

VIVEKANAND

EDUCATION SOCIETY

INSTITUTE OF TECHNOLOGY

(AUTONOMOUS)

**Hashu Advani Memorial Complex, Collector's Colony,
Chembur, Mumbai, 400074, Maharashtra, India
www.vesit.ac.in**



**Syllabus Approved By:
Academic Council of V.E.S. Institute of
Technology Effective from: 2026-27**

Preamble

Engineering education forms the cornerstone of technological innovation, industrial advancement, and societal transformation. As the world navigates an era of rapid change driven by automation, artificial intelligence, sustainable technologies, and global connectivity, VESIT positions itself as a catalyst for cultivating a dynamic learning ecosystem.

At VESIT, we strive to foster critical thinking, technical expertise, academic excellence, and holistic development among aspiring engineers. We are committed to shaping professionals who are adaptable, collaborative and are also deeply conscious of their social and environmental responsibilities.

Leveraging its autonomous status and affiliation with the University of Mumbai, VESIT designs a forward-thinking, outcome-based curriculum that emphasizes industry relevance and experiential learning.

The syllabus at VESIT has been structured in alignment with the principles of the National Education Policy (NEP) 2020, focusing on flexibility and multidisciplinary learning. The key thrust areas of education at VESIT include :-

Student-Centric Approach:

The programme is designed to offer students greater autonomy in shaping their academic journey. The syllabus comprises of **Core (Major) and Minor courses** from Diverse Disciplines as well as a wide range of **Open Electives**. Students can tailor their learning paths based on their interests and career aspirations. The curriculum also integrates mentored field projects and on the job training, providing valuable hands-on experience. Additionally, students with a research inclination can also explore **research-based projects** or pursue **Honours by Research**.

Multidisciplinary Approach:

VESIT's curriculum reflects a strong interdisciplinary focus, incorporating emerging fields and cutting-edge technologies. Courses are designed to bridge various domains with offerings such as **Machine learning, Artificial Intelligence & Data Science, Cyber Security, Geographic Information Systems (GIS), Internet of Things (IoT), Register transfer level VLSI, Robotics, Quantum Technologies, Mobile application development, Industrial Automation, Edge Computing and Embedded Intelligence and Information Security.**

This approach encourages broader thinking and prepares students for diverse career paths.

Emphasis on Conceptual Clarity:

The curriculum lays stress also on a strong theoretical foundation, ensuring that students gain deep conceptual understanding, which is essential for mastering advanced topics and solving real-world problems.

Fostering Creativity and Critical Thinking:

Courses are designed to nurture a critical and creative mindset, promoting analytical reasoning, problem-solving, and innovation. Students are encouraged to question, explore, and think beyond conventional solutions.

Comprehensive Evaluation and Assessment:

Student performance is assessed through a number of assessment tools that includes the Mid-term Tests, Continuous Assessments, End-Semester Examinations. These evaluation tools are designed to measure the knowledge retention of students as well as their ability to apply concepts effectively in practical situations.

Guided by a vision of excellence and inclusivity, and supported by a passionate faculty, VESIT aspires to be a hub where ideas flourish, startups emerge, and industry-academia partnerships thrive. Our goal is to transform students into innovators, entrepreneurs, researchers and responsible leaders poised to drive sustainable growth and meaningful change in society.

Dr. J M Nair

Principal, VESIT

Dr. M Vijayalakshmi

Vice Principal, VESIT

Dr. Mrs. Gresha S Bhatia

Academic Coordinator, VESIT

Department of Master of Computer Applications (MCA)

Preamble –

The **Master of Computer Applications (MCA)** program at Vivekanand Education Society's Institute of Technology is designed to produce industry-ready professionals with a strong foundation in both theoretical and applied aspects of Computer Science and Information Technology. In alignment with the National Education Policy (NEP) 2020, the program emphasizes interdisciplinary learning, skill-based training, and flexible academic pathways.

With a curriculum that integrates cutting-edge Technologies such as Big Data Analytics, Artificial Intelligence, Deep Learning, Blockchain, Cloud Computing, Microservices, Digital Marketing and Business Analytics and Ethical Hacking, the MCA program prepares students to meet the evolving demands of the global IT industry. The course structure also promotes research, innovation, and entrepreneurship through project-based learning, hands-on lab sessions, and Industry-oriented Internships.

The MCA department fosters an environment of academic excellence, critical thinking, and ethical responsibility. The inclusion of emerging domains such as Sustainable Computing and Digital Forensics reflects the department's commitment to sustainability, cybersecurity, and digital trust. Students are further encouraged to engage in MOOCs, Hackathons, and self-paced learning platforms to enrich their academic journey.

This dynamic and forward-looking program not only nurtures Technical Competencies but also aims to shape responsible, innovative, and socially aware IT professionals and Researchers who can contribute effectively to the digital transformation of society.

PROGRAM OUTCOMES

- 1. PO1 (Foundation Knowledge):** Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving.
- 2. PO2 (Problem Analysis):** Identify, review, formulate and analyse problems for primarily focusing on customer requirements using critical thinking frameworks.
- 3. PO3 (Development of Solutions):** Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals.
- 4. PO4 (Modern Tool Usage):** Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.

5. **PO5 (Individual and Teamwork):** Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
6. **PO6 (Project Management and Finance):** Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management.
7. **PO7 (Ethics):** Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware.
8. **PO8 (Life-long learning):** Change management skills and the ability to learn, keep up with contemporary technologies and ways of working.

