in Unit 2.
3. Applying and analyzing multithreading programming of Java Language to create more robust and fast applications. The CLO has been achieved accordingly in Unit 3.
4. To evaluate the application of Web Server and Application Server and how to deploy Web Applications. The CLO has been achieved accordingly in Unit 4.
5. Building and creating Web Applications using front end as html, css and javascript and backend using Java Servlets and J.S.P(Java Server Pages). Creating projects by establishing database connections with IBM DB2 or MySql. The CLO has been achieved accordingly in Unit 5 & 6.

Course Contents

Module	Course Topics	Total Hours	Credits
I	**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	1
II	**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.	30 Hours	1

III	**INTRODUCTION TO ENTERPRISE APPLICATION DEVELOPMENT** JavaBeans, Introduction to Java EE Web Component, Overview of Servlets, Java EE Container Services Overview, Servlet API, Overview of Java Server Pages, Java Server Pages Specification and Syntax.	30 Hours	1
IV	**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	1

Text/Reference Books:

1. A. Tanenbaum, "Computer Network", Prentice Hall, 2002.
2. Behrouz A. Forouzan, "TCP/IP Protocol Suite", McGraw- Hill, 4/e, 2009.
3. J.F. Kurose and K.W. Ross, "Computer Networking, A Top-Down Approach Featuring the Internet", Addison-Wesley, 2002.
4. D.E. Comer, "Computer Networks and Internets with Internet Applications", Prentice-Hall, 2001.
5. L.L. Peterson and B.S. Davie, "Computer Networks, A Systems Approach", Morgan Kaufmann, 2000.
6. James F. Kurose, Keith W. Ross, "Computer Networking", Pearson, 2012.

SYLLABUS

(BAS 3103/BAS 3203) CHEMISTRY

Course Objective: The main objectives of course are:

1. To provide basic building blocks of engineering chemistry.
2. To provide spatial learning style using images, pictures, colors and models.
3. To provide the basic mathematical problems of polymer chemistry.

Learning Outcome: At the end of the course, the student will be able to:

1. understand the role of chemistry in field of engineering.
2. understand the structure of atoms and apply the periodic laws to predict chemical and physical properties of the elements.
3. develop analytical capabilities and techniques of interpretation.
4. apply the knowledge in solving problems in their respective field of study.
5. employ critical thinking and efficient problem-solving skills in the four basic areas of chemistry (analytical, inorganic, organic, and physical).

Course Contents:

Module	Course contents	Total Hours	Credits
I	**Introduction to General Chemistry** Atomic structure, Chemical bonding: Significance of Quantum numbers, Shapes of s, p, d, and f atomic orbitals. Rules for filling electrons in various orbitals. Electronic configuration of atoms, Molecular Orbital Theory and its Applications in Homonuclear and Heteronuclear diatomic molecules. Reactions kinetics: Rate equation, Order and molecularity of reaction. Theories of reaction rates, Integrated rate equations. Electrochemistry: Nernst equation and its importance. Nanomaterials: Types of nanomaterial, Creation and use of Fullerenes. Carbon nanotube and its application. States of matter: Space lattice, Types of unit cell (cube), Density of unit cell, Defects in crystal. Liquid crystal and its application.	30	1

II	**Mechanistic Concepts of Stereochemistry**: Concept of Isomerism. Types of Isomerism. Optical isomerism: Elements of symmetry, molecular chirality, optical activity, chiral and achiral molecules with two stereogenic centers. Properties of Enantiomers and Disasteromers. Relative and absolute configuration: Sequence rules, D & L and R & S systems of nomenclature. Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature. Conformational isomerism: Conformational analysis of ethane and n-butane. Introduction to Green Chemistry, 12 principles of Green Chemistry.	30	1
III	**Titrimetric Analysis:** Introduction, Standard solutions, Equivalents and Normalities and Oxidation numbers, Indicators. **State of Art Analytical techniques** Nuclear Magnetic Resonance: Magnetic nuclei with special reference to ^{1}H. Chemical shift, Shielding and Deshielding. Ultraviolet Spectroscopy: Types of Transition, Chromophores and Auxochromes. Water treatment methods for boiler feed water by Zeolite method. Water treatment: Water Quality Monitoring and Management, Surveillance, Water effluent treatment and Relevant Standards and Regulatory Norms(IS:10500, IS 14543, IS 13428)	30	1
IV	**Principles of Polymer Chemistry** Introduction of Polymer: Classification of Polymers, Mechanism of addition polymerization, Thermoplastic and thermosetting resins, Molecular weight of polymers. Elastomers: Natural rubber, Buna-S, Buna-N, Butyl rubber. Synthetic Fibers: Nylon-6, Nylon 6, 6, Kevlor, Dacron. Organic conducting polymers: Polyacetylene, Polythiophene, Polypyrrole, Polyaniline. Biodegradable polymers.	30	1

Shalini

Manisha

(Dr. P.B. Sharma)

Text Book:

1. Shashi Chawla, A Text book of Engineering Chemistry,8th edition Dhanpatrai & Co(p) ltd.2013.
2. R.K. Agarawal: Engineering chemistry, 15th edition,Krishna publication media (P) Ltd.2014
3. I.L.Finar,Organic Chemistry,6th edition ,Pearson,2011
4. Clark, J. H. "Green chemistry: Challenges and opportunities". *Green Chemistry*.1999

Suggested Readings:

1. Arun Bahl and B.S. Bahl , Advanced organic chemistry,S.Chand,2010
2. R.T. Morrison, R.N. Boyd, S.K. Bhatacharjee, Organic Chemistry, 7thEdn, Pearson, 2011.
3. Charles P Poole, Frank J Owens, Introduction to Nanotechnology,John Wiley Sons.2007
4. Atkins P and de Paula J. Physical Chemistry (8th ed., W.H. Freeman 2006)

SYLLABUS

Course Title: Technical Communication **Course Code: BHS3101/3201**

Course Objectives:

- To make the students aware of the fundamentals of communication and its types and various levels;
- To train them techniques and methods of vocabulary building and paragraphs writing and make communication effective and impressive;
- To groom them expert in oral as well as written communication with the knowledge of various forms and formats;
- To make them understand the role of Nonverbal (Kinesics) in Communication
- To enhance their capacity for comprehension, creative and critical thinking;

Learning Outcome: The successful completion of the course students will be able to:

- Understand the meaning of communication and its various applications;
- Form and apply suitable vocabulary, phrases and sentences in communicating variety of situations;
- Able to use variety of forms/formats and techniques required in different levels of communication;
- Maintain congruity between verbal and nonverbal communication;
- Able to comprehend and clarify the intricacies of art of communication.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Fundamentals of Communication:** Communication: Definition, Nature, Origin, Scope, Features and Process of communication; Types of Communication: Verbal and Non-Verbal, Formal and Informal, Oral & Written Communication and technical and general Communication; Levels of Communication: Extra-personal, Intra-personal, Interpersonal, organisational, Grapevine, Group and Mass Communication; Language as a Tool of Communication; The Flow of Communication: Vertical (Upward and Downward), Lateral or Horizontal; Technical Communication: Definition, Distinction between Technical & General Communication, Importance of Technical Communication for Technocrats & Professionals; Barriers to Communication: definition; types: Physical, Semantic, Psychological barriers or Extra-personal, Intra-personal, Interpersonal, and Organizational barriers, How to Overcome these Barriers;	30	1
II	**Creativities in Communication** **Word Formation:** Affixation, Compounding, Blending,	30	1

10/6/19 10/6/19

	Conversion. Enriching **Vocabulary:** Synonyms, Antonyms, Homophones. Homonyms, One word Substitution, Foreign Words & Phrases; **Forms of Writing and Techniques:** Note taking, Reviewing. Interpreting, Paraphrasing and Précis Writing, Pre-Requisites of Good Sentences; Essentials of Good Sentences, Common Errors to be avoided **Requisites of Good Paragraph Writing:** Unity, Coherence, Clarity. Proper Length, Emphasis, Logical Sequencing, Development of Paragraphs; **Methods of Writing:** Inductive, Deductive, Chronological, Spatial. Comparison & Contrast, Question to Answer, Interruptive. Illustrative;		
III	**Business Communication** Principles. 7 C's of technical Communication; Formats of Business Letters; **Types of Letter:** Sales & Credit Letters, Inquiry. Quotation & Reply Letters, Letters for Placing & Fulfilling Orders, Complaint, Claim & Adjustment Letters; **Job Letters:** Cover letters, Resume **Reports:** Definition, Significance, Features & Purpose, **Types:** Formal . Informal, Periodic, Informational, Analytical; **Formats & Structures of Reports:** Letter Format, Memo Format. Printed Format, Manuscript Format; Writing of a Report Structure of Manuscript Format; **Proposals:** Definition, Significance, Features & Purpose; Types & Structures: Solicited & Unsolicited, Business, Research. Technical; Structure of Technical Proposals.	30	1
IV	**Presentation Strategies:** Purpose, Scope, Understanding Audience & Locale. Organizing contents, Audio-Visual Aids; **Modes of Presentation:** Manuscript, Impromptu, Memorization. Extempore; **Non-Verbal Dimensions of Communication:** **Kinesics:** Gesture. Posture, Facial Expression, Eye Contact; Paralinguistics. Proxemics, Haptics, Chronemics, Oculecsis. Group Discussion.Telephone Etiquettes,Dining Etiquettes, Interviews.Ice-Breaking.	30	1

Text books:

Minakshi Raman et al. Technical Communication, New Delhi: Oxford University Press, 2014.

Singh. R.P. Functional Skills in Language & Literature, New Delhi: Rupa, 2007.

Reference Books:

Sharma, Sangeeta et al. Communication Skills for Engineers and Scientists, New Delhi: PHI, New Delhi, 2009.

Shukla, Aditya. Professional Communication, Pune: Technical Publications, 2013.

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BEE3151/BEE3251 BASIC ELECTRICAL ENGINEERING LAB

(Any 10 experiments)

1. Verification of KCL & KVL.
2. Verification of Thevenin's theorem.
3. Verification of Norton's theorem.
4. Verification of Superposition theorem.
5. Measurement of active and reactive power in 1-phase and Power Factor Improvement.
6. Measurement of active power in 3 -phase circuit using TWO wattmeter methods.
7. Study of transformer through assembling and polarity check.
8. 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.
9. Study of dc shunt motor speed control using (1) Armature control (2) Field Control.
10. Determination of efficiency of DC shunts motor by load test.
11. Study of Electrical Equipment used in daily life.
12. Study of DC Machine.
13. Full wave rectifier circuit using diodes.
14. Transistor input-output characteristics.

CCML3152: Java Programming Lab

The following programs should be implemented preferably on 'UNIX/WINDOWS' platform using 'C'

LIST OF EXPERIMENTS:

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.
2. WAP 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.
3. Write a program in JAVA to demonstrate the method and constructor overloading
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.
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".
6. Write a Java Program to finds addition of two matrices.
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
8. Write a servlet to connect Java Web application to MySQLl/ DB2 Server
9. Create a Login form in Html and validated it on Server Side using Servlet.
10. Create a J.S.P Application to view all data of MySQL/ DB2 table on Web Page.

Project Statement

Airline Reservation System in Java

This Java project is used to book seats for airlines. There 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. It 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.

TEXT/REFERENCE BOOKS

Java: The Complete Reference by SCHILDT and HERBERT, McGraw Hill

BAS 3153/BAS3253 CHEMISTRY LAB

Course Objective: The main objectives of course are:

1. To Purify and identify organic compounds.
2. To calculate reaction yield for relevant lab experiments.

. **Learning objective:** Upon successful completion of this course, students will be able to:

1. identify the difference between scholarly/peer-reviewed research and practical information related to agriculture as well as information that is authoritative, unbiased, and timely.
2. apply the principles of teaching and learning in relation to practical chemistry laboratories and associated chemistry concepts.

Course Contents:

Module	List of Experiments	Total hours	Credit
1.	Determination of constituents and amount of alkalinity of supplied water sample.		
2.	Determination of total hardness of water by complexometric titration method.		
3.	Determination of chloride content in a given sample of bleaching powder		
4.	Determination of chloride content in supplied water sample using mohes method.	60	2
5.	Determination of iron content in the given water sample by using external indicator		
6.	Determination of pH of a solution using a pH meter and titration of such a solution phmetrically.		

Suggested Readings:

1. Textbook of practical chemistry, A.I. Vogel, Prentice Hall, 5th edition.
2. Vogels quantitative chemical analysis, A.I. Vogel, Prentice hall, 6th edition.
3. Practical organic chemistry, F.G. Mann & B.C. Saunders, orient longman,1960.

Shalini Sharma (Asst. V.P. Sharma)

BAS 3201 Differential Equations and Fourier Analysis **Credits: 4**

Course Objective:

The general objective of the course is to introduce

1. the formulation and solution of ordinary differential equations;
2. the concepts of series solution of differential equation and solution of Bessel's, Legendre's equations and their properties;
3. the concept of Fourier series expansion of functions and harmonic analysis;
4. the formulation and solution of partial differential equations arising in a number of practical problems;
5. the applications of partial differential equation in wave equations, heat flow and line transmission.

Learning Outcomes:

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

1. identify an ordinary differential equation and its order and degree;
2. compute the general solution of 2nd order ordinary differential equations and apply them to solve the L-C-R circuits;
3. determine the general solution of higher order linear equations with constant coefficients;
4. determine whether a system of functions is linearly independent using the Wronksian;
5. use the method of reduction of order and undetermined coefficients to find a second linearly independent solution of a second order linear homogeneous equation when one solution is given;
6. use the method of variation of parameters to find particular solutions of second order, linear homogeneous equations;
7. use power series and Frobenius series method to solve differential equations;
8. expand periodic functions into Fourier series the knowledge of which is useful in signal processing;
9. determine the Fourier sine and cosine series for functions defined on an interval;
10. use the method of separation of variables to reduce some partial differential equations to ordinary differential equations;
11. solve quasilinear first-order partial differential equations using the method of characteristics and first integrals;
12. solve second-order hyperbolic partial differential equations by the travelling wave approach (D'Alembert's method of solution);
13. provide an application oriented computation for solving wave equation, heat equation and steady state two dimensional heat flow.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Differential Equations** Linear differential equations of nth order with constant coefficients, Complementary functions and particular integrals, Simultaneous linear differential equations, Solution of second order differential	30	1

	equation by changing dependent and independent variables, Method of variation of parameters, Applications to engineering problems (without derivation).		
II	**Series Solution and Special Functions** Series solution of ordinary differential equations of 2^{nd} order with variable coefficients (Frobenius Method), Bessel and Legendre equations and their series solutions, Properties of Bessel functions and Legendre polynomials.	30	I
III	**Fourier series** Periodic functions, Trigonometric series, Fourier series of period 2π, Euler's formulae, Functions having arbitrary period, Change of interval, Even and odd functions, Half range sine and cosine series. Harmonic Analysis.	30	I
IV	**Partial Differential Equations and its applications** Homogeneous Linear partial differential with constant coefficients, Non- Homogeneous Linear partial differential equation with constant coefficients. Method of separation of variables for solving partial differential equations, Wave equation up to two-dimensions, Laplace equation in two-dimensions, Heat conduction equations up to two-dimensions, Equations of transmission lines.	30	I

ecommended Books:

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.
2. Peter V. O'Neil, Engineering Mathematics-II, Thomson (Cengage) Learning, 2007.
3. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill Publishing Company Ltd., 2008.
4. R. K. Jain & S. R. K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House, 2002.
5. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2005.
6. C. Ray Wylie & Louis C. Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill Publishing Company Ltd. 2003
7. G. F. Simmons, Differential Equations, Tata McGraw-Hill Publishing Company Ltd. 1981.
8. C. Prasad, Advanced Mathematic for Engineers, Prasad Mudranalaya, 1996.
9. A. C. srivastava and P. K. Srivastava, Engineering Mathematics, Vol. II, PHI Learning Pvt. Ltd., New Delhi, 2011.

SYLLABUS

BAS-3202 ENGINEERING PHYSICS II

Course Objective:

The main objectives of the course are

1. To provide knowledge and to develop an understanding of Modern Physics.
2. To develop a scientific attitude at micro and nano scales of materials.