Dr. Shiv Kumar Goel
(H.O.D.)

Dr. Dhanamma Jagli
(Dy. H.O.D.)

VIVEKANAND EDUCATION SOCIETY'S INSTITUTE OF TECHNOLOGY

(Autonomous Institute Affiliated to University of Mumbai)



Master of Computer Applications

MCA

**Sem I - Sem II Syllabus & BC (NEP
Scheme)**

Effect from the academic year 2026–2027

Year (2 Yr PG)	Level	Sem.	Major				Cum. Cr.	Degree
			Mandatory		Electives Any one			
I	6.0	Sem I	NMCA11	4	NMCAE1X (Cr:4)		24	PG Diploma in Computer Application (PGDCA) (After 3 Year Degree)
			NMCA12	3	NMCAE11	4		
			NMCA13	3	NMCAE12	4		
			NMCA14	3	NMCAE13	4		
			NMCAL11	1				
			NMCAL12	1				
			NMCAL13	1				
			NMCAL14	1				
			NMCAL15	2				
			NMCAFP11(Field Project(OJT/FP)	1				
		Sem II	NMCA21	4	NMCAE21X (Cr: 4)		25	
			NMCA22	3	NMCAE211	3		
			NMCA23	4	NMCAE212	3		
			NMCAL21	1	NMCAE213	3		
			NMCAL23	1	NMCALE211	1		
			NMCAL24	2	NMCALE212	1		
			NMCAL25	1	NMCALE213	1		
			NMCAFP21(Field Project (OJT/FP)	1	NMCAE22X(Cr:4)			
					NMCAE221	4		
		NMCAE222	4					
		NMCAE223	4					
Cumulative Credits for PG Diploma			37		12		49	
Exit option: PG Diploma 44-52 Credits after Three Year UG Degree (with additional 4 credits of OJT)								

Master of Computer Applications

Academic Year 2026-27

**CURRICULUM SCHEME FOR NEP POSTGRADUATE ACADEMIC PROGRAM
AT VESIT**

Branch: MCA Semester I

Semester I

CURRICULUM SCHEME FOR NEP POSTGRADUATE ACADEMIC PROGRAM AT VESIT

Branch: MCA Semester I

Semester I Scheme

Type of Course	Course Code	Name of Course	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
Major (Mandatory)	NMCA11	Statistics for Data Science	3	-	1	3	-	1	4
Major (Mandatory)	NMCA12	Java for Full Stack Development	3	-	--	3	--	--	3
Major (Mandatory)	NMCA13	Data Warehousing and Mining.	3	-	--	3	--	--	3
Major (Mandatory)	NMCA14	User Experience Design and Development	3	-	--	3	-	-	3
Major (Elective)	NMCAE1X	Elective - 1	3	-	1	3	-	1	4
Major (Mandatory)	NMCAL11	Python Programming Lab	--	2	--	--	1	--	1
Major (Mandatory)	NMCAL12	Java for Full Stack Development Lab	--	2	--	--	1	--	1
Major (Mandatory)	NMCAL13	Data Analytics Lab	--	2	--	--	1	--	1
Major (Mandatory)	NMCAL14	Skill based Lab: User Interface & User Experience Lab	--	2	--	--	1	--	1
Major (Mandatory)	NMCAL15	Web Application Technologies Lab	1	2	-	1	1	-	2
Field Project (OJT/FP)	NMCAFP11	Project Seminar (Real Life Problems based on Societal Issues)	--	2	--	--	1	--	1
Total			16	12	2	16	06	2	24

Type of Course	Course Code	Name of Course	Examination Scheme							
			Theory					Term Work	Pract & oral	Total
			Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
			MT	CA	Tot					
Major (Mandatory)	NMCA11	Statistics for Data Science	20	20	40	60	2	25	--	125
Major (Mandatory)	NMCA12	Java for Full Stack Development	20	20	40	60	2	--	--	100
Major (Mandatory)	NMCA13	Data Warehousing and Mining.	20	20	40	60	2	--	--	100
Major (Mandatory)	NMCA14	User Experience Design and Development	20	20	40	60	2	--	--	100
Major (Elective)	NMCAE1X	Elective - 1	20	20	40	60	2	25	--	125
Major (Mandatory)	NMCAL11	Python Programming Lab	--	--	--	--	--	25	50	75
Major (Mandatory)	NMCAL12	Java for Full Stack Development Lab	--	--	--	--	--	25	50	75
Major (Mandatory)	NMCAL13	Data Analytics Lab	--	--	--	--	--	25	50	75
Major (Mandatory)	NMCAL14	Skill based Lab Course User Interface & User Experience Lab	--	--	--	--	--	25	50	75
Major (Mandatory)	NMCAL15	Web Application Technologies Lab	--	--	--	--	--	50	50	100
Field Project (OJT/FP)	NMCAFP11	Project Seminar (Real Life Problems based on Societal Issues)	--	--	--	--	--	50	--	50
Total			--	--	200	300	--	250	250	1000

Elective 1

Sr. No.	Course Code	Name of Course
1	NMCAE11	Digital Marketing and Business Analytics
2	NMCAE12	Agile Project Management
3	NMCAE13	Entrepreneurship Management

Semester I

Course Code	Name of Course	Teaching Scheme			Credits Assigned		
NMCA11	Statistics for Data Science	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		1	3	1	4
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	MT	Total			
		20	20	40	25	60	125

Prerequisite: Student must know

1. Set theory
2. Basic principles of counting

Course Objectives: Course is aim to

Sr.No.	Course Objective
1	Statistical measures on various types of data
2	Correlation and regression techniques for estimation
3	Probability aspects to take proper decision
4	Application of discrete and continuous probability distributions
5	Various methods of hypothesis testing
6	Understand different ways to calculate probability.