Learning Outcome:

At the end of the course students shall be able

1. To apply knowledge in developing advanced materials and devices.
2. To apply fundamental laws of electricity and magnetism in engineering.
3. To identify and solve applied physics problems.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Fundamental of quantum Mechanics:** Wave particle duality, de-Broglie matter wave, Davission Germer experiment, Phase velocity and group velocity, Uncertainty principle and its applications, Wave function and its significance, Expectationvalue, Schrödinger wave equation and its significance, Particle in one dimensional box, Linear harmonic oscillator.	30	1
II	**Crystal Structure, X ray Diffraction & Electromagnetism:** Space lattice, basis, Unit cell, Lattice parameter, Seven crystal systems and Fourteen Bravais lattices, Crystal-System Structure, Packing factor (cubic, body and face), Crystal structure of NaCl and diamond, Lattice planes and Miller Indices, Reciprocal Lattice, Diffraction of X-rays by crystal, Laue's experiment, Bragg's Law, Bragg's spectrometer. Displacement current, Equation of continuity, Maxwell's equations (Integral and Differential forms), Poynting. theorem and poynting vectors, EM-wave equation and its propagation characteristics in free space, non-conducting and in conducting media, Skin depth.	30	1

III	**Superconductivity and Nanotechnology:** Superconductors: Temperature dependence of resistivity in superconducting materials, Effect of magnetic field (Meissner effect), Temperature dependence of critical field, Type I and Type II superconductors, BCS theory (Qualitative), High temperature superconductors and applications of super-conductors. Nano-Materials: Basic principle of nanoscience and technology, Structure, properties and uses of fullerene and carbon nanotubes, Synthesis of nanomaterials-chemical vapour deposition technique, pulse laser deposition technique, characterization techniques (XRD, SEM,AFM),. Applications of nanotechnology.	30	1

References:

1. Concept of modern physics, Auther Bieser, Tata Mc-Graw Hill
2. Solid state Physics, S.O. Pillai, New Age International
3. Solid State Physics, CharleKittal Seventh Ed. Wiley Eastren
4. Nanotechnolgy, Reached Booker& Earl Boisen, Welly PL
5. Introduction to Electrodynamics, David J. Griffith, PHI

(Dr. Karunesh Tiwari)
Convener

(Prof. Rajeev Manohar)
External Expert

(Dr. Nitin Jain)
Nominee

(Dr. Neelam Yadav)
Member

BHS3301/BHS3401 Industrial Psychology

Course Objective:

1. To familiarize students with the fundamentals of industrialpsychology required inprofessional areas;
2. To provide the knowledge of theories & concepts of psychologyinvolved in honing industrial & managerial skills;
3. To train them to adjust with the culture & behavior of industrial& managerial environment;
4. To introduce them of different situations/problems arise in industryaffecting human psychology.

Learning Outcome:

After completing the course, the students should be able to:

1. Develop their personality as an employee or an employer in an organization.
2. Understand and analyze the key factors of the relationship between employeeand employer.
3. Understand and apply the fundamental concepts of industrial psychology.
4. Solve the complicacies and conflicts arising in different situations ofindustries andorganization.

Course Contents:

Module	CourseTopics	Total Hours	Credits
I	**Introduction to Industrial Psychology** Introduction to Industrial Psychology, Definitions & Scope, Applications of Industrial Psychology, Management Theories or Approaches: Scientific Management Theory, Human Relation Approach, Hawthorne Experiment. **Individual in work place** Motivation, Job Satisfaction, Stress Management, Organizational Culture, Types of Leaders and Leadership Styles, Group Dynamics.	30 Hours	**1**
II	**Industrial Environment** Work Environment & Engineering Psychology: Industrial Fatigue and Industrial Boredom, Industrial Accidents & Safety Measures, Job Analysis and its Methods, Recruitment and Selection process, Performance Appraisal, 360 Degree Performance Appraisal, Training &Development.	30 Hours	**1**

References:

Text Books

1. Aamodt , M.G. (2007). Industrial/Organizational Psychology: An AppliedApproach.
2. Blum & Naylor.(1982). Industrial Psychology, Its Theoretical & SocialFoundations C.B.S.
3. Miner, J.B. (1992). Industrial/Organizational Psychology. N Y: McGraw Hill.

Suggested Readings

1. Aswathappa, K. (2010). Human Resource Management. New Delhi: TataMcGraw Hill.
2. Rao, V.S.P. (2005). Human Resource Management. Excel Books India.

BHS3302/BHS3402 Industrial Sociology

Course Objective:

1. To familiarize the students with the fundamentals of industrial sociology;
2. To make them understand the impact of industries in society andsocial aspect inindustries
3. To introduce different modern business societies and social stratification;

Learning Outcome:

After completing the course, the students should be able to:

1. Understand and analyze basic terminology and concepts of industrialsociology;
2. Understand the cultural and behavioral differences betweengeneral societies andsocieties;
3. Maintain harmony between social and industrial environment;
4. Adjust with the culture and behavior of multinational industrial organizations;

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Concept of Industrial Sociology** Industrial Sociology: Meaning, Nature and Scope of Industrial Sociology. Industrial and post- industrial society. Industrialization in India: causes and consequences, Industrial Disputes: causes and preventions, Understanding others: Attributions, Types of Bargaining, Collective Bargaining, Personnel Management and Human Resource Management, Social Change in India: Westernization, Modernization and Globalization. Sociology of Modern Organizations. Modern business organization: Ownership and control	30 Hours	**1**
II	**Socio cultural issues in Indian industries** Grievances and handling procedure, Strikes and lockouts, Models of Industrialization Collectivist, Anarchist, free market, environmentalist, etc. Cultural issues, Consumer society and Sociological concerns.	30 Hours	**1**

References:

Text Books

1. Barnard, Chester I. (1936). The functions of the executive. HarvardUniversity Press,Cambridge Mass.
2. Burak. (1975).Organization analysis: Theory and applications. Dryden Press.
3. Weber, Max. (1947). The theory of Social and economic organization.
4. Damel Bell.(1973). Coming of post Industrial Society. Basic Book.

Suggested Readings

1. Gupta, Giriraj.(2010).Main currents of Indian Sociology series, vol. 6 onUrban India.
2. Gupta, Dutta, Bela.(2011). Contemporary social problems in India.
3. Srinivas and Panini. (1977).Development of Sociology and socialAnthropology in India.Sociological Bulletin.

BAS 3301 Complex Analysis and Integral Transform

Course Objective:

The general objective of the course is to provide

1. the concept of algebra and geometry of complex numbers, concept ofanalytic function, Cauchy-Reimann equations and their applications;
2. concept of expansion of functions by Taylor's and Laurent's series;
3. concept of complex integration, singularities and residues;
4. concept of integral transforms and to introduceLaplace, Fourier andZ transforms.

Learning Outcome:

Upon successful completion of Complex Analysis, a student will be able to

1. Represent complex numbers algebraically and geometrically;
2. Define and understand the concept of limits, continuity anddifferentiability of functions ofcomplex variables;
3. Apply the concept and consequences of analyticity and the Cauchy-Riemann equations and ofresults on harmonic and entire functions including the fundamental theorem of algebra;
4. Identify and construct examples of paths satisfying prescribed properties.Evaluate complex path integrals and state and prove properties of such integrals;
5. Understand the concept and consequence of Cauchy's theorem and alsothat of Cauchy's integral formula, the power series representation for analytic functions, Liouville's theorem;
6. Find Taylor and Laurent series for a complex function, compute residuesand apply the residuetheorem to evaluate integrals;
7. apply Laplace transform to solve the differential equations;
8. **determine** Fourier transform, Fourier sine and cosine transform of afunction;
9. Apply Z-transform to solve the difference equations.

BAS 3301 Complex Analysis and Integral Transform **Credits: 4**

Course Objective:

The general objective of the course is to provide

1. the concept of algebra and geometry of complex numbers, concept of analytic function, Cauchy-Reimann equations and their applications;
2. concept of expansion of functions by Taylor's and Laurent's series;
3. concept of complex integration, singularities and residues;
4. concept of integral transforms and to introduce Laplace, Fourier and Z – transforms.

Learning Outcomes:

Upon successful completion of Complex Analysis, a student will be able to

1. represent complex numbers algebraically and geometrically;
2. define and understand the concept of limits, continuity and differentiability of functions of complex variables;
3. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions including the fundamental theorem of algebra;
4. identify and construct examples of paths satisfying prescribed properties. Evaluate complex path integrals and state and prove properties of such integrals;
5. understand the concept and consequence of Cauchy's theorem and also that of Cauchy's integral formula, the power series representation for analytic functions, Liouville's theorem;
6. find Taylor and Laurent series for a complex function, compute residues and apply the residue theorem to evaluate integrals;
7. apply Laplace transform to solve the differential equations;
8. **determine** Fourier transform, Fourier sine and cosine transform of a function;
9. apply Z-transform to solve the difference equations.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Complex Analysis I** Analytic function, Cauchy-Reimann equation and harmonic functions, Line Integral in complex plane, Cauchy's theorem (without proof) Cauchy's Integral formula, Cauchy's Integral formula for derivatives of analytic functions, Morera's Theorem (without proof) Liouville's theorem, Fundamental Theorem of algebra.	30	1
II	**Complex Analysis II** Representation of a function by power series, Taylor's and Laurent's Series, Singularities, Zeroes and Poles, Residue theorem, Evaluation of real	30	1

	integrals of the type $\int_0^{2\pi} f(\cos\theta,\sin\theta)d\theta$ and $\int_{-\infty}^{\infty} f(x)dx$, Introduction to Conformal Mapping.		
III	**Laplace Transform** Laplace transform, Existence theorem, Laplace transform of derivatives and integrals, Inverse Laplace transform, Unit step function, Dirac delta function, Convolution theorem, Application to simple linear and simultaneous differential equations.	30	1
IV	**Fourier and Z-transforms** Fourier Integral, Fourier complex transform, Fourier sine and cosine transforms, Z-transform and applications.	30	1

Recommended Books:

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2005.
3. Churchill and Brown, Complex Variables and Applications, Tata McGraw- Hill, 1996.

BCS3301 Discrete Mathematics

Course Objective:

1. To introduce a number of Discrete Mathematical Structures (DMS) found to beserving as tools even today in the development of theoretical computer science.
2. Course focuses on of how Discrete Structures actually helped computer engineers to solveproblems occurred in the development of programminglanguages.
3. Also, course highlights the importance of discrete structures towardssimulation of a problemin computer science and engineering.
4. Introduction of a number of case studies involving problems of ComputerTechnology.
5. List the terms in a sequence, write a sequence in closed from computer the sum of a finite sequence, compute the product of a finite sequence and express sequence in term recursive or non-recursive forms.
6. Simplify and evaluate basic logic statement including compound statement implications, inverse, converse and contra positive using truth table and properties of logic. Determine if a graph has Euler or Hamilton path or circuit.

Learning Outcome:

At the end of the course, the student should be able to**:**

1. Have a complete knowledge on various discrete structures available in literature.
2. Have realization of some satisfaction of having learnt that discrete structures are indeed useful in computer science and engineering and thereby concludingthat no mistake has been done in studying this course.
3. Gain some confidence on how to deal with problems which may arrive incomputer science andengineering in near future.
4. To appreciate the basic principles of Boolean algebra, Logic, Set theory.
5. Be able to construct simple mathematical proofs.
6. Be able to understand logical argument and logical constructs have a betterunderstanding ofsets, functions and relations.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**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, Recursively defined functions, Growth of Functions. Natural Numbers: Introduction, Mathematical Induction, Induction with Nonzero Base cases, Proof Methods, Proof by counter example, Proof bycontradiction.	30 Hours	1
II	**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, Completelattice;	30 Hours	1
III	**Boolean Algebra & Proposition Logic** Boolean Algebra: Introduction, Axioms andTheorems of Boolean algebra, Algebraic manipulation of Boolean expressions, Simplification of Boolean Functions, Karnaugh maps, Logic gates, Digital circuits and Boolean algebra. Propositional Logic: Proposition, well-formed formula, Truth tables, Tautology, Satisfiability; Contradiction; Algebra of proposition; Theory of Inference; Predicate Logic: First order predicate-well-formed	30 Hours	1

	formula of predicate, quantifiers, Inferencetheory of predicate logic.		
IV	**Trees, Graph, Recurrence Relation & Combinatorics** Trees: Definition: Binary tree, Binary tree traversal, Binary search tree; Graphs: Definition and terminology: Representation of graphs, Multigraphs, Bipartite graphs, Planar graphs, Isomorphism and Homeomorphism of graphs, Euler and Hamiltonian paths, Graph Coloring. Recurrence Relation & Generating function: Recursive definition of functions, Recursive algorithms, Method of solving recurrences. Combinatorics: Introduction; Counting Techniques: Pigeonhole Principle.	30 Hours	1

Text/Reference Books:

1. Koshy, "Discrete Structures", Elsevier Publication.
2. Kenneth H. Rosen, "Discrete Mathematics and Its Applications", (2017) McGraw-Hill.
3. B. Kolman, R.C. Busby, and S.C. Ross, "Discrete Mathematical Structures", (2015) Prentice Hall.
4. R.P. Grimaldi, "Discrete and Combinatorial Mathematics", (1998) AddisonWesley.

CCML3301 Fundamentals of Data Science

Course Outcome:

6. To provide an overview of an exciting field of Predictive Analytics. To introduce the tools and frameworks required to build Java Enterprise Applications.
7. To introduce the tools required For Predictive Analytics.
8. Review and explore data to look at data distributions and to identify data problems, including missing values.
9. To enable students to have skills that will help them to solve complex real-world problems in decision support.
10. To study, understand and implement each unit according to National Education Policy 2020.

Learning Outcome:

At the end of the course, the student should be able to:

6. Understand and critically apply the concepts and methods of Business analytics. The learning outcomes has been achieved accordingly in Unit 1.
7. To understand and apply IBM SPSS Modeler in Data Mining, what kinds of data can be mined, what kinds of patterns can be mined. The learning outcomes has been achieved accordingly in Unit 2.
8. Applying and analyzing how to use functions, deal with missing values, use advanced field operations, handle sequence data and improve efficiency. The learning outcomes has been achieved accordingly in Unit 3 & 4.
9. To evaluate the Model on the basis of different Predictive Methods. The learning outcomes has been achieved accordingly in Unit 4.
10. Building and creating advanced analytical models that leverage historical data to uncover real-time insights to predict future events. The CLO has been achieved accordingly in Unit 6.

Course Contents

Module	Course Topics	Total Hours	Credits
I	**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	1
II	**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	1
III	**PREDICTIVE ANALYTICS WITH IBM WATSON STUDIO** IBM Watson Studio, Watson studio Components, Data preparation, Watson Machine learning, Data Refinery,	30 Hours	1

	Watson Studio Neural Network Modeler, IBM Watson Studio jobs, Use case with AutoAI.		
IV	**PROJECT** Predicting using IBM SPSS Modeler & IBM Watson with real Case studies.	30 Hours	1

Text/Reference Books:

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

BAI3302 Artificial intelligence in Mechanical Engineering Systems

Course Objective:

1. To learn how Artificial Intelligence (AI) works in Mechanical Engineeringsystem.
2. To learn about Mechanical Engineering system.
3. To learn how to Apply AI in Mechanical Engineering system.
4. To learn the application of AI in Mechanical Engineering system.

Learning Outcome:

After completing the course, the students should be able to:

1. To understand the usefulness of AI system for Mechanical Engineering systems
2. To understand designing, selection and application AI system for Mechanical Engineering systems
3. To understand the knowledge base system and software for Mechanical Engineering systems
4. To understand the application AI in selection Mechanical Engineering systems
5.

Course Contents:

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

Text/Reference Books:

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

BCS3305/BCS3405 Computer Concepts & Programming in 'C'

Course Objective:

1. The course aims to provide exposure to problem solving through programming.
2. It aims to train the student to the logic concepts of c- programming language.
3. To learn C programs and to apply your skills in writing real application programs using C.
4. Explains all the concepts of C programming language clearly with simple programs.
5. To learn the basics of all other programming languages such as C++, Java,

Learning Outcome:

At the end of the course, the student should be able to:

1. Identify situation where computational methods and computers would be useful.
2. Write, compile and debug programs in C language.
3. Choose the right data representation formats based on the requirements of the problem.
4. Design programs involving decision structures, loops and functions.
5. Explain the difference between call by value and call by reference
6. Understand the dynamics of memory by the use of pointers.
7. Use different data structures and create/update basic data files.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**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 types, short, long. Unsigned Character types, single and double precision floating point.	30 Hours	1
II	**Storage Classes, Operators and Control Statements** Storage Classes in C: Automatic, register, static, extern, Operators and Expressions in C: Arithmetic,	30 Hours	1

	Relational, Logical, Assignment, Bitwise, Conditional, Increment and Decrement, Special Operators such as comma, sizeof etc. Type Conversion inC, Operator Precedence and Associativity, Mixed mode operations, Standard Input/outputfunctions: 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.		
III	**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	1
IV	**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	1

Text/Reference Books:

1. Yashavant P. Kanetkar, "Let Us 'C'", BPB Publications
2. Jeri R. Hanly, Elliot B. Koffman, "Problem Solving and Program Design in C", Pearson Addison-Wesley.
3. Behrouz A., "Computer Science- A Structured Programming Approach Using C".
4. E Balaguruswamy, "Computer Concepts and Programming in C", Tata McGraw Hill Publications

BCS3351 UNIX & Shell Programming

Introduction to basic UNIX commands and scripts.

1. To Study Basic UNIX / Linux Commands.
2. Study & use of commands for performing arithmetic operations with UNIX/Linux.
3. Performing input output redirection.
4. Practicing Disk related utilities.
5. Implementing the file security using chmod, umask and sticky bit.
6. Understanding filters & pipes to perform complex taskspr, head,
7. tail, cut, paste, sort, uniq, nl, tr, grep etc.
8. Using Regular Expressions (including basic awk programming)

Shell Programming

1. Learning vi editor
2. Writing and executing Shell script for UNIX environment
3. Implementing positional parameters, shell Meta characters,argument validation in Shell scripts.
4. Shell programming- writing simple functions, basic tests, loops, patterns, expansions, substitutions
5. Writing, compiling and running a C program on UNIX / Linux.
6. Implementation of eval command to handle input and output

CCML3351 Data Science Lab

List of Programs

1. Work with IBM SPSS Modeler.
2. Create a data-mining project to predict churn in telecommunications.
3. Understand the telecommunications data.
4. Set the unit of analysis for the telecommunications data.
5. Integrate telecommunications data
6. Predict churn in telecommunications and cluster customers into segments.
7. Use functions to cleanse and enrich telecommunications data
8. Improve efficiency with telecommunications data.
9. Analyzing data with Watson Studio.
10. Creating a machine learning model with IBM Watson Studio and the AutoAI tool

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 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.