Course Outcomes: On successful completion of the course learner/ student will be able to

Sr.No.	Outcome
CO1	Apply different statistical measures to various types of data
CO2	Evaluate using regression analysis
CO3	Analyze different types of probability and their fundamental Applications.
CO4	Apply probability distribution to real world problems
CO5	Formulate and test the hypothesis for business problem using various methods
CO6	Evaluate probability distribution using random variables.

Module	Detailed Contents	Hrs
1	Measures of Central Tendency & Measures of Dispersion: Frequency Distribution, Histogram, Stem and leaf diagram, ogives, Box whisker plot, Frequency Polygon, Mean, Median, Mode, Range, Quartile Deviation, Standard Deviation, and Coefficient of Variation. Self-Learning Topics: Basics of variance, Basic principles of counting.	5
2	Skewness, Regression, and correlation: Skewness: Karl Pearson's coefficient of skewness, Bowley's coefficient of skewness. Correlation: Karl Pearson's coefficient of correlation, Spearman's rank correlation coefficient. Regression: Linear and Non-linear regression (quadratic), Estimation using linear regression. Self-Learning Topics: Apply correlation and regression on real world data and its graphical representation.	8
3	Introduction to probability & conditional probability: Introduction to probability, Random experiment, Sample space, Events, Axiomatic Probability, Algebra of events. Conditional Probability, Multiplication theorem of Probability, Independent events, Bayes' Theorem. Self-Learning Topics: Applications based on Bayes' theorem.	8
4	Random variable: Discrete random variable, Continuous random variable, Two-dimensional random variable, Joint probability distribution, Stochastic independence, Properties of Expectation and Variance, Covariance. Self-Learning Topics: Study of various random variables and its independence.	8
5	Theoretical probability distributions: Binomial, Poisson, Normal. Self-Learning Topics: Study of properties of standard normal variate.	5
6	Sampling & Testing of hypothesis: Sampling: Probability Sampling, Non- Probability Sampling Hypothesis testing, Type I and Type II errors. Tests of significance – single sample, Student's t-test, large sample test (z-test). Self-Learning Topics: Study of elementary sampling methods	5

Reference Books:

Reference No	Reference Name
1	S.C.Gupta, V.K.Kapoor, S Chand, Fundamentals of Mathematical Statistics, Sultan and Chand sons publication, First Edition
2	Hwei P. Hsu, Schaum's Outlines Probability, Random Variables & Random Process, Tata McGraw Hill, Third Edition
3	J.Susan Milton, Jesse C. Arnold, Introduction to Probability & Statistics, Tata McGraw Hill, Fourth Edition
4	Dr J Ravichandran, Probability & Statistics for Engineers, Wiley
5	Dr Seema Sharma, Statistics for Business and Economics, Wiley
6	Ken Black, Applied Business Statistics, Wiley, Seventh Edition

Web References:

Reference No	Reference Name
1	IIT Kharagpur – Probability and Statistics by Dr. Somesh Kumar https://nptel.ac.in/courses/111105041/
2	IIT Madras – Introduction to Probability and Statistics by Dr. G. Srinivasan https://nptel.ac.in/courses/111/106/111106112/
3	IIT Kanpur – Descriptive Statistics with R Software by Prof. Shalabh https://nptel.ac.in/courses/111/104/111104120/
4	IIT Roorkee – Business Statistics by Prof. Mukesh Kumar Barua https://nptel.ac.in/courses/110/107/110107114/
5	MIT – Introduction to Probability and statistics by Jeremy Orloff and Jonathan Bloom https://ocw.mit.edu/courses/mathematics/18-05-introduction-to-probability-and-statistics-spring-2014/index.htm
6	An Introduction to Statistical Learning with Applications in R by Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani http://faculty.marshall.usc.edu/gareth-james/ISL/data.html

Tutorials:

Sr No	Topic	Hours
1	Find Bowley's & Karl Pearson's coefficient of skewness	1
2	Calculate Karl Pearson's and Spearman's coefficient of correlation	1
3	To fit linear regression and estimate	1
4	Examples on addition and multiplication theorem of probability	1
5	Examples based on Bayes' theorem	1
6	Examples based on independence of discrete random variables.	1
7	Examples based on independence of continuous random variables.	1
8	Example on Poisson distribution	1

9	Example on normal distribution	1
10	Example on t-test	1

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Term Work: 25 marks

The term work will be based on Tutorial Performance.

Course Code	Course Name	Teaching Scheme			Credits Assigned		
NMCA12	Java for Full Stack Development	Contact Hours					
		Theory	Tutorial		Theory	Tutorial	Total
		3	--		3	--	3
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	MT	Total			
		20	20	40	--	60	100

Prerequisite:

1. Basic understanding of any Object-Oriented Programming Language
2. Successfully completed Programming Concepts of Core Java course

Course Objectives: Course is aim to

Sr.No.	Course Objective
1	Learn the basic data structure operation using Java Collection Framework and understand Lambda expressions.
2	Build web applications using JSP and JSTL.
3	Understand Spring Framework and build Java EE applications and services.
4	Apply Data Access using Spring Framework
5	Understand how to simplify Spring applications using Spring Boot
6	Understanding Spring Boot RESTful Web Services.