BAI3352 Artificial intelligence in Mechanical Engineering Systems

1. Study of Artificial Intelligence for a Thermal System
2. Study of NC Machine
3. Study of CAD software
4. Study of Additive Manufacturing.
5. Study of 3 D printing
6. Study of Sensors
7. Study of Actuators

BCS3355/ BCS3455 'C' Programming Lab

Note: Minimum 10 experiments to be performed by students.

List of Experiments: Using Turbo C / Visual Studio 6.0 C++ environment

Part I:

1. Creating and editing simple C program, debugging, compilation, execution.
2. 'C' programming on variables and expression assignment, simple arithmetic Loops, If-else, Case statements, break, continue, goto.
3. Implementing different operations on Single & Multidimensional arrays.
4. Implementing different String handling inbuilt and user defined functions.
5. Functions, recursion, file handling in 'C'.
6. Pointers, address operator, declaring pointers and operations on pointers.
7. Address of an array, structures, pointer to structure, dynamic memory allocation.
8. 2's complement of a numbers.

BAS 3401 Statistical and Numerical Technique

Course Objective:

The general objective of the course is to

1. Introduce statistical methods and various tests to draw inferences in variousdecisionmaking situations;
2. Introduce the concept of an error analysis for various numerical methods;
3. Develop appropriate numerical methods to solve algebraic and transcendentalequations;
4. Develop results for various numerical root finding methods;
5. Develop appropriate numerical methods to approximate a function;
6. Develop appropriate numerical methods to solve a differential equation;
7. Develop appropriate numerical methods to evaluate a derivative at a value;
8. Develop appropriate numerical methods to solve a linear system of equations;
9. Develop appropriate numerical methods to calculate a definite integral.

Learning Outcomes:

Upon successful completion of this course, students will be able to

1. Understand and to calculate correlation and fit lines of regression;
2. Prepare control charts and interpret on the basis of results shown in chart;
3. Understand Normal distribution and apply it in various inferential problems (-tests);
4. Apply various exact sample tests (χ^2- &est) and draw inference from it;
5. Perform an error analysis for a given numerical method;
6. Solve an algebraic or transcendental equation using an appropriate numericalmethod;
7. Approximate a function using an appropriate numerical method;
8. Solve a differential equation using an appropriate numerical method;
9. Evaluate a derivative at a value using an appropriate numerical method;
10. Solve a linear system of equations using an appropriate numerical method;
11. Prove results for numerical root finding methods;
12. Calculate a definite integral using an appropriate numerical method.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Statistical Method & Inference** Correlation, regression and statistical qualitycontrol (R, p, np , and c charts). Brief Introduction of Normal distribution, Testingof hypothesis: Small sample test (t-test, chi square test), Large sample test: z-test, Analysisof variance.	**30**	**1**
II	**Numerical Method I:** Errors and their computation, General error formula, Error in a series	30	1

	Solution of algebraic and transcendental equations using Bisection, Regula-Falsi, Newton- Raphsonmethods and the rate of convergence. Solution of system of linear algebraic equations: Gauss elimination, Gauss Jordan, Jacobi, Gauss- Seidal and Crout methods.		
III	**Numerical Method II:** Interpolation, Finite differences, difference tables, and backward interpolation, anddivided difference formula for unequal intervals. Newton's forward Lagrange's Newton's Numerical differentiation, Numerical integration:Newton-one third and three-eight rules. Numerical solution to ordinary differential (firstorder) equations by Euler's, Cotes formula, Trapezoidal, and fourth-orderRunge-Kutta methods. Simpson's Picard's	30	1

Recommended Books:

1. E. Balagurusamy, Numerical Methods, Tata McGraw Hill, 2009.
2. S. S. Sastry, Introductory Methods of Numerical Analysis, 3rd ed. Prentice- Hallof India,New Delhi (2002).
3. M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific andEngineering Computation, New Age International, NewDelhi, 2003.
4. B. S. Grewal, Numerical Methods in Engineering and Science, Khanna Publishers,Delhi.(2013)
5. J. N. Kapoor, Mathematical Statistics, S. Chand Publication, 2004.

BCS3401 Database Management Systems

Course Objective:

1. The course DBMS provides an introduction to the management of system.
2. The course emphasizes the understanding of the fundamental of relational systemincludes data mode, data architecture and data manipulations.
3. The course also provides an understanding of new development such as internetDatabase environment and data warehousing.
4. The course uses a problem based approach to learning.
5. To develop the concepts of Transaction Processing System, Concurrency control,and Recovery procedures in database.

Learning Outcome:

At the end of the course, the student should be able to:

1. Understand terms related to database design and management.
2. Understand the objectives of data and information management.
3. Understanding of data development problems.
4. Relation model and RDBMS understanding.
5. Construct conceptual data model.
6. Understand data base performance issues.
7. Understand the basic of data management and administration.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**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	1

II	**Data Modeling & Relational Database Management System** Data Modeling 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 inRelational Algebra	30 Hours	1

III	**SQL and Database Design Theory and Methodology** Structured Query Language- The Relational Database Standard, Data Definition, Constraints, and Schema Changes in SQL, Types of SQL Commands, SQL Operators and their Procedure, Insert, Delete, and Update Statements in SQL, Queries and Sub Queries, 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	30 Hours	1
IV	**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, Multi version 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, Client Server Database Environment, Internet Database Environment, Data Warehousing Introduction	30Hours	1

Text/Reference Books:

1. Korth, Silbertz, Sudarshan, "Data Base Concepts", McGraw-Hill.(1997)
2. Ivan Bayross, "SQL, PL/SQL: The Programming Language Of Oracle" (2010)
3. Date C. J., "An Introduction to Data Base System", AddisionWesley.(2003)
4. Elmasri, Navathe, "Fundamentals of Data Base Systems", AddisionWesley.(2015)
5. Bipin C. Desai, "An introduction to Data Base Systems", GalgotiaPublication.(2012)
6. Ramakrishnan, Gehrke, 'Data Base Management System", McGraw-Hill.(2014)
7. Connolly &Begg, "Database Systems: A Practical Approach to Design, Implementation and Management", Pearson Education.(2015)

BCS3402 Operating system

Course Objective:

1. Study the basic concepts and functions of operating systems.
2. Understand the structure and functions of OS.
3. To gain insight on the distributed resource managementcomponents.
4. Learn about Processes, Threads and Scheduling algorithms.
5. To gain knowledge on O.S concepts that includes architecture mutualexclusion algorithms, deadlockdetection algorithms and agreement.
6. Understand the principles of concurrency and Deadlocks.
7. Learn various memory management schemes.
8. Study I/O management and File systems.

Learning Outcome:

At the end of the course, the student should be able to:

1. Understanding of the concepts, structure and design of O.S.
2. Design various Scheduling algorithms.
3. Apply the principles of concurrency.
4. Design deadlock, prevention and avoidance algorithms.
5. Compare and contrast various memory management schemes.
6. Design and Implement a prototype file systems.
7. Demonstrate understanding of O.S design and its impacton applicationsystem design and performance.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**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 andSchemes	30 Hours	1

II	**Process Synchronization and Deadlock** Process synchronization, Producer/Consumer Problem, Critical Section Problem, solution, Synchronization of hardware, Semaphore, Classical- problem of synchronization, Deadlock, Deadlock characterization, Deadlock Prevention, Deadlock Avoidance, Resource allocation graph algorithm, algorithm, Deadlock detection, Recovery from deadlock	30 Hours	1
III	**Memory Management** Memory Management, Basic bare machine, Resident monitor, 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	1
IV	**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 Management	30 Hours	1

Text/Reference Books:

1. Silberschatz, Galvin and Gagne, "Operating Systems Concepts", WileyPublication, 2002
2. Sibsankar Halder and Alex A Aravind, "Operating Systems", PearsonEducation, 2010
3. D M Dhamdhere, "Operating Systems: A Concept based Approach", TMH,2017
4. William Stallings, "Operating Systems: Internals and Design Principles", Pearson Education,2018

BCS3403 Data Structure using 'C'

Course Objective:

1. Master analysing problem writing program solutions to problems using the above techniques. Demonstrate familiarity with major algorithms and data structures.
2. Demonstrate familiarity with major algorithms and data structures.
3. Master the implementation of linked data structures such as link list and binary trees.
4. Analyse performance of algorithms.
5. Be familiar with several sub quadratic solving algorithms including quick short, heap sort and merge short.
6. Choose the appropriate data structure and algorithm design method for a specified application.
7. Determine which algorithm or data structure to use in different scenarios.
8. Be familiar with writing recursive methods.
9. Demonstrate understanding of the abstract properties of various data structures such as stacks, queues, lists, trees and graphs.
10. Use various data structures effectively in application programs.
11. Demonstrate understanding of various sorting algorithms, including bubble sort, insertion sort, selection sort, heap sort and quick sort.
12. Understand and apply fundamental algorithmic problems including Tree traversals, Graph traversals, and shortest paths.
13. Demonstrate understanding of various searching algorithms.

Learning Outcome:

At the end of the course, the student should be able to:

1. Student develop knowledge of applications of data structures including the ability to implement algorithms for the creation, insertion, deletion, searching and sorting of each data structures.
2. Demonstrate knowledge of underlying data structures needed for solving problems and programming.
3. Develop knowledge of applications of data structures for storage and retrieval of ordered and unordered data.
4. Learn to analyse and compare algorithms for efficiency using Big-O notation.
5. Implement/ utilize various data structures using a programming language such as C.
6. Analyse algorithms in connection with data structures.
7. Demonstrate knowledge of various searching and sorting techniques.
8. Apply dynamic memory allocation in creation of linked lists.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction** Introduction: Basic Terminology, Data types and its classification, Algorithm complexity notations like big Oh, Time-Space trade-off. Abstract Data Types (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	1

II	**Stack and Linked List** Stack, Array Implementation of stack, Linked Representation of Stack, Application of stack: Conversion of Infix to Prefix and Postfix Expressions	30 Hours	1
	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		
III	**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 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.	30 Hours	1
IV	**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: Warshal Algorithm and Dijikstra Algorithm.	30 Hours	1

Text/Reference Books:

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

CCML3401 DevOps

Course Outcome:

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.

Learning Outcome:

At the end of the course, the student should be able to:

1. Implementation of concepts of DevOps in real life scenarios to improve the process.
2. Automation can be implemented for swift completion of the tasks and increase productivity.
3. Students will be able to understand the concepts of DevOps and Design Thinking which are being followed by MNCs around the globe.
4. Understand the working of tools used for automation purposes.

Course Contents

Module	Course Topics	Total Hours	Credits
I	**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	1
II	**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	30 Hours	1
III	**Agile Deep Dive** 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 **Scrum Deep Dive** Foundation of Scrum; Scrum Team; Roles in Scrum Team; Sprints; Definition of Ready **Scrum Artifacts**	30 Hours	1

	Product backlog; Sprint Backlog; Sprint Burndown; Impediments list		
IV	**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	1

Text/Reference Books:

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

BCS3451 Database Management System Lab

Note: Minimum 8 experiments to be performed by students

List of Experiments**:**

1. Write the queries for Data Definition and Data Manipulation Language.
2. Write SQL queries using logical operations (=, <,>, etc)
3. Write SQL queries using SQL operators.
4. Write SQL query using character, number, date and group functions.
5. Write SQL queries for relational algebra.
6. Write SQL queries for extracting data from more than one table.
7. Write SQL queries for sub queries, nested queries.
8. Write programme by the use of PL/SQL.
9. Concepts for ROLL BACK, COMMIT & CHECK POINTS.
10. Create VIEWS, CURSORS and TRGGERS & write ASSERTIONS.
11. Create FORMS and REPORTS.
12. Create table command.
13. Alter table command.
14. Drop table command.
15. Update table command.

CCML3451: DevOps Lab

LIST OF EXPERIMENTS:

1. Designing a better way for cab booking from start to finish. Create a List of Stakeholders, Empathy Map and As-is Scenario Map
2. In Above case discussed in practical I, create Big Idea Vignettes, Prioritization grid and Need statements.
3. For the same case create story board, Hills
4. Create a To-be Scenario for the case discussed in Practical I
5. Installing Docker and Creating Docker Image
6. Pull and Push of docker images to and from docker repository.
7. Installation of Ubuntu on a virtual machine.
8. Installation of GIT and Creating GIT Repository.
9. Testing Using Junit
10. Setting up DevOps on IBM Cloud

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.

BCS3453 Data Structure Lab

List of Experiments:

Write Programs in C or C++ for following.

1. Array implementation of Stack.
2. Array implementation of Queue.
3. Array implementation of Circular Queue.
4. Array implementation of List
5. Implementation of Stack,
6. Implementation of Circular Queue,
7. Implementation of List using Dynamic memory Allocation.
8. Implementation of Queue.
9. Implementation of Tree Structures,
10. Implementation of Binary Tree.
11. Implementation of Tree Traversal.
12. Implementation of Binary Search Tree.
13. Implementation of Insertion in BST.
14. Implementation of Deletion in BST.
15. Implementation of Searching and Sorting Algorithms.
16. Graph Implementation, BFS.
17. Graph Implementation, DFS.
18. Graph Implementation, Minimum cost spanning tree.
19. Graph Implementation, shortest path algorithm.

BCS3454 Numerical Techniques Lab

Write Programs in 'C' Language:

1. To deduce error evolved in polynomial equation.
2. To find out the root of the Algebraic and Transcendental equations using Bisection, Regula-falsi, Newton Raphson and Iterative Methods. Also give the rate of convergence of roots in tabular form for each of these methods.
3. To implement Newton's forward and Backward Interpolation formula.
4. To implement Gauss Forward and Backward, Bessel's, Sterling's and Evertt's Interpolation formula
5. To implement Newton's Divided Difference and Langranges Interpolation formula.
6. To implement Numerical Differentiations.
7. To implement Numerical Integration using Trapezoidal, Simpson 1/3 and Simpson 3/8 rule.

BHS3501: Engineering and Managerial Economics

Course Objectives:

1. to familiarize the students with the real world problems with asystematic theoreticalframework;
2. to impart the internal and external decisions to be made by managers;
3. to provide the competitive strategies including pricing, product differentiationaccording to thenature of products and the structures of the markets;

Learning Outcome:

After the successful completion of the course the student shall be able to

1. analyze the supply and demand analysis for economic and business strategyissues;
2. illustrate how economies of scale, scope and learning determine theboundaries of a firm andmarket structure;
3. make decisions and plans for the business;
4. demonstrate and evaluate global, economic problems impacting theinternal and externalenvironments of organizations;
5. evaluate the risks associated with developing and commercializing newtechnologies andproducts, and research new business formation and growth;

Course Contents:

Module	Course Topic	Total Hours	Credit
I	**Introduction and basic concepts** Meaning ,nature and scope of Economics, Role of Engineering in Economics, Managerial economics and its scope in Engineering perspective. Relationship between Science, Engineering and Managerial Economics Demand Analysis, law of Demand, Determinants of demand, Elasticity of Demand- Price, Income and Cross elasticity. Law of supply, factor affecting supply, Elasticity of supply.	30 Hours	1

II	**Demand Forecasting** Meaning, Significance and methods of demand forecasting, Production functions, Law of Return to scale and Law of Diminishing Return to scale. An overview of Short run and Long run cost curve-Fixed cost, variable cost, average cost, marginal cost and opportunity cost. Break- Even Analysis	30 Hours	1
III	**Market Structure** Perfect Competition, Imperfect Competition, Monopoly, Monopolistic, Oligopoly, Duopoly, Sorbent features of Price discrimination	30 Hours	1
IV	**National Income, Inflation and Business Cycle:** Nature and characteristic of Indian Economy, Concept of National Income and measurement, Meaning of Inflation, Types, causes and prevention methods. Deflation, Phases of Business Cycle.	30 Hours	1

References:

Text Books

1. McGuigan, James R., Moyer, R. Charles. (2007). *Managerial Economics: Applications, Strategies, and Tactics* .
2. Samuelson, Paul A. (2010). *Economics* . Tata McGraw Hill.

Suggested Readings

1. Dwivedi, D. N. (2010). *Managerial Economics* . Vikas Publishing.
2. Mithani, D. M. (2007). *Managerial Economics* . Himalaya Publishing House.

CCML 3501 Predictive Analytics

Course Outcomes

1. Introduction to concepts and methods of predictive analytics.
2. To prepare data for exploratory data analysis
3. To apply various regression and clustering models
4. To apply time series analysis, text mining and sentiment analysis.

Learning Outcomes

1. Understand the principles and techniques of predictive analytics
2. Appling regression and classification methods and models to analyze different types of data
3. Application of clustering algorithm
4. Analysis of time series, text and sentiments

Module	Course Contents	Contact Hrs.	Credits
1	**INTRODUCTION**: Introduction to Predictive Analytics, What is predictive analytics and why is it important?, The predictive analytics process and framework, Examples and applications of predictive analytics in various domains, **TOOLS AND SOFTWARE FOR PREDICTIVE ANALYTICS:** Data Preparation and Exploratory Data Analysis, Data sources, types and formats, Data cleaning, transformation and integration, Data exploration and visualization, Descriptive statistics and summary measures,	30 Hours	1
2	**REGRESSION ANALYSIS:** Simple linear regression, Multiple linear regression, Model selection and validation, Polynomial regression and nonlinear models, Logistic regression **CLASSIFICATION ANALYSIS:** Decision trees, K-nearest neighbors, Support vector machines, Naive Bayes	30 Hours	1
3	**CLUSTERING ANALYSIS:** K-means clustering, Hierarchical clustering, Density-based clustering, Evaluation and validation of clustering results,	30 Hours	1
4	**TIME SERIES ANALYSIS:** Components and patterns of time series data, Stationarity and autocorrelation, Moving average and exponential smoothing methods, ARIMA models and forecasting. **TEXT MINING AND SENTIMENT ANALYSIS:** Text data preprocessing and representation, Term frequency-inverse document frequency (TF-IDF), Topic modeling and latent semantic analysis (LSA), Sentiment analysis and opinion mining	30 Hours	1

Suggested Readings

1. Data Science and Predictive Analytics: Biomedical and Health Applications using R by Ivo D. Dinov.
2. Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies by John D. Kelleher, Brian Mac Namee and Aoife D'Arcy.
3. Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die by Eric Siegel.
4. Predictive Analytics: Modeling and Optimization by Vijay Kumar and Mangey Ram.
5. Predictive Analytics For Dummies by Dr. Anasse Bari and Mohamed Chaouchi.

CCML3502 CLOUD COMPUTING

Course Outcome:

1. To provide an overview of an exciting field of Cloud Computing
2. To introduce tools requires building, deploying, running and managing applications on a cloud platform.
3. To develop the cloud application development skills, such as Node.js, REST architecture, JSON, Cloud Foundry and DevOps services
4. To enable students to have skills that will help them to solve complex real-world problems in decision support.
5. To study, understand and implement each unit according to National Education Policy 2020.

Learning Outcome:

At the end of the course, the student should be able to:

1. Understand the vision of Cloud Computing from a global context. The CLO has been achieved accordingly in Unit 1.
2. To understand various compute options on IBM Cloud by market perspective of Cloud Computing. The CLO has been achieved accordingly in Unit 2.
3. Analyzing architecture and implementation of APIs with services of IBM Cloud in Cloud Computing. The CLO has been achieved accordingly in Unit 3.
4. To integrate the Node.js application with Watson services over IBM Cloud. The CLO has been achieved accordingly in Unit 4.
5. Building and creating state of the art architecture in Kubernetes cluster. The CLO has been achieved accordingly in Unit 5.

Course Contents

Module	Course Topics	Total Hours	Credits
I	**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	1
II	**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	1
III	**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	30 Hours	1
IV	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	1

Text/Reference Books:

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

BCS3503 Computer Networks

Course Objectives:

1. Build an understanding of the fundamental concepts of computer networking.
2. To understand the organization of computer networks, factors influencing computer network development and the reasons for having variety of different types of networks.
3. To apply knowledge of different techniques of error detection and correction to detect and solve error bit during data transmission.
4. To demonstrate proper placement of different layers of ISO model and illuminate its function.
5. To understand internals of main protocols such as FTP, SMTP, TCP, UDP, IP
6. To analyze simple protocols and can independently study literature concerning computer networks.
7. Have a basic knowledge of the use of cryptography and network security.

Learning Outcomes:

At the end of the course, the student should be able to:

1. Independently understand basic computer network technology.
2. Identify the different types of network topologies and protocols.
3. Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
4. Identify the different types of network devices and their functions within a network
5. Understand and building the skills of routing mechanisms.
6. Analysis the requirements for a given organizational structure and select the most appropriate networking architecture and technology.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction** Introduction: Network objectives and applications; network structure and architecture; OSI reference model; network services; network standardization; examples of network; 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	1
II	**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 networks and FDDI.	30 Hours	1

III	**Transport, Session and Presentation layer** Transport layer: Design Issues; connection management; example of a simple transport protocol. Session layer: Design issues; remote procedure call; examples, Presentation layer: Design issues; data compression and encryption; network security and privacy. Examples;	30 Hours	1
IV	**Application Layer** Application layer: Design issues; File transfer and file access; electronic mail; virtual terminals; other applications, Case study based on available network software.	30 Hours	1

Text/Reference Books:

1. Andrew S. Tanenbaum "Computer Networks" Prentice Hall of India.
2. William Stallings "Local Networks" Maxwell Macmillan International Edit
3. B.A. Forouzan "Data Communication and Networking". Tata McGraw Hill.

BCS3504 Automata Theory and Formal Languages

Course Objective:

1. Students will learn several formal mathematical models of computation along with their relationships with formal languages.
2. They will learn regular languages and content free languages which are crucial to understand how compilers and programming languages are built.
3. Also students will learn that not all problems are solvable by computers and some problems do not admit efficient algorithms.
4. Throughout this course, students will strengthen their rigorous mathematical reasoning skills.

Learning Outcome:

At the end of the course, the student should be able to:

1. Demonstrate an understanding of abstract models of computing, including deterministic (DFA), non deterministic (NFA) and Turing Machine (TM) models.
2. Understand the relative computing power of the different abstract machine models.
3. Demonstrate an understanding of regular expression and grammars.
4. Understand the associations between language classes and machine models.
5. Understand the associations between language classes and language descriptors.
6. Understand decidable and undecidable problems.
7. Understand the application of machine models and descriptors to compiler theory and parsing.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction to Automata** Introduction, Alphabets, Strings and Languages, Automata and Grammars, Deterministic finite Automata (DFA)-Formal Definition- State transition graph, Transition table, Language of DFA. Nondeterministic finite Automata (NFA)-NFA with epsilon transition, Language of NFA, Equivalence of NFA and DFA, Minimization of Finite Automata, Myhill-Nerode Theorem.	30 Hours	1
II	**Regular expression** Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, Application and Limitations of FA, DFA to Regular expression- Arden Theorem, Non Regular Languages, Pumping Lemma for regular Languages - Application of Pumping Lemma, Closure and Decision properties of Regular Languages, FA with output -Moore and Mealy machine, Equivalence of Moore and Mealy Machine.	30Hours	1

III	**Context free grammar and Context Free Languages** Definition, Examples, Derivation , Derivation trees ,Ambiguity in Grammar, -Inherent ambiguity , Ambiguous to Unambiguous CFG, Useless symbols ,Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure and Decision properties of CFL, Pumping lemma for CFLs. **Push Down Automata (PDA)**-Description and Definition, Instantaneous description, Language of PDA Acceptance by Final state, Acceptance by empty stack-Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG ,Two stack PDA.	30 Hours	1
IV	**Turing machines (TM):** Basic model, definition and representation, Instantaneous description, Language acceptance by TM, Variants of Turing Machine, Universal TM,TM as computer of integer function, Church's Thesis, Recursive and recursively enumerable languages., Halting problem , Introduction to Undecidability - Undecidable problems about TMs, Post correspondence problem (PCP), Modified PCP and Introduction to recursive function theory .	30 Hours	1

Text/Reference Books:

1. 1.Hopcroft, Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education.
2. K.L.P. Mishra and N. Chandrasekaran, "Theory of Computer Science: Automata, Languages and Computation", PHI Learning Private Limited, Delhi India.
3. Peter Linz, "An Introduction to Formal Language and Automata", Narosa Publishing house.
4. Y. N. Singh "Mathematical Foundation of Computer Science", New Age International.
5. Papadimitrou, C. and Lewis, C.L., "Elements of the Theory of computation", PHI Learning Private Limited, Delhi India.
6. K. Krithivasan and R. Rama; Introduction to Formal Languages, Automata Theory and Computation; Pearson Education.
7. Harry R. Lewis and Christos H. Papadimitriou, Elements of the theory of Computation, Second Edition, Prentice-Hall of India Pvt. Ltd.
8. Micheal Sipser, "Introduction of the Theory and Computation", Thomson Learning

CCML3503 NOSQL and MongoDB

Course Outcome:

1. To provide an overview of RDBMS and NOSQL
2. Develop an understanding of the advanced MongoDB concepts like Mapreduce, Data Aggregation, sharding
3. To introduce the tools required to manage and analyze big data like Hadoop, NoSQL MapReduce
4. To teach the fundamental techniques and principles in achieving data processing with scalability
5. To enable students to have skills that will help them to solve complex real-world problems in decision support.
6. To study, understand and implement each unit according to National Education Policy 2020.

Learning Outcome:

At the end of the course, the student should be able to:

1. Understand the vision of Big Data from a globalcontext. The CLO has been achieved accordingly in Unit 1.
2. To understand and apply MongoDB in the Market perspective of Big Data. The CLO has been achieved accordingly in Unit 2.
3. Applying and analyzing architecture and APIs with use of Devices, Gateways and Data Management in data. The CLO has been achieved accordingly in Unit 3.
4. To evaluate the application of MongoDB in Industrial and Commercial Building Automation, evaluating Data performance using MapReduce and Real-World Design Constraints. The CLO has been achieved accordingly in Unit 4.
5. Building and creating fundamental concepts in the context of a number of different NOSQL products.The CLO has been achieved accordingly in Unit 5 & 6.

Course Contents

Module	Course Topics	Total Hours	Credits
I	**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	1
II	**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	30 Hours	1

	Query by a Top Level Field		
III	**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	30 Hours	1
IV	**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 and research letters.	30 Hours	1

Text/Reference Books:

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..

CCML3551 PREDICTIVE ANALYTICS LAB

LIST OF EXPERIMENTS:

1. WAP in Python to implement simple linear regression without using Python libraries.
2. WAP in Python to implement logistics regression without using Python libraries.
3. WAP in Python to implement Polynomial regression, without using Python libraries.
4. WAP in Python to implement Decision trees without using Python libraries.
5. WAP in Python to implement K-nearest neighbors without using Python libraries.
6. WAP in Python to implement K-means neighbors without using Python libraries.
7. WAP in Python to implement SVM.
8. WAP in Python to implement time series analysis.
9. WAP in Python to implement text mining.
10. WAP in Python to implement Sentiment analysis.

CCML3552: Cloud Computing Lab

LIST OF EXPERIMENTS:

1. Configuring IBM Cloud account and creating an application using Cloud Foundry Service on IBM Cloud.
2. Mention all commands used in IBM cli to push an application from local system to IBM cloud environment.
3. Configuring secure web-application with single sign-on (APP ID) on IBM cloud.
4. Configuring Cloudant and managing the datasets on IBM Cloud.
5. Configuring Visual Recognition Service with IBM Watson.
6. Configuring IAM (identity access management) service on IBM cloud.
7. Configuring a server to fetch files from a local file system using Nodejs.
8. Implementation of containerization using Docker.
9. Implementation of container orchestration using Kubernetes.
10. Creating a Nodejs application using Express Framework.

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.
- 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

BCS3553 Computer Networks Lab

List of Experiments

1. Study of different type of Network cables and practically implement the cross wired cable.
2. Study and implementation of basic network command and network configuration commands.
3. Connect the computers in local area network.
4. To write a socket program for implementation of echo.
5. Write a program in C, to perform character stuffing.
6. Write a program in C, to perform Bit stuffing.
7. Implement CRC (Cyclic redundancy check) in C.
8. Study of Network Simulators like NS2, OPNET.
9. Write a program in C, to implement sliding window protocol.
10. To create Scenario and Study the performance of Ring topology through simulation.
11. To create Scenario and Study the performance of Bus topology through simulation.

BHS3601: Industrial Management

Course Objectives:

1. to provide the knowledge of contemporary issues related to theindustries;
2. to introduce them of various technological appliances required formanagerial skills;
3. to provide the knowledge of inventory control, quality control withrespective to theindustry;
4. to familiarize the organizational structure, technology and theconditions of theorganizational environment;

Learning Outcome:

After the successful completion of the course the student shall be able to

1. aware of the prominent managerial concepts and tools usedwithin the differentorganizational functions;
2. able to adapt managerial concept and solve increasing complexproblems faced byindustry;
3. competent in managing variety of trades, business and organizations;
4. expert in managing the business and project management teams;

Course Contents:

Module	CourseTopic	Total Hours	Credit
I	**Introduction** Concept, Development, Scope of Industrial Management. Productivity: Measurement and Productivity index.Types of Production System, Production Planning andControl.	30 Hours	1
II	**Management Functions** Management Tools: Time and Motion study,Process Chart, Flow Diagrams. IndustrialOwnership. CSR (Corporate Social Responsibility),PPP Model(Public PrivatePartnership)	30 Hours	1
III	**Inventory and Quality Control** Inventory, Deterministic Models, Concept ofSupply Chain Management. Quality Control: SQC, Control Charts, Single, Doubleand Sequential Sampling. Introductionto TQM	30 Hours	1
IV	Project Management: Project network analysis, CPM,PERT and project crashing andResource leveling.	30 Hours	1

References:

Text Books

1. Banga,T.R., Khanna Publisher, Delhi. *Industrial Engineering and Management*
2. Khanna,O.P.(2000), *Industrial Engineering and Management*
   Danpat Rai Publication, New Delhi.
3. Martand,Telsang .(2005).*Industrial Engineering and Production Management* . S.Chand and Company.

Suggested Readings:

1. Bounds,G.(1994). *Beyond Total Quality Management* . McGraw Hill.
2. Pandey,O.N.,& Aneja,B.(2011). *Industrial Management* . Kataria and Sons.

CCML3601 Machine Learning

Course Outcome:

1. To provide an overview of an exciting field of Machine Learning and R Programming
2. To introduce the tools required to manage and analyze machine learning like RStudio.
3. To teach the fundamental techniques and principles in achieving Machine Learning using R with scalability and streaming capability.
4. To enable students to have skills that will help them to solve complex real-world problems in decision support.
5. To study, understand and implement each unit according to National Education Policy 2020.

Learning Outcome:

At the end of the course, the student should be able to:

1. Understand the vision of Machine Learning and R Programming from a global context. The CLO has been achieved accordingly in Unit 1.
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. The CLO has been achieved accordingly in Unit 2.
3. Design effective data visualizations in order to provide new insights into a research question or communicate information to the viewer in Unit 3.
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. The CLO has been achieved accordingly in Unit 4 & 5.
5. Be able to design and implement various machine learning models in a range of real-world applications. Creating projects and research activities based on Machine Learning using R. The CLO has been achieved accordingly in Unit 6.

Course Contents

Module	Course Topics	Total Hours	Credits
I	**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	1
II	**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, critical value one tail and two tail test, Type 1 and type 2 error.	30 Hours	1
III	**Supervised machine learning:** Regression and classification analysis, Algorithms - Linear	30 Hours	1

	Regression, Logistic Regression, Support Vector Machine, KNN, Naïve Bayes, 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.		
IV	**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	1

Text/Reference Books:

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.

BCS3602 Design & Analysis of Algorithm

Course Objective:

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.
5. Synthesize efficient algorithms in common engineering design situations

Learning Outcome:

At the end of the course, the student should be able to:

1. Argue the correctness of algorithms using inductive proofs and invariants.
2. Analyze worst-case running times of algorithms using asymptotic analysis.
3. Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize divide-and-conquer algorithms. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.
4. Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize dynamic-programming algorithms, and analyze them.
5. Describe the greedy paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize greedy algorithms, and analyze them.
6. Explain the major graph algorithms and their analyses. Employ graphs to model engineering problems, when appropriate. Synthesize new graph algorithms and algorithms that employ graph computations as key components, and analyze them.
7. Explain the different ways to analyze randomized algorithms (expected running time, probability of error). Recite algorithms that employ randomization. Explain the difference between a randomized algorithm and an algorithm with probabilistic inputs.
8. Explain what amortized running time is and what it is good for. Describe the different methods of amortized analysis (aggregate analysis, accounting, and potential method). Perform amortized analysis.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**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 Binary Search Tree and AVL tree: Traversal and Related Properties, Binomial Heaps, Fibonacci Heaps; Data Stricture for Disjoint Sets	30 Hours	1

II	**Advanced Design and Analysis Techniques** Dynamic Programming: Matrix chain multiplication Problem, Optimal Binary search tree etc., Greedy Algorithms; Amortized Analysis	30 Hours	1
III	**Graph Algorithms** Graph Algorithms: Elementary Graphs Algorithms, Depth first Search and Breadth First Search, Minimum Spanning Trees, Shortest paths problem Single-source Shortest Paths, All-Pairs Shortest Paths Maximum Flow and Flow networks, Back Tracking	30 Hours	1
IV	**Selected Topics** Randomized Algorithms, String Matching, Travelling Salesman Problem, NP Completeness , Approximation Algorithms	30 Hours	1

Text/Reference Books:

1. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", Second Edition, MIT Press/McGraw-Hill, 2001.
2. Jon Kleinberg and ÉvaTardos, "Algorithm Design", Pearson, 2005.
3. Michael T Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis", and Internet Examples, Second Edition, Wiley, 2006

CCML3602 Cloud Security

Course Objective:

1. To understand Cloud concepts, introduction to IBM cloud, ISO 27017-Cloud Security, PCI DSS Controls, Flips Levels.
2. To learn introductory concepts of Cloud Data Life Cycle (CSUSAD).
3. This course will provide an overview regarding Management plan implementation & Cloud Forensics
4. Learners will be able to understand how to work on containerization concept using Docker as a Tool and will work on Kubernetes
5. To study, understand and implement each unit according to National Education Policy 2020.