Course Outcomes: On successful completion of the course learner/student will be able to

Sr.No.	Outcome
CO1	Demonstrate use of data structure and data manipulation concept using Java Collection Framework and Lambda expressions.
CO2	Create JSP using standard actions, custom tags, Introduction to JSP Standard Tag Library (JSTL) and JSTL Tags.
CO3	Understand and develop applications using Spring Framework, Lightweight Container and Dependency Injection with Spring.
CO4	Develop applications using Aspect Oriented Programming with Spring.
CO5	Apply JDBC Data Access with Spring and demonstrate Data access operations with JDBC Template and Spring.
CO6	Create Spring Boot Web Application and Spring Boot RESTful WebServices.

Module	Detailed Contents	Hrs
01	Introduction Java EE Programming JSP Architecture, JSP building blocks, Scripting Tags, implicit object, Introduction to Bean, standard actions, session tracking types and methods. Custom Tags, Introduction to JSP Standard Tag Library (JSTL) and JSTL Tags. Self-learning topics Simple Application using Servlet.	8
02	Spring Frameworks: Introduction to Spring Framework, POJO Programming Model, Lightweight Containers (Spring IOC container, Configuration Meta Data, Configuring and using the Container) Dependency Injection with Spring- Setter Injection, Constructor Injection, Circular Dependency, Overriding Bean, Auto Wiring Bean Lookup, Spring Manage Beans). Self-learning topics Bean Definition Profiles.	6
03	Spring and AOP Aspect Oriented Programming with Spring, Types of advice, Defining PointCut Designator, Annotations. Self-learning topics AspectJ.	5
04	JDBC Data Access with Spring Managing JDBC Connection, Configuring Data Source to obtain JDBC Connection, Data Access operations with JDBC Template and Spring, RDBMS operation classes, Modelling JDBC Operations as Java Objects. Self-learning topics JDBC Architecture and basic JDBC Program using DML operation	6
05	Getting Started with Spring Boot Introduction, Spring Boot and Database, Introduction to exception handling in spring boot. Self-learning topics Spring Boot Web Application Development, Understanding Transaction Management in Spring.	5
06	ReactJS Introduction to reactjs, understanding JSX, React components, component lifecycle, react class, introduction to react State and Props, react event, react conditionals, react list and forms, hook. Self-learning topics Model-ViewController framework, Flux,	9

Reference Books:

Reference No	Reference Name
1	Java 6 Programming Black Book, Wiley–Dreamtech ISBN 10: 817722736X ISBN 13: 9788177227369
2	Web Enabled Commercial Application Development using java 2.0, Ivan Byaross ISBN-10: 8176563560 / ISBN-13: 978-8176563567
3	Java Server Programming java EE6, Black book, Dreamtech Press. ISBN-10: 8177229362 / ISBN-13: 978-8177229363
4	Core Servlets and Java Server Pages: Vol I: Core Technologies 2/e , Marty Hall and Larry Brown, Pearson , ISBN: 9788131701638, 8131701638
5	Java Enterprise in a Nutshell, 3rd Edition A Practical Guide, Jim Farley, William Crawford, O'Reilly ISBN-13: 978-0596101428 / ISBN-10: 0596101422
6	Java EE 6 Server Programming For Professionals, Sharanam Shah and Vaishali Shah, SPD, ISBN-10: 9788184049411 / ISBN-13: 978-8184049411
7	Spring in Action, Craig Walls, 3rd Edition, Manning, ISBN 9781935182351
8	Professional Java Development with the Spring Framework by Rod Johnson et al. John Wiley & Sons 2005 (672 pages) ISBN: 0764574833
9	Beginning Spring , Mert Caliskan and Kenan Sevindik Published by John Wiley & Sons, Inc. 10475 Crosspoint Boulevard Indianapolis, IN 46256 www.wiley.com

Web References:

Reference No	Reference Name
1	https://docs.oracle.com
2	Spring.io

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:-NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks

6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Course Code	Name of Course	Teaching Scheme			Credits Assigned		
NMCA13	Data Warehousing and Mining	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		--	3	--	3
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	MT	Total			
		20	20	40			
					--	60	100

Prerequisite: Database Management System

Course Objectives: Course is aim to

Sr. No.	Course Objective
1	To understand the concepts of data warehouse architecture , ETL process, and OLAP functions.
2	To acquire the knowledge of data analytics and apply them to real world scenarios.
3	To demonstrate the importance of the various data pre-processing techniques and applications.
4	To analyze the data and generate the association rules for real world problems.
5	To acquire the knowledge of classification algorithms and apply them to real world problems.
6	To demonstrate the various clustering algorithms and apply them to real world scenarios.

Course Outcomes:

Sr. No.	Outcome
CO1	Model the data warehouse with the ETL process and perform dimensional modeling and data analysis using OLAP operations.
CO2	Apply various types of analytics to get data insights.
CO3	Apply various Data preprocessing and Data reduction techniques.
CO4	Discover associations among items using association rule mining.
CO5	Classify data using various Classification Algorithms to support decision making.
CO6	Apply various Clustering Algorithms to make informed decisions.