Learning Outcome:

At the end of the course, the student should be able to:

1. Understand the vision of Cloud and its security. The CLO has been achieved accordingly in Unit 1.
2. To understand the implementation of Forensic Science. The CLO has been achieved accordingly in Unit 2.
3. Applying and analyzing architecture with data management over cloud platforms. The CLO has been achieved accordingly in Unit 3.
4. To evaluate the application of cloud security with its phases. The CLO has been achieved accordingly in Unit 4.
5. Building a secure architecture and analyzing it with different phases of security. The CLO has been achieved accordingly in Unit 5 & 6.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**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.	30 Hours	1

II	**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	1
III	**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	1
IV	**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 Supply-chain (API) management, ISO/IEC 27034-1**IAM 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	30 Hours	1

Text/Reference Books:

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.
4. Building the Infrastructure for Cloud Security: A Solutions View Book by Enrique Castro-Leon and Raghuram Yeluri
5. Cybersecurity for Executives in the Age of Cloud Book by Teri Radichel

BCS3604 Compiler Design

Course Objective:

1. The aim of this module is to show how to apply the theoryof language translation introduced in the prerequisite courses to build compilers andinterpreters.
2. It covers the building of translators both from scratch andusing compiler generators.
3. In the process, the module also identifies and explores themain issues of thedesign of translators.
4. The construction of a compiler/interpreter for a small language is a necessary component of this module, so students can obtainthe necessary skills.

Learning Outcome:

At the end of the course, the student should be able to:

1. Understand the structure of compilers.
2. Understand the basic techniques used in compiler construction such as lexical analysis, top-down, bottom-up parsing, context-sensitive analysis, and intermediate code generation.
3. Understand the basic data structures used in compiler construction such as abstract syntax trees, symbol tables,three-address code, and stack machines

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction to Compiler**Introduction-Compiler and features, AnalysisSynthesis model, Phases of compiler, Grouping of Phase, Concept of pass,Bootstrapping. Lexical analyzer-Implementation and Role of lexical analyzer,Token, Pattern and Lexemes and function,Finite state machine and Regular expression.Formal grammar and their application tosyntax analysis- CFG, derivation and Parse trees **Basics Parsing Techniques I: Top-Down Parser-** Back tracking, Predictive Parser	30 Hours	1

II	**Basic parsing techniques-II: Bottom Up Parser** Shift Reduce Parser, OperatorPrecedence parsing, Recursive descentparsing, LR Parser-LR(0) Parser , SLR parser ,Canonical LR Parser, LALR Parser. Syntax-Directed Translation-Syntax Directed definition and type, Construction of SyntaxTree and DAG representation. Symbols Table- Storage Allocation strategies, Runtime Storage Organization, Structure Storage Allocation, Error detection and Recovery-Lexical, syntax and semantic error.	30 Hours	1
III	**Intermediate code Generator** Intermediate code- forms of intermediatecode, Implementation of 3-address code-Quadruple, direct and triple, Translation ofAssignment statements, Translation ofBoolean expression- Flow of ControlStatement, and Case statements. CodeGeneration-Design issues, The Target codeand addresses in target code, Code generator algorithm.	30 Hours	1
IV	**Code Optimization** Machine-independent optimization, Basic Blocks, Flow graph-DAG representation ofbasic blocks, Loop in Flow graph .Transformation, Loop Optimization ,Peephole Optimization, Global Data Flow-Control Flow Analysis, Data FlowAnalysis	30 Hours	1

Text/Reference Books:

1. Aho, Sethi& Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education
2. V Raghvan, "Principles of Compiler Design", TMH
3. Kenneth Louden, "Compiler Construction", Cengage Learning.
4. Charles Fischer and Ricard LeBlanc, "Crafting a Compiler with C", Pearson Education

CCML3651 Machine Learning Lab

List of Programs

1. Write an R program to check given no. is positive, negative or zero.
2. Write an R program to get the statistical summary and nature of the data of a given data frame.
3. Draw a bar chart that shows cylinder num grouped by number of gears.
4. Write a program to implement Linear Regression algorithm.
5. Write a program to implement a Logistic Regression algorithm. Compute the accuracy of the classifier.
6. Write a program to implement k-Nearest Neighbour algorithm to classify data set.
7. 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.
8. Write a program to implement the naïve Bayesian classifier for a sample training data set. Compute the accuracy of the classifier.
9. Write a program for clustering using k-Means algorithm.
10. Write a program for clustering using Hierarchical clustering algorithm.

Project Statement

Project Title – Text Message Classification Spam or Ham

How often have we come across messages saying we have won a trip to Hawaii or won a million dollars or won a cash prize. This form of scam through text messages which are generally spam messages is called smishing. A lot of times they ask us to fill in forms and ask for our personal information or SSN number which is really fishy or bound to be a fraud. The goal of this project is to use Data Science to accurately classify whether a message is spam or not.

Since not all online reviews are truthful and trustworthy, it is important to develop techniques for detecting review spam. By extracting meaningful features from the text using Natural Language Processing (NLP), it is possible to conduct review spam detection using various machine learning techniques. Additionally, reviewer information, apart from the text itself, can be used to aid in this process. In this project, we survey the prominent machine learning techniques that have been proposed to solve the problem of review spam detection and the performance of different approaches for classification and detection of review spam.

BCS3652 Algorithms Lab

Programming assignments on each algorithmic strategy:

1. Divide and conquer method (quick sort, merge sort, Strassen's matrix Multiplication),
2. Greedy method (knapsack problem, job sequencing, optimal merge patterns, minimal spanning trees).
3. Dynamic programming (multistage graphs, OBST, 0/1 knapsack, traveling salesperson problem).
4. Back tracking (n-queens problem, graph coloring problem, Hamiltonian cycles).
5. Sorting : Insertion sort, Heap sort, Bubble sort
6. Searching : Sequential and Binary Search
7. Selection : Minimum/ Maximum, K-th smallest element

CCML3701 Artificial Intelligence & Deep Learning

Course Objective:

1. To provide an overview of an exciting field of Artificial Intelligence
2. To introduce the tools required to build and study the services like Watson Assistant and WKS.
3. To teach the fundamental techniques and principles in achieving the concepts of machine learning and AI.
4. To provide an overview of an exciting field of Deep Learning
5. Develop an understanding of the complete process of deep learning project and its near term future direction
6. To introduce the tools required to manage and analyse deep learning projects like: Jupyter Notebook and tensorflow.

Learning Outcome:

At the end of the course, the student should be able to:

1. Understand the vision of AI from a global context. The CLO has been achieved accordingly in Unit 1.
2. To understand and apply IBM Watson Services in the Market perspective of Big Data. The CLO has been achieved accordingly in Unit 2.
3. Applying and analyzing architecture and APIs with use of WKS and Watson Assistant. The CLO has been achieved accordingly in Unit 3.
4. Understand the concept of Deep Learning from a global context. The CLO has been achieved accordingly in Unit 1.
5. To understand and apply Neural Networks in the Market perspective of Deep Learning Projects. Applying and analyzing architecture of Convolutional Neural Networks to achieve data learning models. The CLO has been achieved accordingly in Unit 2.
6. Be able to design and implement recurrent neural network and LSTM systems. The CLO has been achieved accordingly in Unit 3.

Course Contents:

Module	Course Topics	Total Hours	Credits

I	**Artificial Intelligence Overview** Eras of Computing, types & main focus of AI, ML & its types, Neural Networks, NLP and processes, Use Cases, Computer Vision tools and use cases, Cognitive Computing, Setting up of IBM Bluemix Account. **Artificial Intelligence Foundation** IBM Watson and real-world problems, Deep QA Architecture, Commercialization of Watson, Watson Services – capabilities of each Watson service, Watson Knowledge Studio, Usage of Watson API explorer.	30 Hours	1
II	**NLP and NLC** NLP – Processes, Tools and services of NLP, NLP Use cases, Different components of NLP, Challenges with NLU, NLP Pipeline. Capabilities of IBM Watson NLC, NLU and its capabilities, Watson Tone Analyzer, Watson Discovery Service, Using Discovery API **Chatbots** Chatbot and its applications, growing popularity of chatbots, tools and services for chatbots, Workspace, Intent, entity and dialog nodes. Nodes in a dialog, Advanced Features of a chatbot, Creation of Watson Assistant Instance, Add Intents and test in slack. **Computer Vision** CV – history and advancement with AI, CU Use Cases, Pipeline with in a CV application, Feature Extraction, image classification and recognition, IBM Visual Recognition Service.	30 Hours	1
III	**Introduction to Deep Learning** Why Deep Learning? Introduction to Neural Networks. Neural Network Architecture. Full-cycle of a Deep Learning Project. Activation Functions. Forward and Backward Propagation. Loss function and optimization functions. **Convolutional Networks** Introduction to convolutional networks. CNN Architecture. Understanding Convolutions. CNN for Classification.	30 Hours	1

IV	**Recurrent Neural Network** Introduction to RNN model. What is a Sequential Problem? The LSTM model **Restricted Boltzmann Machines and Autoencoders** Introduction to RBMs. Training RBMs. Introduction to autoencoders. Structures of autoencoders.	30 Hours	1

Text/Reference Books:

1. Elaine A Rich, "Artificial Intelligence", Tata McGraw-Hill Publishing Company Limited.
2. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", Shroff Publishers & Distributors Pvt. Ltd.
3. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig.Deep Learning with Python by François Chollet
4. Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow: Concepts, Tools and Techniques to Build Intelligent Systems by Aurelien Geron
5. Deep Learning (Adaptive Computation and Machine Learning series) by Ian Goodfellow

BCS3702 Network Security and Cryptography

Course Objective:

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 breach the secure communication

Learning Outcome:

At the end of the course, the student should be able to:

1. Understanding cryptography and network security concepts and applications
2. Apply security principals to system design and Real time Scenarios.
3. Identify and investigate network security threats
4. Analysis of network traffic and security threats
5.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**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	1
II	**Basics of Number Theory and Public key 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	1
III	**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.	30 Hours	1

IV	**Network and System Security** Authentication Applications: Kerberos, X.509 Certificates; Electronic Mail Security: Pretty Good Privacy, S/MIME; IP 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.	30 Hours	1

Text/Reference Books:

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
4. Bernard Menezes, "Network Security and Cryptography", Cengage Learning.
5. Atul Kahate, "Cryptography and Network Security", Tata McGraw-Hill

CCML3751 Artificial Intelligence & Deep Learning Lab

List of Programs

1. To create an IBM cloud account and understand different IBM Watson Services.
2. To create an AI virtual assistant.
3. To understand different modules used in python for data analysis.
4. To understand and implement Linear Regression algorithms.
5. To Classify images using Node-Red Guide.
6. Building your own translator with AI guide
7. Gaining insights from AIRBnB reviews guide.
8. Creating a Machine Learning model with Knowledge Studio
9. Predict Fraud using AUTO AI guide
10. To understand and implement Text to Speech and Speech to Text Service using IBM Watson
11. Write a program to implement Convolutional Neural Network.
12. Write a program to implement Recurrent Neural Network.
13. Write a program to implement LSTM.
14. Write a program to RBM.

Project Statement

- Use Node-RED and Telegram to create a chatbot translator. The IBM Language Translator service can connect to other IBM services, and these services can be linked to the Telegram application using a Node-RED app. When you link the services, users can easily use the translation app by sending text or voice to your bot. You will be creating a Node-RED boilerplate that's available on IBM Cloud and link Tarkman to a Telegram app as the user interface using Node-RED flows.
- According to Forbes, by 2020 about 1.7 MB of new information will be created every second—for each and every human being on the planet. You will gain insights from actual AirBnB reviews of Manhattan apartments. A typical query from Yelp or other review engines may depict a certain apartment as most desirable to stay at, however, for example, the reviews may not mention that there is a bar nearby and the noise level during closing hours are enough to wake up any of the residents in the vicinity apartments; the Discovery service can surface those concerns.

- **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 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.

BCS3752 Network Security Lab

Tools/Software used: C/C++/Java

1. Write program for Mono alphabetic cipher.
2. Implementation of Play Fair cipher.
3. Implementation of Vigenere cipher (Polyalphabetic substitution).
4. Implementation of Hill cipher.
5. Implementation of Gauss cipher.
6. Implementation of Rail Fence cipher.
7. Implementation of S-DES algorithm for data encryption.
8. Implement RSA asymmetric (public key and private key)-Encryption. Encryption key (e, n) & (d,n)
9. Generate digital signature using Hash code.
10. Generate digital signature using MAC code.

BCS3801 Digital Image Processing

Course Objective:

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

Learning Outcome:

1. Understand image formation and the role human visual system plays in perception of gray and color image data.
2. Get broad exposure to and understanding of various applications of image processing in industry, medicine, and defense.
3. Learn the signal processing algorithms and techniques in image enhancement and image restoration.
4. Acquire an appreciation for the image processing issues and techniques and be able to apply these techniques to real world problems.
5. Be able to conduct independent study and analysis of image processing problems and techniques.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**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 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.	30 Hours	1
III	**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.	30 Hours	1
IV	**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	1

Text/ Reference Books:

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.

BCS3851 Digital Image Processing Lab

Tools/Software used: MATLAB

List of Experiments:

Implement the following on MATLAB-

1. Display of Gray scale Images.
2. Histogram Equalization.
3. Design of Non-linear Filtering
4. Determination of Edge detection using Operators.
5. 2-D DFT and DCT.
6. Filtering in frequency domain.
7. Display of colour images.
8. Conversion between colour spaces.
9. DWT of images.
10. Segmentation using watershed transform.

GE33811 Deployment of Private Cloud

Course Objective:

1. Introduction to RedHat OpenShift
2. Get familiarized with OpenShift core concepts
3. Understanding Docker images and building custom Docker images
4. Understanding persistent storage and Network for OpenShift
5. Install and configure OpenShift cluster
6. Deploy containerized application on an OpenShift cluster
7. Understand user and resource access management
8. Managing application deployments and scaling

Learning Outcome:

At the end of the course, the student should be able to:

1. Openshift ,installation & Configuration
2. Openshift architecture, networking concepts
3. 1.Understanding the web interface
4. Controlling access to OpenShift resources
5. Managing application deployments

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**(About OpenShift)** 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	1

II	**(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	30 Hours	1
III	**(Use of command line interface)** Create projects and applications,Verify if the application us running,Configuring automated builds,code change and manually rebuild images (**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**) access control on OpenShift resources,secrets and their application, security policies and their application	30 Hours	1
IV	(**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)	30 Hours	1

Text/Reference Books:

1. Ajay Kumar, "Microsevices Architecture", Self published, 2018, 1st Edition.
2. Sam Newman, "Building Microservices", O'Reilly Media Inc, 2014, 1st Edition.

GE33813 Soft Computing

Course Objective:

1. Learn the basic concept of fuzzy set theory.
2. Understand the working principle of various AI techniques and heuristic search algorithms.
3. Learn about the architecture of artificial neural networks and implement them in fuzzy environment.
4. Study the concept behind genetic algorithm and its various operations.
5. Learn different levels of CPN Networks and ART algorithms.

Learning Outcome:

At the end of the course, the student should be able to:

1. Implement numerical methods in soft computing.
2. Design the algorithms which can work as an intelligent production system.
3. Demonstrate various learning methods in artificial neural networks, like: supervised and unsupervised learning.
4. Familiar about the various mutation and cross over techniques of genetic algorithm for producing new strings.
5. Design and Implement different predicate logic rules for solving any specific AI problem.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Artificial Intelligence** Soft Computing; Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques; Artificial neural networks, Fuzzy logic, Genetic Algorithms. Applications of soft computing. Artificial Intelligence; Introduction of AI. Production systems; Types of production systems, Characteristics of production systems. Search Algorithms; Breadth first search, Depth first search. Heuristic Search Algorithms; Hill Climbing, Best first Search, A* algorithm, AO* Algorithms. Knowledge representation issues. Prepositional and predicate logic. Forward Reasoning and backward reasoning. Weak & Strong Slot & filler structures. Natural Language Processing (NLP).	30 Hours	1

II	**Neural networks** Structure of Biological neuron; Neuron, Nerve Structure and synapse. Artificial Neuron and its model. Activation functions. Neural network architecture; Single layer feed forward networks, multilayer feed forward networks, Recurrent networks. Various learning techniques; Perceptron training algorithm; Linear separability, Widrow & Hebb's learning rule/Delta rule. ADALINE v/s MADALINE. Introduction of MLP and BPN. Error	30 Hours	1
	back propagation algorithm (EBPA); Characteristics and application of EBPA, momentum factor and limitation of EBPA. Difference between ANN and human brain. Characteristics and applications of ANN. Associative Memory and its characteristics. Counter propagation network (CPN); Architecture of CPN, functioning & characteristics of CPN. Hopfield/ Recurrent network. Hopfield v/s Boltzman machine. Adaptive Resonance Theory (ART); Architecture of ART, Classification and training of ART.		
III	**Fuzzy logic** Basic concepts of fuzzy logic. Fuzzy sets versus Crisp sets. Fuzzy set theory and operations. Properties of fuzzy sets and crisp sets. Fuzzy relations and Crisp relations. Fuzzy to Crisp conversion. Membership functions. Fuzzyfications & Defuzzifications. Fuzzy preposition. Fuzzy inference System. Fuzzy Rule Base. Fuzzy reasoning and decision making. Fuzzy Logic Controller (FLC). Formation, decomposition & aggregation of fuzzy rules. Industrial applications of Fuzzy.	30 Hours	1
IV	**Genetic Algorithm(GA)** Introduction of Genetic Algorithm; Fundamentals of GA, Basic concepts of GA, Working principle, Encoding, fitness function, Reproduction. Genetic modeling; Inheritance operator, Cross over Operators, Inversion & deletion, Mutation operator, Bitwise operators. Generational Cycle of GA. Convergence of GA. Applications & advances in GA. Differences& similarities between GA & other traditional methods.	30 Hours	1

Text/Reference Books:

1. S. Rajsekaran & G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications" Prentice Hall of India.
2. Sivanandani, Deepa, "Principles of Soft Computing", Wiley India (2007)
3. Jang J.S.R. Sun C.T. and Mizutani E., "Neuro-Fuzzy and Soft computing", Prentice Hall
4. Timothy J. Ross. "Fuzzy Logic with Engineering Applications", McGraw Hill
5. Laurene Fausett. 'Fundamentals of Neural Networks", Prentice Hall
6. D.E. Goldbery, "Genetic Algorithms: Search, Optimization and Machine Learning". Addison Wesley.

GE33814 Evolutionary Algorithms

Course Objective:

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.

Learning Outcome:

Upon completion of this course, students will be able to:

1. Explain the principles underlying Evolutionary Computation in general and Genetic Algorithms in particular.
2. Apply Evolutionary Computation Methods to find solutions to complex problems
3. Analyze and experiment with parameter choices in the use of Evolutionary Computation
4. Summarize current research in Genetic Algorithms and Evolutionary Computing

Course Contents:

Module	Course Topics	Total Hours	Credits
I	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	1
II	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	1
III	Evolutionary Strategies: Introduction, Comparison with GA & GP Operators: Gaussian Mutation Operator and Intermediate Recombination Operator. Application of ES for Image Enhancement	30 Hours	1
IV	Foundations of Evolutionary Algorithms, Schemas and the two-armed bandit problem, Advantages and	30 Hours	1

	disadvantages of evolutionary algorithms over alternative methods. Co-evolutionary Algorithms: Cooperative co-evolution, Competitive co-evolution, Swarm intelligence and ant colony optimization.		

Text/Reference Books:

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.

GE33812 CLOUD NATIVE APPLICATION DEVELOPER

Course Objective:

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.
5. To enable students to have skills that will help them to articulate the differences between Docker and Kubernetes platform.
6. To study, understand and implement each unit according to National Education Policy 2020 and Bloom's Taxonomy.

Learning Outcome:

Upon completion of this course, students will be able to:

1. Understand the vision of Cloud native application development from a global context. The CLO has been achieved according to BL1 and BL2 in Unit 1.
2. To understand and apply Kubernetes architecture in Market perspective of cloud native application development. The CLO has been achieved according to BL2 and BL3 in Unit 2.
3. Applying and analyzing RedHat OpenShift architecture and APIs with application development. The CLO has been achieved according to BL3 and BL4 in Unit 3.
4. To evaluate the application of DevOps with Redhat OpenShift architecture in Industrial Automation. The CLO has been achieved according to BL 5 and BL6 in Unit 4.
5. Building and create state of continuous integration with pipelines of Redhat OpenShift architecture. The CLO has been achieved according to BL5 and BL6 in Unit 5
6. Creating projects and research activities based on application development with Redhat OpenShift. The CLO has been achieved according to BL6 in Unit 6

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**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**	30 Hours	1

	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		
II	**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 **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.	30 Hours	1
III	**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, 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	30 Hours	1
IV	**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,	30 Hours	1

	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		
	disadvantages of evolutionary algorithms over alternative methods. Co-evolutionary Algorithms: Cooperative co-evolution, Competitive co-evolution, Swarm intelligence and ant colony optimization.		

TEXT/REFERENCE BOOKS

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 Hausenblas and Stefan Schimanski (Software engineer)
4. Cloud Native Development Patterns and Best Practices: Practical Architectural Patterns for Building Modern, Distributed Cloud-native Systems Book by John K. Gilbert
5. Cloud Native Architectures: Design High-availability and Cost-effective Applications for the Cloud Book by Erik Farr, Kamal Arora, and Tom Laszewski

GE33815 Internet of Things

Course Objective:

1. To assess the vision and introduction of IoT.
2. To Understand IoT Market perspective.
3. To Implement Data and Knowledge Management and use of Devices in IoT Technology.
4. To Understand State of the Art - IoT Architecture.
5. To classify Real World IoT Design Constraints, Industrial Automation in IoT.

Learning Outcome:

1. Interpret the vision of IoT from a global context.
2. Determine the Market perspective of IoT.
3. Compare and Contrast the use of Devices, Gateways and Data Management in IoT.
4. Implement state of the art architecture in IoT.
5. Illustrate the application of IoT in Industrial Automation and identify Real World Design Constraints.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Overview** An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management.	30 Hours	1
II	**Reference Architecture** IoT Architecture-State of the Art – Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints-Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.	30 Hours	1
III	**Iot Data Link Layer & Network Layer Protocols** PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), WirelessHART,Z-Wave,Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP.	30 Hours	1

IV	**Transport Layer , Session Layer And Service Layer Protocols & Security** Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT,	30 Hours	1
	Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4 , 6LoWPAN, RPL, Application Layer		

Text/Reference Books:

1. Samuel Greengard , "TheInternet of Things" .
2. Klaus Schwab, "The Fourth Industrial Revolution".
3. CunoPfister, "Getting started with Internet of Things".
4. Peter Waher, "Learning Internet of Things".

GE33821 **Big Data Analytics & Architecture**

Course Objective:

1. To provide an overview of an exciting growing field of big data analytics.
2. To introduce the tools required to manage and analyze big data like Hadoop, NoSql MapReduce.
3. To explain the importance of Big Data , spark
4. To strengthen the understanding of basic concepts of spark and scala.
5. To prepare a sample project in hadoop.
6. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
7. To enable students to have skills that will help them to solve complex real-world problems in decision support.

Learning Outcome:

1. Develop an understanding of the complete open-source Hadoop ecosystem and its near term future direction
2. Understand the MapReduce model v1 and review java code
3. Develop an understanding of the complete open-source Hadoop ecosystem and its near-term future directions
4. Mining of Big Data.
5. Processing of data streams

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Chapter 1:(Introduction to Big Data):** Explain what Big Data is • Describe the complete open-source Hadoop ecosystem and its near-term future directions • Describe the major challenges of data • Explain how the growth of interconnected devices contributes big data • List real-life examples of Big Data • List the types of Big Data • Identify Big Data use cases **Chapter -2: (Hadoop and HDFS):** Describe the nature of the Hadoop Distributed File System (HDFS). • Explain the function of NameNode and DataNode in a Hadoop cluster. • Explain how files are stored and blocks (splits) are replicated **Chapter -3 (Sqoop) :**Loading data with Sqoop, How to import and export data from Mysql to hive, HDFS	30 Hours	1
II	**Chapter -4 (Introduction to Hortonworks Data Platform (HDP))** Describe the functions and features of HDP. • List the IBM added value components. • Describe the purpose and benefits of each added value component. Explain the purpose of Apache Ambari in the HDP stack. • Describe the overall architecture of Ambari and its relation to other services and components of a Hadoop cluster. • List the functions of the main components of Ambari. • Explain how to start and stop services with the Ambari Web UI. Explain the basic need for a big data strategy in terms of parallel	30 Hours	1

	reading of large data files and internode network speed in a cluster. **Chapter -5 (MapReduce and YARN) :** Describe the MapReduce programming model. • Describe Hadoop v1 and MapReduce v1 and list their limitations. • Describe Apache Hadoop v2 and YARN. • Compare Hadoop v2 and YARN with Hadoop v1		
III	**Chapter -5 (Lambda Architecture) : Introduction , features , real time use** **Chapter -7 (Speed Processing and Batch Processing)**: When to use batch processing and speed processing , advantages, hive **Chapter -8(Spark Core):** Explain the nature and purpose of Apache Spark in the Hadoop ecosystem. • Describe the architecture and list the components of the Apache Spark unified stack. • Describe the role of a Resilient Distributed Dataset (RDD). • Explain the principles of Apache Spark programming. • List and describe the Apache Spark libraries. • Start and use Apache Spark Scala and Python shells. • Describe Apache Spark streaming, Apache Spark SQL, MLib and Graphx, data file formats, including flat text files, CSV, XML, JSON, and YAML • List the characteristics of the four types of NoSQL data stores	30 Hours	1
IV	**Chapter -9(Components of Spark Unified stack)** : RDD, Word count using scala **Chapter -10(Introduction to queuing systems. Eg. Kafka):** Need for Kafka What is Kafka?, Kafka Features, Kafka Concepts, Kafka Architecture, Kafka Components	30 Hours	1

Text/Reference Books:

1.Bigdata Analytics by Shankarmani wiley

2. IBM material
3. **Hadoop** in Practice. by Alex Holmes.

GE33825 System Modeling & Simulation

Objective:

1. The basic system concept and definitions of system.
2. Techniques to model and to simulate various systems the ability to analyze a system and to make use of the information to improve the performance.

Learning Outcome:

At the end of the course, the student should be able to:

1. Define basic concepts in modelling and simulation (M&S)
2. Classify various simulation models and give practical examples for each category
3. Construct a model for a given set of data and motivate its validity
4. Generate and test random number variants and apply them to develop simulation models
5. Analyze output data produced by a model and test validity of the model
6. Explain parallel and distributed simulation methods

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**INTRODUCTION TO SIMULATION** Simulation: Simulation as a tool, Advantages and Disadvantages of Simulation, Areas of Application, Systems and System Environment. Components of a System. Discrete and Continuous Systems. Model of a System, Types of Models, Discrete-Event System Simulation. Steps of Simulation Study	30 Hours	1
II	**GENERAL PRINCIPLES** Concepts in Discrete-Event Simulation: The Event- Scheduling / Time-Advance: Algorithm, World Views. Manual simulation, Using Event Scheduling. Properties of Random Numbers, Generation of Pseudo-Random Numbers. Techniques for Generating Random Numbers. Tests for Random Numbers	30 Hours	1
III	**RANDOM-VARIATE GENERATION** Inverse Transform technique: Exponential Distribution, Uniform Distribution, Discrete Distributions, Acceptance-Rejection Technique, Poisson Distribution. Data Collection, Identifying the distribution with Data, Parameter Estimation, Goodness of Fit Tests, Selecting Input Models	30 Hours	1

	without Data Multivariate and Time-Series Input Models.		
IV	**VERIFICATION AND VALIDATION OF SIMULATION MODELS** Model Building, Verification and Validation: Verification of Simulation Models, Calibration and Validation of Models. Types of Simulations with Respect to Output Analysis .Stochastic Nature of Output Data. Measures of Performance and Their Estimation. Output Analysis for Terminating Simulations, Output Analysis for Steady-State Simulations. Simulation Tools, Model Input. High-Level Computer-System Simulation, CPU Simulation, Memory Simulation.	30 Hours	1

Text/Reference Books:

1. Jerry Banks, John S. Carson, Barry L. Nelson, David M. Nicol, "Discrete- Event System Simulation", Third Edition, Prentice-Hall India
2. Averill M. Law, W. David Kelton, "Simulation Modelling and Analysis" Third Edition, McGraw Hill.
3. Geoffrey Gordon, "System Simulation", Second Edition, Prentice-Hall India.

GE33822 Artificial Neural Network (ANN)

Course Objective:

1. To understand the biological neural network and to model equivalent neuron models.
2. To understand the architecture, learning algorithm and issues ofvarious feed forward and feedback neural networks.
3. To understand the fundamental theory and concepts of neural networks, neuro-modelling, several neural network paradigms and its applications.
4. To understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic control and other machine intelligence applications of fuzzy logic.
5. To understand the basics of an evolutionary computing paradigm known as genetic algorithms and its application to engineering optimization problems.

Learning Outcome:

After completing the course, the students should be able to:

1. Create different neural networks of various architectures both feed forward and feed backward.
2. Perform the training of neural networks using various learning rules.
3. Perform the testing of neural networks and do the perform analysis of these networks for various pattern recognition applications.
4. Understanding the impact of the environment and proposing technological solutions for sustainable development.
5. Ability to use current techniques, skills, and IT tools necessary for computing practice.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction:** Neural Network, Human Brain,Models of a Neuron, Neural Networks viewed asDirected Graphs, Network Architectures,Knowledge Representation, Artificial Intelligenceand Neural Networks, Error Correction Learning,Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, StatisticalNature of the Learning Process	30 Hours	1

II	**Perceptron:** Adaptive Filtering Problem, Unconstrained Organization Techniques, LinearLeast 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,	30 Hours	1
	Heuristics, Output Representation and DecisionRule, Computer Experiment, Feature Detection.		
III	**Back Propagation:** Back Propagation and Differentiation, Hessian Matrix, Generalization,Cross Validation, Network Pruning Techniques, Virtues, and Limitations of Back Propagation Learning, Accelerated Convergence, SupervisedLearning	30 Hours	**1**
IV	**Neuro Dynamics:** Dynamical Systems, Stability of Equilibrium States, Attractors, Neuro Dynamical Models, Manipulation of Attractors as a RecurrentNetwork Paradigm Hopfield Models – Hopfield Models, Computer Experiment	30 Hours	**1**

Text/Reference Books:

1. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition,1997
2. Artificial Neural Networks - B. Yegnanarayana Prentice Hall of India P Ltd 2005
3. Neural Networks in Computer Intelligence, Li Min Fu TMH 2003

GE33823 Natural Language Processing

Course Objective:

1. To tag a given text with basic Language features
2. To design an innovative application using NLP components
3. To learn the fundamentals of natural language processing
4. To understand the use of CFG and PCFG in NLP

Learning Outcome:

After completing the course, the students should be able to:

1. Teach students the leading trends and systems in natural language processing.
2. Make them understand the concepts of morphology, syntax, semantics and pragmatics of the language and that they are able to give the appropriate examples that will illustrate the above mentioned concepts.
3. Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.
4. Understand approaches to discourse, generation, dialogue and summarization within NLP.
5. Understand approaches to syntax and semantics in NLP.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction to NLP, Need of NLP, History of NLP, Advantages and Disadvantages of NLP, Applications ofNLP. How does NLP work, components of NLP, Phases ofNLP, NLP vs. Machine learning. NLP examples, Future of NLP.	30	**1**
II	Lexical analysis, Unsmoothed N grams, evaluating N grams, Morphology and Finite state Transducers, Interpolation and Back off word classes, Part of Speech Tagging Markov Models, Hidden Markov Models. Transformation based Models Maximum Entropy Models.	**30**	1
III	Concept of Parser, Types of Parsing, Concept of Derivation, Types of Derivation, Concept of Grammar,CFG, Definition of CFG. Grammar rules for English Treebank, Normal forms for grammar Dependency Grammar, Syntactic Parsing, Ambiguity, Dynamic Programming Parsing- Shallow Parsing.	**30**	**1**

IV	Elements of Semantics Analysis, Difference between Polysemy and Homonymy. Meaning Representatives, Need of Meaning Representative, Disclosure Pragmatic-Concept of Coherence, Disclosure structure, Text coherence, Building Hierarchical Disclosure structure. Reference Resolution, Terminology used in Reference Resolution.	**30**	**1**

Text/Reference Books:

1. Daniel Jurafsky, James H. Martin: "Speech and Language Processing", 2/E, Prentice Hall, 2008.
2. James Allen, "Natural Language Understanding", 2/E, Addison-Wesley, 1999 Christopher D. Manning, Hinrich Schütze: "Foundations of Statistical Natural Language Processing", MIT Press, 1999
3. Steven Bird, Natural Language Processing with Python, 1st Edition, O'Reilly, 2009.
4. Jacob Perkins, Python Text Processing with NLTK 2.0 Cookbook, Packt Publishing, 2010

GE33824 Big Data Security

Course Objective:

1. The Big Data Security Training module will introduce participants to concepts of Big Data
2. understand & define security control –core disciplines
3. Monitoring data usage
4. Secure and Protect Data.

Learning Outcome:

At the end of the course, the student should be able to:

1. Introduction to Big Data, Big Data use cases and Capabilities, Big Data Architecture Security goals, controls
2. Inventorying and classifying sensitive data, Remediation plans, Security Perimeters Encryption of data
3. Introduction to Kerberos, Identity management, Activity Monitoring, Apache Knox overview
4. Guardium overview, Working with Data in motion, Implementing Masking, Data life cycle management, Access Management, Case studies & hands on

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction to B** Explain what Big Data is Reviewing concept of Big data capabilities, use cases & Architecture Explain Threats Introduction to Security Disciplines	30 Hours	1
II	**Securing & Protecting Data** Understand how to identify data for down streaming processes Understand how to integrate, process , generate data Understand Security perimeter for security Management Know how Access management and Auditing works.	30 Hours	1
III	**Monitor ,Enforce and Audit** Understand Guardium data activity Monitoring Benefits of Big Infosphere Guardium Understand Architecture of Guardium Hands-on experience with all of them	30 Hours	1
IV	**Data Protection Laws for Big data** Explain GDPR Laws Explain ILG (Lifecycle Governance) ISO 27000 Series HIPAA	30 Hours	1

Text/Reference Books:

IBM COURSEWARE.