Module	Detailed Contents	Hrs
01	Data Warehousing and OLAP: Data warehouse: Introduction to DW, DW architecture, ETL process, Top- down and bottom-up approaches, characteristics, and benefits of data mart. Dimensional Modeling: Star, Snowflake, and Fact Constellation Schemas, major features and functions of OLAP, OLAP models- ROLAP and MOLAP, and the difference between OLAP and OLTP. Self-Learning Topics: Study any one DW implementation.	08
02	Data Analytics: Data Analytics Overview, Importance of Data Analytics, Types of Data Analytics, Descriptive Analytics, Diagnostic Analytics, Predictive Analytics, Prescriptive Analytics, Benefits of Data Analytics, and Data Visualization Techniques. Self-Learning Topics: Case Studies of Data analytics.	06
03	Module: Data Pre-processing: Introduction to data mining, knowledge discovery- KDD process. Data Preprocessing: Types of Attributes; Data Cleaning - Missing Values; Noisy Data; Data Integration and Transformations. Data Reduction - Data cube aggregation, dimensionality reduction, data compression, numerosity reduction, discretization, and concept hierarchy .Binning Self-Learning Topics: Data normalization.	07
04	Data Mining Algorithm- Association Rules: Association rule mining: support and confidence, Lift, frequent item sets, Market Basket Analysis, the Apriori algorithm, associative classification, and classification- Rule mining. Self-Learning Topics: Evaluation Metrics.	06
05	Data Mining Algorithm-Classification: Classification methods: Statistical-based algorithms- Linear Regression, Naïve Bayesian classification, K-Nearest Neighbor, Decision Tree Algorithms -ID3, C4.5, and CART, Rule-Based Classification, Evaluating Metrics for Classification. Self-Learning Topics: Case-Based Reasoning.	07
06	Module: Data Mining Algorithm-Clustering: Clustering Methods: Partitioning methods - K-Means, K-median, Hierarchical- Agglomerative and Divisive Methods, Model-Based Cluster Analysis, Clustering Metrics. Self-Learning Topics: Expectation Maximization Clustering Algorithm.	05

Reference Books:

Reference No	Reference Name
1	Han, Jiawei, Jian Pei, and Micheline Kamber, Data mining: concepts and Techniques, Second Edition, Elsevier, Morgan Kaufmann, 2011.
2	Ponniah Paulraj, Data warehousing fundamentals: a comprehensive guide for IT professionals, John Wiley & Sons, 2004.
3	Dunham, Margaret H, Data mining: Introductory and advanced topics, Pearson Education India, 2006.
4	Gupta, Gopal K, Introduction to data mining with case studies, PHI Learning Pvt. Ltd., 2014.
5	Ramakrishnan, Raghu, Johannes Gehrke, and Johannes Gehrke, Database management systems, Vol. 3, McGraw-Hill, 2003.
6	Elmasri, Ramez, and Shamkant B. Navathe, Fundamentals of Database Systems, Pearson Education, 2008, (2015).
7	Silberschatz, Abraham, Henry F. Korth, and Shashank Sudarshan, Database system concepts, Vol. 5, McGraw-Hill, 1997.
8.	Data Analytics Made Accessible by Dr. Anil Maheshwari

Web References:

Reference No	Reference Name
1	https://www.guru99.com/data-mining-vs-datawarehouse.html
2	https://www.tutorialspoint.com/dwh/dwh_overview
3	https://www.geeksforgeeks.org/
4	https://blog.eduonix.com/internet-of-things/web-mining-text-mining-depth-mining-guide/

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

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3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Course Code	Name of Course	Teaching Scheme		Credits Assigned		
NMCA14	User Experience Design and Development	Contact Hours				
		Theory	Tutorial	Theory	Tutorial	Total
		3	—	3	—	3
		Examination Scheme				
		Theory		Term Work	End Exam	Sem Total
		CA	Test	Total		
		20	20	40	—	60 100

Prerequisite: Knowledge of Software Engineering and its Concepts

Course Objectives: course aim to

Sr.No.	Course Objective
01	Understand the concepts of Software Engineering process Model and Agile development
02	Understand the User Experience and Usability
03	Gain an understanding of user experience design life cycle
04	Understand and familiarize the Process of Interaction Design
05	Understand and familiarize Design thinking, Design perspectives, User personas and Ideation
06	To learn Evaluation and Usability Testing Techniques and Models

Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Course Outcome
CO1	Demonstrate Software development Process Model in the designing and concept of Agility
CO2	Be able to Understand the concept of Usability and user experience in design .
CO3	Assess the possibilities for user experience design life cycle.
CO4	Be able to design applications and services that are user-centered.
CO5	Demonstrate the ability to understand Design thinking, Design perspectives, User personas and Ideation
CO6	Demonstrate the ability to evaluate the User Experiences Interface Design

Module	Detailed Contents	Hrs
01	Software Engineering and Software Development Process Model- Software, types of software engineering, evolving role of software, challenges in software development. Module: Agile Development- Introduction, Basics of agile SE method , drawbacks of agile SE method from the UX perspective, What is Agility? 12 Agile principles, Agility and the cost of change, what is an agile process? Extreme programming, Scrum, Scrum Life cycle and Agile Scrum Framework. Self-Learning Topics: -Incremental Process model: Iterative approach, RAD model,UML.	04
02	Introduction to UX Design What is UX, Ubiquitous interaction, Emerging desire for usability, From usability to user experience, Emotional impact as part of the user experience, User experience needs a business case, Roots of usability. Self-Learning Topics: -.Task Analysis, Psychology and Cognitive science	07
03	The UX Design - life cycle Introduction, A UX process lifecycle template, Choosing a process instance for your project, The system complexity space, Meet the user interface team, Scope of UX presence within the team. Self-Learning Topics: - More about UX lifecycles.	07
04	The UX Design Process –Understand Users Introduction, The system concept statement, User work activity gathering, Look for emotional aspects of work practice, Abridged contextual inquiry process, Data-driven vs. model-driven inquiry, History. , Contextual Analysis, Extracting Interaction Design Requirements, Constructing Design-Information Models. Self-Learning Topics: Data Analysis, Interpretation and Presentation.	08
05	The UX Design Process- : Design thinking,ideation, mental model Introduction, Design paradigms, Design thinking, Design perspectives, User personas, Ideation, Sketching, More about phenomenology, Mental Models and Conceptual Design, Wireframe, Prototyping Self-Learning Topics: Social Interaction, Emotional Interaction.	06
06	The UX Design Process : UX Evaluation and Improve UX Goals, Metrics and Targets, UX Evaluation Techniques.- Formative vs summative ,types of formative and informal summative evaluation methods, types of evaluation data, some data collection techniques, variations in formative evaluation results, informal summative data analysis, formative data analysis , feedback to process ,evaluation report Self-Learning Topics: Predictive Models.	07

Reference Books:

Reference No.	Reference Name
1	Software Engineering 3rd edition by KK Agrawal, Yogesh Singh, New Age International publication.
2	Interaction Design Beyond Human-Computer Interaction , Sharp Rogers , 2nd edition , Wiley
3	Software Engineering, 7 th Edition, "Roger S Pressman", TMH
4	Rex Hartson and Pardha S Pyla, The UX Book, Morgan Kaufmann 978-0123852410

Web References:

Reference No.	Reference Name
1	https://www.tutorialspoint.com
2	https://technologyadvice.com
3	https://archive.nptel.ac.in/courses/107/103/107103083/

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed. Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme			Credits Assigned		
NMCAE11	Digital Marketing and Business Analytics	Contact Hours					
		Theory	Tutorial		Theory	Tutorial	Total
		3	1		3	1	4
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	MT	Total			
		20	20	40	25	60	125

Prerequisite: Knowledge about designing tools and basics of marketing

Course Objectives: Course is aim to

Sr.No.	Course Objective
01	Examine and explore the role and importance of Digital Marketing in the current business scenario.
02	Familiarize yourself with the various Digital Marketing Tools.
03	Apply Digital Marketing tools for formulating a Digital Marketing Strategy.
04	Understand Digital Marketing Campaigns using various Tools and measure their Effectiveness.
05	Understand the various aspects of Social Marketing
06	Familiarize with Digital Analytics and its impact in Marketing

Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Course Outcome
CO1	Understand the role of Digital Marketing
CO2	Demonstrate use of various Digital Marketing Tools.
CO3	Discuss key elements of Digital Marketing Strategy.
CO4	Understand use of Digital Marketing Tools for Digital Marketing Campaigns
CO5	Assess / Measure the effectiveness of the Digital Marketing Campaigns.
CO6	Demonstrate practical skills using common digital marketing tools Like SEO, SEM, and Content Marketing...

Module No.	Detailed Contents	Hrs.
1	Fundamentals of Digital Marketing: Origin and development of Digital Marketing. Digital Marketing Strategy. Skills Required in Digital Marketing, Digital Marketing Plan, Digital Marketing: Display Advertising Introduction to Display Advertising, Types of Display Ads, What Makes a Good Ad? Buying Models, Display Plan, Challenges Faced by Display Advertising. Self Learning Topics: Programmatic Digital Advertising, YouTube Advertising	04
2	Search Engine Advertising Introduction, Understanding Ad Placement, Understanding AdRanks, Creating First Ad Campaign, Enhance Your Ad Campaign, Performance Reports. Social Media Marketing Building a Successful Strategy Facebook Marketing Facebook Marketing for Business, Anatomy of an Ad Campaign, Adverts, Facebook Insights, Other Marketing Tools, Other Essentials Self Learning Topics: Campaign Management, Running Campaigns, Lead Generation, Qualified Leads	07
3	LinkedIn Marketing Importance of LinkedIn Presence, LinkedIn Strategy, Sales Leads Generation Using LinkedIn, Content Strategy, LinkedIn Analytics, Targeting, Ad Campaign Twitter Marketing Getting Started with Twitter, Building a Content Strategy, Twitter Usage, Twitter Ads, Twitter Analytics, Twitter Tools and Tips for Marketers Self Learning Topics: LinkedIn Sales Navigator	10
4	Mobile Marketing Mobile Usage, Mobile Advertising, Mobile Marketing Toolkit, Mobile Marketing Features, Mobile Analytics Self Learning Topics: Addressing the Diversity in India through Mobile	06
5	SEO Search Engine, Concept of Search Engine Optimization (SEO), SEO Phases, On Page Optimization, Off Page Optimization, Social Media Reach, Maintenance Self Learning Topics: SEM	06
6	Digital Analytics Data Collection: Web logs, Benefits of Weblogs, Challenges with web logs, Key Metrics: Behaviours Analysis : visits/Session, Time on Site, Page views, Bounce Rate, Heat Map Analysis, Experience Analysis	06