GE33831 Security Governance and Law

Course Objective:

1. Recognize and differentiate information security policies and strategies to guide the development of standards and procedures, in alignment with organizational goals and objectives
2. Identify and analyze risk management processes and procedures to ensure compliance with applicable security, privacy laws and regulations
3. Identify and differentiate among the four types of access control: identification, authentication, authorization, and accountability.
4. Identify logical and physical access controls necessary to safeguard critical systems and information pursuant to compliance requirements.
5. Determine the proper steps to implement comprehensive business continuity, disaster recovery, and incident response plans.
6. Identify incident response processes for detecting and responding to security risks

Learning Outcome:

At the end of the course, the student should be able to:

2. Understand the concept of cyber security law and multilevel security. The CLO has been achieved according to BL1 and BL2 in Unit 1.
3. To understand and apply the strategies of protecting against cyber crime, fraud and terrorism. The CLO has been achieved according to BL2 and BL3 in Unit 2.
4. Applying and analyzing international standards, Analysis and Logging along with security models. The CLO has been achieved according to BL3 and BL4 in Unit 3.
5. To evaluate the application of IT Act 2000 & IT Amendment Act 2008. The CLO has been achieved according to BL 5 in Unit 4.
6. Copyright Infringe Remedies of Infringement Multimedia, Copyright issues Software Piracy. The CLO has been achieved according to BL6 in Unit 5 & 6.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Overview Security Types and Laws** Designing Trusted Operating Systems, Security Policies Methods of security, Trusted operating system design, Database Security, Multilevel databases, Proposals for Multilevel security, Administrating Security, Security planning, Risk analysis, Organization and security Policies, Legal, Privacy and Ethical Issues in Computer Security, International Cyber crimes	30 Hours	1
II	**Cyber Fraud and Electronic Misuse** Characteristics Cyber Fraud Offence, fraud related Offenses, Encryption in Crime and Terrorism- Law Enforcement Options, Data protection for system designers, Evaluation criteria and security testing	30 Hours	1

III	**International standards** Analysis and Logging, Recovery and data backs, Security policy development, Security Models: Frameworks, Standards, Security Certification ISO 17799/ ISO 27001, System Security Engineering Capacity Maturity Model, Laws and Legal Framework for Information Security, Recovery and risk analysis, Operating system and application specific auditing	30 Hours	1
IV	**IT Act 2000 & IT Amendment Act 2008**: Introduction, Digital Signature, Secure Electronic records and secure digital signatures, Digital Signature Certificates, Offences covered under IT Act 2000, Major Amendments in IT Act, Understanding Copy Right in Information Technology: Understanding the technology of Software software-copyright vs Patent debate Authorship **Copy right and Legal Issues** Software Copyright Jurisdiction Issues, Copyright Infringe Remedies of Infringement Multimedia, Copyright issues Software Piracy, Patents understanding, Data Privacy laws: GDPR. **PROJECT** Research Activities on Security Governance with projects and research letters. (POC on dataset)	30 Hours	1

Text/Reference Books:

1. Information Security Governance: A Practical Development and Implementation Approach (Wiley Series in Systems Engineering and Management Book 92) by Krag Brot Phillip. A. Laplante, "Real-Time Systems Design and Analysis", second edition, PHI, 2005.
2. Information Security Governance Simplified: From the Boardroom to the Keyboard by Todd Fitzgerald
3. Handbook of Governance and Security Edited by James Sperling, Professor of Political Science, University of Akron, US Publication Date: 2014 ISBN: 978 1 78195 316 7 Extent: 752 pp

GE33833 Real Time Operating System

Course Objective:

1. This course will provide students with an introduction to operating systems theory
2. Practical problem solving approaches to real-time systems.
3. Real-time scheduling and schedulability analysis
4. Formal specification and verification of timing constraints and properties
5. Design methods for real-time systems

Learning Outcome:

At the end of the course, the student should be able to:

1. List characteristics of real-time operating systems (RTOS).
2. Compare hard and soft real-time systems.
3. List features and services that are typically provided by an RTOS.
4. Configure the scheduler that is used in an RTOS.
5. Write applications that create and delete tasks, control task scheduling, and obtain task information.
6. Compare binary semaphores, counting semaphores, and mutexes.
7. Describe how semaphores are typically used in RTOS applications.
8. Write applications that create, delete, acquire and release a semaphore.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Definition of Real Time Operating Systems, Classification of RTOS, Concept of computer control, Sequence, loop and supervisor control, Centralized, hierarchical and distributed systems, Human Computer interface , Hardware requirement for real time applications, Specialized processors, interfaces and communications	30 Hours	1
II	Scheduling strategies, Priority structures and Task management, Real Time Clock Handler, Code sharing, Resource Control, Inter task Communication and Control , Example of Creating and RTOS based on Modula-2 kernel	30 Hours	1
III	Introduction to Design of Real Time Systems: Specification, Preliminary Design, Multitasking Approach, Monitors and Rendezvous, Fault Tolerance Techniques: Introduction, Faults, Fault types, Detection and Containment, Redundancy, Errors and Failures, Integrated Failure Handling.	30 Hours	1

IV	Introduction to Semaphores, Semaphore States, Types of Semaphores, Semaphores Implementation, Applications of RTOS, Semaphores in RTOS Applications, Examples: Creating Semaphores, Deleting Semaphores, Acquiring Semaphores, Releasing Semaphores	30 Hours	1

Text/Reference Books:

4. Silberschatz, Galvin and Gagne, "Operating Systems Concepts", Wiley
5. Phillip. A. Laplante, "Real-Time Systems Design and Analysis", second edition, PHI, 2005.
6. Jane. W. S. Liu, "Real Time Systems", Pearson education, 2005

GE33834 Robotics

Course Objective:

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.

Learning Outcome:

At the end of the course, the student should be able to:

1. Be familiar with the history, concept development and key components of robotics technologies.
2. Understand basic mathematic manipulations of spatial coordinate representation and transformation.
3. Understand and able to solve basic robot forward and inverse kinematics problems.
4. Understand and able to solve basic robotic dynamics, path planning and control problems.
5. Able to undertake practical robotics experiments that demonstrate the above skills.

Course Contents:

Module	**Course Topics**	**Total Hours**	**Credits**
I	**Introduction** Definition, Classification of Robots, geometric classification and control classification. Robot Elements: Drive system, control system, sensors, end	30 Hours	1

	effectors, gripper actuators and gripper design.		
II	**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	1
III	**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.	30 Hours	1
IV	**Applications** Applications: Application of robot in welding, machine tools, material handling, and assembly operations parts sorting and parts inspection.	30 Hours	1

Text/Reference Books:

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.

GE33835 Computer Vision

Course Objective:

1. To introduce students with practice and theory of computer vision.
2. To give basics of pattern recognition concepts with application to computer vision.
3. Study about the concept of facial recognition system.
4. To provide students with necessary theory and skills for automatic analysis of digital images.
5. Learn basics of video processing and object recognition systems.

Learning Outcome:

At the end of the course, the student should be able to:

1. Understand the vision technology in conjunction with real world application.
2. Students will able to implement the functioning methods of surveillance cameras.
3. Apply all the enhancement methods of digital images.
4. Make automatic decision based on extracted feature information of images.
5. Understand the basic and commonly used paradigms of vision technology.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction to Recognition and Morphological Image Processing** Recognition Methodology; Conditioning, Labeling, Grouping, Extracting, Matching. Morphological Image Processing; Introduction, Dilation and Erosion, Opening and Closing, Hit-or-Miss transformation. Morphological algorithm operations on binary images; Morphological algorithm, Operations on gray-scale images, Thinning and Thickening, Region growing and region shrinking. Image Representation and Description. Representation schemes. Boundary descriptors. Region descriptors.	30 Hours	1
II	**Segmentation and Edge detection in Binary Machine Vision** Binary Machine Vision; Thresholding, Segmentation; Hierarchal segmentation, Rule-based segmentation, Motion-based segmentation. Connected component Labeling. Spatial Clustering; Split and Merge. Area Extraction in an image; Basic Concepts, Data Structures. Edge; Line Linking, Hough Transform. Line fitting and Curve fitting (Least-Square fitting).	30 Hours	1
III	**Projection and Image Matching Techniques** Region Analysis; Region properties, External points, Spatial 05 moments, Mixed spatial gray-level	30 Hours	1

	moments. Boundary Analysis; Signature properties, Shape numbers. Facet Model Recognition; Labeling lines, Understanding line drawings. Classification of shapes by labeling of edges; Recognition of shapes, Consisting labeling problem, Back-tracking Algorithm. Projection; Perspective Projective geometry, Inverse perspective Projection, Photogrammetry - from 2D to 3D. Image matching; Intensity matching of ID signals, Matching of 2D image, Hierarchical image matching.		
IV	**Object Modeling and Object Recognition** Object Models And Matching; 2D representation, Global vs. Local features. General Frame Works For Matching; Distance relational approach, Ordered structural matching, View class matching, Models database organization. Knowledge Based Vision; Knowledge representation, Control strategies, Information Integration. Object recognition; Hough transforms and other simple object recognition methods. Shape correspondence and shape matching. Principal component analysis (PCA). Shape priors for recognition	30 Hours	1

Text/Reference Books:

1. Robert Haralick and Linda Shapiro, "Computer and Robot Vision", Vol I, II, Addison-Wesley, 1993.
2. David A. Forsyth, Jean Ponce, "Computer Vision: A Modern Approach"
3. Milan Sonka,Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", Thomson Learning

GE33832 Data Visualization and Statistics

Course Objective:

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 functionalities and usages of Seaborn.

Learning Outcome:

At the end of the course, the student should be able to:

1. Gain knowledge of Watson Studio, R and Python.
2. Identify appropriate data visualization techniques given particular requirements imposed by the data.
3. Acquire and Apply data visualization tools on various data sets.

Course Contents:

Module	Course Topics	Hours	Credits
I	**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	1
II	**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	1
III	**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 using Matplotlib-Waffle Charts, Word Clouds.	30 Hours	1
IV	**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.	30 Hours	1

Text/Reference Books:

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.

GE33844 Data mining and Warehousing

Course Objective:

1. Understand data mining principles and techniques.
2. Building basic terminology.
3. Learning how to gather and analyze large sets of data to gain useful business understanding.
4. Learning how to produce a quantitative analysis report/memo with the necessary information to make decisions.
5. Describing and demonstrating basic data mining algorithms, methods, and tools.
6. Identifying business applications of data mining.
7. Overview of the developing areas - web mining, text mining, and ethical aspects of data mining.
8. Develop and apply critical thinking, problem-solving, and decision-making skills.

Learning Outcome:

At the end of the course, the student should be able to:

1. Learn the concepts of database technology evolutionary path which has led to the need for data mining and its applications.
2. Examine the types of the data to be mined and present a general classification of tasks and primitives to integrate a data mining system.
3. Apply preprocessing statistical methods for any given raw data.
4. Explore DWH and OLAP, and devise efficient & cost effective methods for maintaining DWHs.
5. Discover interesting patterns from large amounts of data to analyze and extract patterns to solve problems, make predictions of outcomes.
6. Comprehend the roles that data mining plays in various fields and manipulate different data mining techniques.
7. Select and apply proper data mining algorithms to build analytical applications.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Data Mining** Overview , Motivation(for Data Mining),Data Mining, Definition & Functionalities, Data Processing, Form of Data Preprocessing ,Data Cleaning: Missing Values ,Noisy Data, Inconsistent Data, Data Integration and Transformation. , Data Reduction, Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Clustering, Discretization and Concept Hierarchy generation.	30 Hours	1

II	**Data Mining Statistics and Association rule** Concept Description, Definition, Data Generalization, Analytical Characterization, Analysis of attribute relevance, Mining Class comparisons ,Statistical measures in large Databases, Measuring Central Tendency, Measuring Dispersion of Data ,Range ,Quartiles, Outliers, Box plots, Variance, Standard Deviation, Graph Displays of Basic Statistical class Description, Mining Association Rules in Large Databases, Association rule mining, Mining Single- Dimensional Boolean Association rules from transactional Databases– A priori Algorithm, Mining Multilevel Association rules from Transaction Databases, Mining Multi-Dimensional Association rules from Relational Databases.	30 Hours	1
III	**Classification and Predictions** What is Classification & Prediction ,Issues regarding Classification and prediction, Decision tree, Bayesian Classification ,Classification by Back propagation, Multilayer feed-forward Neural Network, Back propagation Algorithm, Classification methods ,K nearest neighbor classifiers, Genetic Algorithm, Cluster Analysis ,Data types in cluster analysis, Categories of clustering methods, Partitioning methods, Hierarchical Clustering- ,CURE and Chameleon, Density Based Methods- DBSCAN, OPTICS, Grid Based Methods-STING, CLIQUE ,Model Based Method –Statistical Approach, Neural Network approach, Outlier Analysis.	30 Hours	1
IV	**Data Warehousing and OLAP** Overview ,Definition, Delivery Process ,Difference between Database System and Data Warehouse, Multi- Dimensional Data Model, Data Cubes ,Stars ,Snow Flakes ,Fact Constellations ,Concept hierarchy, ProcessArchitecture,ThreeTierArchitecture,DataMarting, Aggregation,Historical information ,Query Facility, OLAP function and Tools, OLAP Servers, ROLAP, MOLAP, HOLAP, Data Mining interface, Security, Backup and Recovery, Tuning Data Warehouse, Testing Data Warehouse.	30 Hours	1

Text/Reference Books:

1. M.H. Dunham, "Data Mining: Introductory and Advanced Topics" Pearson Education
2. Jiawei Han, Micheline Kamber, "Data Mining Concepts & Techniques", Elsevier
3. Sam Anahory, Dennis Murray, "Data Warehousing in the Real World : A Practical Guide for Building Decision Support Systems, 1/e", Pearson Education
4. Mallach, "Data Warehousing System", McGraw –Hill

GE33841 Fuzzy Logic

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.
5. Make applications on Fuzzy logic membership function and fuzzy inference systems.

Learning Outcomes:

After completing the course, the students should be able to:

1. Recognize fuzzy logic membership function.
2. Make applications on Fuzzy logic membership function and fuzzy inference systems.
3. Use the fuzzy set theory on the statistical method which is given.
4. Analyse statistical data by using fuzzy logic methods.
5. Recognize fuzzy logic fuzzy inference systems

Course Content:

Module	Course Topics	Total Hours	Credits
I	**Introduction, Classical Sets and Fuzzy Sets:-** Background, Uncertainty and Imprecision, Statistics and Random Processes, Uncertainty in Information Fuzzy Sets and Membership, Chance versus Ambiguity. Classical Sets - Operations on Classical Sets Properties of Classical (Crisp) Sets, Mapping of Classica Sets to Functions Fuzzy Sets - Fuzzy Set operations, Properties of Fuzzy Sets. Sets as Points in Hypercubes	12 Hours	1
II	**Classical Relations and Fuzzy Relations :-** Cartesian Product, Crisp Relations- Cardinality of Crisp Relations, Operations on Crisp	9 Hours	1

	Relations, Properties of Crisp Relations Composition. Fuzzy Relations Cardinality of Fuzzy Relations, Operations on Fuzzy Relations, Properties of Fuzzy Relations, Fuzzy Cartesian Product and Composition Non- interactive Fuzzy Sets Tolerance and Equivalence Relations - Crisp Equivalence Relation, Crisp Tolerance Relation Fuzzy Tolerance and Equivalence Relations Value Assignments -Cosine Amplitude, Max-min Method, Other Similarity methods		
III	**Membership Functions:** Features of the Membership Function, Standard Forms and Boundaries, Fuzzification, Membership Value Assignments – Intuition, Inference, Rank Ordering Angular Fuzzy Sets, Neural Networks, Genetic Algorithms, Inductive Reasoning.	11 Hours	1
IV	**Fuzzy Rule- Based Systems:** Natura Language, Linguistic Hedges, Rule-Based Systems - Canonical Rule Forms, Decomposition of Compound Rules, Likelihood and Truth Qualification, Aggregation of Fuzzy Rules Graphical Techniques of Inference	8 Hours	1

Text/ReferenceBooks:

1. Fuzzy Logic with Engineering Applications By Timothy J. Ross · 2016.
2. Kosko, B, 'Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence", PrenticeHall, NewDelhi, 2004.

GE33842 IoT Application Development

Course Objective:

1. To introduce a complete Internet of Things (IoT) solution by using IBM Watson IoT Platform.
2. To introduces basic concepts such as the service catalog, cloud applications, cloud services, and starter kits.
3. To enable students to closer look at the building blocks of IoT architecture and at the capabilities that is provided by Watson IoT Platform.
4. To introduce flow-based programming tool for wiring together hardware devices, APIs, and online services.
5. To describes the common protocols that can be used to connect devices to Watson IoT Platform: MQTT and HTTP
6. To provides an overview of android and connecting Watson Android SDK with Android studio.
7. To study, understand and implement each unit according to National Education Policy 2020 and Bloom's Taxonomy.