	Self Learning Topics: Interpretation of various Charts available in Google Analytics. How to connect Offline with Online	
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Reference Books:

Reference No.	Reference Name
1	Digital Marketing, Seema Gupta, McGraw Hill Education (India) Private Limited
2	Social Media & Mobile Marketing: Includes Online Worksheets Puneet Singh Bhatia, ISBN: 9788126578078
3	Digital Marketing for Dummies, Ryan Deiss & Russ Henneberry, John Wiley & Son, Inc.
4	Social Media Marketing All-In-One, Jan Zimmerman, Deborah Ng, John Wiley & Sons Inc.
5	Epic Content Marketing, Joe Pulizzi, McGraw Hill Education
6	The Art of SEO, Eric Enge, Stephan Spencer, Jessie Stricchiola, O'Reilly Media Inc,
7	Digital Marketing 2020, Danny Star,

Tutorial/Case Studies

Faculty can make the group of students according to class strength, Group has to present case studies based on the following topics. The Case Studies mentioned are indicative and not limited to given topics. The Teacher has the flexibility of taking similar Case Studies taking into consideration the current scenario and technological changes.

Sr. No.	Detailed Contents	Hrs
01	Digital Marketing – Case Study : Ariel Fashion Shoot	01
02	Display Advertising – Case Study : Anything for Jetta	01
03	Search Engine Advertising – Case Study : Kotak Services	01
04	Social Media Marketing – Case Study : The Fall and Rise of Maggie	01
05	Facebook Marketing – Case Study : Tata DoCoMo	01
06	Facebook Marketing – Case Study : ICICI Bank – Building India's Most Social Bank on Facebook	02
07	LinkedIn Marketing – Case Study : Mercedes Benz, DELL	01
08	Twitter Marketing – Case Study : Mercedes-Benz (2011)	01

09	Instagram – Case Study : H & M	01
10	Mobile Marketing – Case Study : Philips Airfryer	01
11	SEO – Case Study : Barclays Business Banking SEO Campaign	01
12	Web Analytics – Case Study : Conversion Tracking through URL Builder – A Hotel Brand	01

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemylany MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Term Work: 25 marks

The term work will be based on the Tutorial Performance.

Course Code	Name of Course	Teaching Scheme			Credits Assigned		
NMCAE12	Agile Project Management	Contact Hours					
		Theory	Tutorial		Theory	Tutorial	Total
		3	1		3	1	4
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	MT	Tot			
		20	20	40	25	60	125

Prerequisite: Knowledge of Software Engineering

Course Objectives: course aim to

Sr.No.	Course Objective
01	Understand the concepts of Agile Project Management.
02	Familiarize Project Management framework and Agile estimation Tools.
03	Apply knowledge of Project Life Cycle to implement the projects.
04	Understand the techniques of project scheduling & project implementation.
05	Understand the Aspects of International Projects
06	Learn software Risk Management Process.

Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Course Outcome
CO1	Define the key concepts of Software Project Management.
CO2	Applying the tools for Project Scheduling
CO3	Make use of estimation logic for Agile estimation of software size.
CO4	Managing Scope And Procurement with Agile
CO5	Assess various factors involved in Team building and project conflict management.
CO6	Identifying and Analysing Risk Categories

Module	Detailed Contents	Hrs
01	An Overview of Software Project Management Introduction to Project, Project Management, Difference between Software Engineering and Software Project Management. IT Project Management: Project Management Framework, Role of Project Manager, Systems View of Project Management, Stakeholder Management, Leadership in Projects: Modern Approaches to Leadership and Leadership Styles. Introduction to Agile: Agile Manifesto and Agile Principles, Traditional vs Agile Project Management. Self Learning Topics: Evolving role of software.	05

02	Software Project Planning, Scrum Framework and Agile Estimation Software Project Planning: Business Case, Creating Work Breakdown Structure (WBS). Scrum Framework: Scrum Roles: Product Owner, Scrum Master, Development Team; Scrum Artifacts: Product Backlog, Sprint Backlog, Increment; Scrum Events: Sprint Planning, Daily Scrum, Sprint Review, Sprint Retrospective; AI-based tools within the Scrum lifecycle. Agile Software Estimation: Story Points, Epics, Themes, Ideal Time, Splitting User Stories, Estimating Size with Story Points, Estimating in Ideal Days, Techniques for Estimating, Choosing between Story Points and Ideal Days. Self-Learning Topics: Function Point, COCOMO, AI-assisted Scrum Tools.	10
03	Project Scheduling, Sprint Lifecycle and Agile Monitoring Project Scheduling: Project Schedule, Schedule Control, Critical Path Method (CPM) (Numericals), Earned Value Management (EVM) (Numericals). Sprint Lifecycle: Sprint Initiation, Sprint Execution, Sprint Monitoring, Sprint Review and Retrospective. Managing Scope and Procurement with Agile: Agile Project Scoping, Agile Procurement. Agile Metrics: Velocity, Burn-down Chart, Burn-up Chart. Self-Learning Topics: Change Management.	07
04	Managing Participation, Teamwork and Conflict Leadership in Project Management, Participative Management, Teams in Project Management, Team Building Approach, Origins of Conflict, Consequences of Conflict, Managing Conflicts, Team Methods for Resolving Conflicts, Emotional Stress, Stress Management. Self-Learning Topics: Social Support to Reduce Job Stress.	06