Learning Outcome:

At the end of the course, the student should be able to:.

1. Understand the IBM Watson IoT Platform. The CLO has been achieved according to BL1 and BL2 in Unit 1.
2. To understand and apply IoT concepts over IBM Watson IoT Platform. The CLO has been achieved according to BL2 and BL3 in Unit 2.
3. Understanding and Applying the IoT concepts over Node-red and analyzing the network protocols in its working and The CLO has been achieved according to BL2, BL3 and BL4 in Unit 3.
4. To understand and apply the programming interface to connect IoT devices using Rest API for analysis and evaluation. The CLO has been achieved according to BL2, BL3, BL4 and BL5 in Unit 4.
5. To understand the analytics services on IBM Cloud and applying to create better solution. The CLO has been achieved according to BL2, BL3, BL4, BL5 and BL6 in Unit 5 & 6.

Course Contents:

Module	Course Topics	Total Hours	Credits

I	**Introduction to the Internet of Things and IBM Watson IoT Platform** IBM IoT point of view, IoT reference architecture, Watson IoT Platform overview, Connecting devices to Watson IoT Platform, Communication protocols **Introduction to IBM Cloud & IBM Watson IoT Platform** IBM Cloud overview, Databases on IBM Cloud, Managing users and resources on IBM Cloud, Managing applications and services on IBM Cloud, Getting started with Watson IoT Platform Watson IoT Platform features overview, Watson IoT Platform dashboard, Device management and security policies, Application management, Access Management, Advanced features in Watson IoT Platform, Watson IoT Platform recipes	30 Hours	1
II	**Introduction to Node-RED and Network protocols** Introduction to flow-based programming, Node-RED overview, Node-RED flow editor, Node-RED Palette Manager MQTT protocol overview, HTTP and MQTT protocol comparison	30 Hours	1
III	**Enhancing Internet of Things solutions with REST APIs** Application programming interface overview, REST API overview, API versus SDK and API versus a library, JSON data format overview, Accessing Watson and Cloudant services with REST APIs, Enhancing an IoT solution with Watson AI	30 Hours	1
IV	**Introduction to analytics services on IBM Cloud** Analytics services on IBM Cloud overview, IBM Analytics Engine overview, **Introduction to Watson Android SDK in Android** Introduction to Android development Explore the benefits of JSON and XML in Android applications **Project** Simple application with the Watson Android SDK in Android Studio Developing full-stack mobile apps for Android Integrating IoT applications with IBM Watson Visual Recognition,	30 Hours	1

Text/Reference Books:

1. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet

of Things by David Hanes, Gonzalo Salgueiro, Rob Barton Released June 2017 Publisher(s): Cisco Press ISBN: 9780134307091

2. Enterprise Internet of Things Handbook by Arvind Ravulavaru Released April 2018 Publisher(s): Packt Publishing ISBN: 9781788838399
3. Analytics for the Internet of Things (IoT) by Andrew Minteer Released July 2017 Publisher(s): Packt Publishing ISBN: 9781787120730
4. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things by David Hanes, Gonzalo Salgueiro, Rob Barton Released June 2017 Publisher(s): Cisco Press ISBN: 9780134307091
5. Analytics: Data Science, Data Analysis and Predictive Analytics for Business" by Daniel Covington.
6. Artificial Intelligence for IoT: "IBM Reference Architecture for High Performance Data and AI in Healthcare and Life Sciences" by Dino Quintero, Frank N. Lee.

GE33843 Optimization Techniques

Course Objective:

1. Enumerate the fundamental knowledge of Linear Programming and Dynamic Programming problems.
2. Learn classical optimization techniques and numerical methods of optimization.
3. Know the basics of different evolutionary algorithms.
4. Understand different optimization techniques to solve various models arising from engineering areas.
5. To understand optimization in different areas like Machine learning, Neural Networks.

Learning Outcome:

After completing the course, the students should be able to:

1. Understand the importance of optimization of industrial process management.
2. Apply basic concepts of mathematics to formulate an optimization problem.
3. Analyze and appreciate a variety of performance measures for various optimization problems.
4. Apply the theoretical concepts of Artificial Intelligence and practical knowledge in analysis, design, and development of computing systems and applications.
5. Work as a socially responsible professional by applying Artificial Intelligence with optimization.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction of optimization technique** History, Engineering application of optimization techniques. Tool for optimization, Design issues and formulation of mathematical programming. Role of optimization technique in machine learning techniques, supervised, unsupervised, Types of optimization technique, linear, non-linear and discrete.	30 Hours	1
II	**Linear optimization** Geometry, Simplex method, Duality theory, Analysis, sensitivity, Convex, Non convex analysis; **Non-linear optimization**, Application, Discrete techniques and its application, Branch Bound, Cutting Planes method, Heuristic and	30 Hours	1

	Approximation algorithms.		
III	**Dynamic Programming** Optimality, condition, Gradient method, Conjugate, Accelerated, Noise reduction method, Line search and Newton search method, Robust optimization, Large scale optimization, Network flows.	30 Hours	1
IV	**Modern Optimization Techniques**: Genetic algorithm terms and concept, mathematical formulation, Neural Network-based optimization, Fuzzy optimization techniques , real life application; Ant colony optimizing method, application, real life issues and overcome using formulation.	30 Hours	1

Text/Reference Books:

1. Optimization for Engineering Design by Kalyanmoy Deb, PHI Publishers, 2012
2. Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers, 1989
3. Operations Research by Hillar and Liberman, TMH Publishers, 2021
4. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers, 2016

GE33845 Augmented & Virtual Reality

Course Objective:

1. To provide students with a solid background in alternative 3D compositing techniques using computer vision with applications in interactive interfaces – most notably augmented reality interfaces on mobile devices.
2. Provide students with a comprehensive knowledge in 3D vision.
3. Develop skills in the design and development of interactive augmented reality games

Learning Outcome:

At the end of the course, the student should be able to:.

1. Develop interactive augmented reality applications for both PC based mobile devices using a variety of novel input devices.
2. Demonstrate a knowledge of the research literature in Augmented Reality for both compositing and interactive applications

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**VIRTUAL REALITY AND VIRTUAL ENVIRONMENTS:** The historical development of VR: Scientific landmarks Computer Graphics, Real- time computer graphics, Flight simulation, Virtual environments, Requirements for VR, benefits of Virtual reality. **HARDWARE TECHNOLOGIES FOR 3D USER INTERFACES:** Visual Displays Auditory Displays, Haptic Displays, Choosing Output Devices for 3D User Interfaces. **3D USER INTERFACE INPUT HARDWARE:** Input device characteristics, Desktop input devices, Tracking Devices, 3D Mice, Special Purpose Input Devices, Direct Human Input, Home Brewed Input Devices, Choosing Input Devices for 3D Interfaces.	30 Hours	1
II	**SOFTWARE TECHNOLOGIES:** Database - World Space, World Coordinate, World Environment, Objects - Geometry, Position / Orientation, Hierarchy, Bounding Volume, Scripts and other attributes, VR Environment - VR Database, Tessellated Data, LODs, Cullers and Occluders, Lights and Cameras, Scripts, Interaction - Simple, Feedback, Graphical User Interface, Control Panel, 2D Controls, Hardware Controls, Room / Stage / Area Descriptions, World Authoring and Playback, VR toolkits, Available software in the market.	30 Hours	1

III	**3D INTERACTION TECHNIQUES:** 3D Manipulation tasks, Manipulation Techniques and Input Devices, Interaction Techniques for 3D Manipulation, Deign Guidelines - 3D Travel Tasks, Travel Techniques, Design Guidelines - Theoretical Foundations of Wayfinding, User Centered Wayfinding Support, Environment Centered Wayfinding Support, Evaluating Wayfinding Aids, Design Guidelines - System Control, Classification, Graphical Menus, Voice Commands, Gestrual Commands, Tools, Mutimodal System Control Techniques, Design Guidelines, Case Study: Mixing System Control Methods, Symbolic Input Tasks, symbolic Input Techniques, Design Guidelines, Beyond Text and Number entry . **VIRTUAL REALITY APPLICATIONS:** Engineering, Architecture, Education, Medicine, Entertainment, Science, Training.	30 Hours	1
IV	Augmented and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.	30 Hours	1

Text/Reference Books:

1. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.
2. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
3. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
4. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.
5. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003.
6. John Vince, "Virtual Reality Systems", Addison Wesley, 1995.
7. Howard Rheingold, "Virtual Reality: The Revolutionary Technology and how it Promises to Transform Society", Simon and Schuster, 1991.
8. William R Sherman and Alan B Craig, "Understanding Virtual Reality: Interface, Application and Design (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann

Publishers, San Francisco, CA, 2002
9. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.

GE33852 Data Compression

Course Objective:

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.

Learning Outcome:

At the end of the course, the student should be able to:

1. Display competence in the fundamental ideas of the lossless data compression.
2. Demonstrate understanding of the underlying mathematical theory and algorithms.
3. Understand fundamental ideas of quantization and transform coding.
4. Understand how lossless and lossy compression algorithms can be used for solving scientific and engineering problems.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**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	1
II	**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	30 Hours	1

	Applications of Huffman coding: Lossless image compression, Text compression and Audio Compression Arithmetic Coding: Introduction, Coding a Sequence, Generating a Tag, Deciphering a Tag, Comparison of Huffman and Arithmetic Coding, Applications.		
III	**Dictionary Coding and Context Based Compression** Dictionary Techniques: Introduction, Static Dictionary: Diagram Coding; Adaptive Dictionary: The LZ77Approach, TheLZ78Approach, 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	1
IV	**Mathematical Preliminaries for Lossy Coding, Scalar and Vector Quantization** Mathematical Preliminaries for Lossy Coding: Introduction, Distortion criteria, Models. Scalar Quantization: Introduction, The Quantization Problem, Uniform Quantizer, Adaptive Quantization, Non- uniform Quantization Vector Quantization: Introduction, Advantages of Vector Quantization *over* Scalar Quantization, The Linde -Buzo- Gray Algorithm, Tree structured Vector Quantizers.	30 Hours	1

Text/Reference Books:

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

GE33853 Distributed System

Course Objective:

1. To learn issues related to clock synchronization and the need for global state in distributed system.
2. Have knowledge and understanding of the main principles, techniques and methods involved when dealing with distributed systems.
3. To get the knowledge of how distributed objects communicate by means of remote invocation.
4. To provide an in-depth overview of research topics in distributed systems.
5. To learn distributed mutual exclusion and Deadlock detection algorithms.

Learning Outcome:

At the end of the course, the student should be able to:

1. Understand the foundations and issues of distributed systems.
2. Understand in detail how distributed applications work and what requirements they aim to satisfy.
3. Understand the various synchronization issues and global state for distributed system.
4. Understand in detail how distributed applications work and what architecture they exhibit.
5. Understand in detail how distributed applications work and what techniques and infrastructures they are built upon.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction to distributed systems: Definitions and Examples of Distributed systems; System Models: Architectural models and Fundamental models; limitations of distributed systems. Logical Clocks: Lamport's clocks, Vector logical clock, NTP; Message Passing System: Causal ordering of messages, Sates of a Distributed system, Local and Global State, Consistent and inconsistent states; Termination detection.	30 Hours	1
II	Mutual Exclusion: Requirements of Mutual Exclusion, Classification of distributed mutual exclusion: Non-token based Quorum Based and Token Based mutual exclusion with examples; Performance metric for distributed mutual exclusion algorithms. Deadlock Detection: System models, Preliminaries, Deadlock prevention, Deadlock avoidance, Deadlock detection & resolution Agreement Protocols: Classification of Agreement	30 Hours	1

	Problem: Byzantine agreement problem, Consensus problem, Interactive consistency Problem; Solution to Byzantine Agreement problem; Application of Agreement problem.		
III	Resource Management: Distributed File Systems, Issues in distributed File System. Failure Recovery: Backward and Forward recovery, Recovery in Concurrent systems: Checkpoints; Recovery in Distributed Database Systems; Fault Tolerance: Issues in Fault Tolerance, Voting Protocols. Transaction Control: Nested Transactions, Locks; Concurrency Control: Methods and their comparison, Concurrency control in Distributed Transactions, Replication: Fault tolerant services, Transactions with replicated data.	30 Hours	1

Text/Reference Books:

1. Singhal & Shivaratri, "Advanced Concept in Operating Systems", McGraw Hill
2. Ramakrishna, Gehrke, "Database Management Systems", McGrawhill
3. Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design", Pearson Education
4. Tenanuanbaum, Steen, "Distributed Systems", Prentice Hall of India
5. Gerald Tel, "Distributed Algorithms", Cambridge University Press

GE33854 Bioinformatics

Course Objective:

1. Study to develop methods and software tools for understanding biological data.
2. To introduce students to the fundamentals of evolution, molecular biology, and molecular evolution.
3. To study DNA, RNA important molecules, protein data, etc. their structure, replication and transcription.
4. Study on biological databases which help in analyzing biological data and their interpretation.
5. Introduction of Perl programming for developing tools for genome sequencing and other applications.

Learning Outcome:

After completing the course, the students should be able to:

1. Have a good working knowledge of basic bioinformatics tools and databases such as GenBank, BLAST, multiple alignment, and phylogenetic tree construction.
2. Describe the contents and properties of the most important bioinformatical databases, perform text- and sequence-based searches, and analyse and discuss the results in light of molecular biological knowledge.
3. Explain the major steps in pair wise and multiple sequence alignment, explains the principle for, and executes pair wise sequence alignment by dynamic programming.
4. give examples of methods for describing and analysing genes, genomes and gene expression
5. explain the major features of methods for modelling protein structures and use programs for visualizing and analysing such structures

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**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	1

II	**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- Bioperl, Linux Operating System, Understanding and Using Biological Databases, Java clients, CORBA, Introduction to biostatics	30 Hours	1
III	**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, general data retrieval techniques: indices, Boolean search, fuzzy search and neighboring, application to biological data warehouses.	30 Hours	1
IV	**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.	30 Hours	1

Text/Reference Books:

1. O'Reilly, " Developing Bio informatics computer skills", Indian Edition's Publication
2. Rastogi, Mendiratta, Rastogi,"Bioinformaticsconcepts, skills & Applications", CBS Publishers
3. Rashidi, Hooman and Lukas K. Buehler, "Bioinformatics Basic Applications" CRC Press.
4. "Bioinformatics" , Addison Wesley
5. Stephen Misner& Stephen Krawetz, " Bioinformatics- Methods & Protocols"
6. Cynthia Gibas and Per Jambeck, "Introduction to Bioinformatics computer Skills", 2001 SPD
7. Atwood, "Introduction to Bioinformatics", Person Education
8. James Tisdall, "Beginning Perl for Bioinformatics", SPD

GE33855 Pattern Recognition

Course Objective:

1. Learn the fundamental concepts and applications of pattern recognition.
2. Learn the concepts of Bayes decision theory.
3. Understand the concepts of linear and nonlinear classifiers.
4. Understand the concepts of feature selection and generation techniques.
5. Understand the concepts of supervised learning and system evaluation.
6. Understand the concepts of unsupervised learning and clustering algorithms.
7. Develop some applications of pattern recognition.

Learning Outcome:

At the end of the course, the student should be able to:

1. Understand the fundamental pattern recognition and machine learning theories.
2. Design and implement certain important pattern recognition techniques.
3. Applying the pattern recognition theories to applications of interest.
4. Design systems and algorithms for pattern recognition (signal classification), with focus on sequences of patterns.
5. Analyze classification problems probabilistically and estimate classifier performance.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	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	1
II	Statistical Patten Recognition, Bayesian Decision Theory, Classifiers, Normal density, Discriminant functions.	30 Hours	1
III	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	1
IV	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	1

Text/Reference Books:

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.

GE33851 Essentials of Block Chain Technology

Course Objective:

1. Blockchain technology and the key concepts like cryptography and cryptocurrency concepts
2. Gain a deep insight into Bitcoin, its network and how Bitcoin 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
5. Infer Hyperledger project, its architecture, APIs and network topology

Learning Outcome:

At the end of the course, the student should be able to:

1. Understand how blockchain solutions are transforming the industry landscape.
2. Develop a deeper understanding of blockchain technical topics such as consensus, cryptography, privacy and security.
3. Acquire hands-on expertise using popular blockchain open source technology, including Hyperledger Fabric.
4. Design and develop for a permissioned blockchain.
5. Explore a variety of blockchain case studies, including food provenance, container tracking, payments, identity.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**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 Deplooying Docker containers, Introduction to Blockchain	30 Hours	1
II	**Blockchain in detail and Blockchain Status** Understand the business context behind blockchain and the problems that blockchain aims to solve, Distinguish between blockchain for business and other blockchain implementations, Enumerate the broad categories of blockchain solutions, 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		
III	**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 business value **Blockchain Developer part 1:-** Block chain principles and its use in the enterprise, Blockchain infrastructure and applications, Identify participants, assets, transactions in a business network, Hyperledger Fabric, Blockchain solution architecture, Peers, smart contracts, channels, world state	30 Hours	1
IV	**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	30 Hours	1

Text/Reference Books:

1. IBM Courseware
2. Implementing Blockchain solutions using Hyperledger