05	International Project Management Introduction to International Projects, Challenges in Managing International Projects, Local Institutions and Culture, Local Stakeholders, Team and Relationship Building, Communication, Project Monitoring, Risks and Contingencies. Self-Learning Topics: Law of Contracts and Rights at International Level.	06
06	Risk Exposure and Risk Management Process Risk Exposure and Risk Management Process: Risk Components, Risk Categories: Product Size Risk, Technology Risk, Business Impact Risk, People Risk, Process Maturity Risk, Risk Exposure, Risk Management Planning, Risk Identification, Qualitative Risk Analysis, Quantitative Risk Analysis. Agile Risk Management Perspective: Risk Management in Agile Projects, Managing Risks through Iterative Development and Continuous Feedback. Self-Learning Topics: Risk Monitoring Tools.	05

Reference Books:

Reference No.	Reference Name
1	Managing Information Technology Project, 6th edition, by Kathy Schwalbe, Cengage Learning publication.
2	Information Technology Project Management by Jack T Marchewka Wiley India Publication.
3	Agile project Management by Jason Bennett and Jennifer Bowen
4	Agile Estimating and Planning by Mike Cohn , Pearson edu

Web References:

Reference No.	Reference Name
1	https://www.projectmanager.com
2	https://www.tutorialspoint.com
3	https://www.atlassian.com/agile/project-management/epics-stories-t-hemes
4	https://technologyadvice.com

Tutorials:-

Suggested Tutorials List, but not limited to the following Lists:-

Sr. No.	Detailed Contents	Hrs.
01	Business Case for Project (Case study).	01
02	Software Requirement Specification (SRS Case Study).	02
03	Hands-on Scrum Framework: Create Product and Sprint Backlogs, assign Scrum roles, and conduct Sprint Planning using open-source Scrum tools (Taiga/OpenProject/Plane/etc.).	03
04	Project Scheduling Tools (e.g., Microsoft Project or open-source alternatives such as ProjectLibre/OpenProject). Creating a Project Plan or WBS, Establishing the Project Start or Finish Date, Entering Tasks.	02
05	Gantt Chart, Critical Path Method (CPM) and EVM Numericals	01
06	Study of Agile Project Management Tools: Jira, Trello, ClickUp, OpenProject, Taiga or Plane	02
07	Identifying Roles, Responsibilities and Qualifications of Agile Project Team Members (Case Study)	01
08	Identify the conflicts and stress involved in the Project undertaken	01

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed. Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks

6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Term Work : 25 marks

The term work will be based on the Tutorial Performance

Course Code	Name of Course	Teaching Scheme			Credits Assigned		
NMCAE13	Entrepreneurship Management	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		1	3	1	4
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	MT	Tot			
		20	20	40	25	60	125

Prerequisite: Nil

Course Objectives: The course aim to

Sr.No.	Course Objective
1	Instill a spirit of entrepreneurship among the student participants.
2	Provide an overview of the competences needed to become an entrepreneur.
3	Understand growth and managing strategies of venture and Social Responsibilities
4	Understand how to design an effective and efficient Business Plan for intended users.
5	Understand role of Small-Scale Industries (SSI) & Institutions Supporting Small Scale Enterprise
6	Recognize the importance of entrepreneurship and identify the profile of entrepreneurs and their role in economic growth.

Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Outcome
CO1	Understand the concepts and fundamentals of Entrepreneurship.
CO2	Understand the growth and development strategies for venture and Social Responsibilities
CO3	Identify the Role of Small-Scale Industries (SSI) & Institutions Supporting Small Scale Enterprise.
CO4	Analyze the process of Business Idea generation and converting the idea into a Business Model.
CO5	Evaluate the effectiveness of different entrepreneurial strategies, policies and measures for promoting small industries.
CO6	Create presentations and marketing strategies that articulate financial, operational, organizational, market, and sales knowledge for value creation.

Module	Detailed Contents	Hrs
1	Overview of Entrepreneurship: The Entrepreneurial Perspective Concept and Definitions: Manager, Entrepreneur, Entrepreneurship and Intrapreneurship, Importance and Significance of Growth of Entrepreneurial Activity, Traits, Characteristics, Skills and Qualities of Entrepreneurs, Classification and Types of Entrepreneurs, Emerging trends and issues in Entrepreneurship. Self-learning topics: Differences Between Entrepreneurs, Intrapreneurs & Ultrapreneurs	5
2	Creativity and New Venture Management Creative Business Ideas: Identify and Recognizing Opportunities: Observing Trends and solving problems, Creativity: Concept, Components and types, Sources of New Venture Ideas: Concept, Pre-selection Process, Sources of Business Idea, Preliminary Research, Business Idea Evaluation, Other Analysis. Writing a Business Plan: Introduction of Business Plan, Guidelines for writing A Business Plan, Layout of Business Plan (Executive summary, Business Description, Industry Analysis, Market Analysis, Management Team and Company Structure, Operations Plan, Product Design and Development Plan, Financial Projections and Critical Risk Assessment, Harvest Strategy, Milestone Scheduling), Presenting the Business Plan to Investors. Why some Business Plans Fail. Self-learning topics: Writing business plan for benefiting to an entrepreneur	7
3	Small Scale Industries Management Introduction to Small Industry: Introduction, Concept of small industry, Position in India, Role of small industries in economic development. Definition of Small-scale Industries, Undertakings, SSI Policy Statement, Procedure for SSI Registration, The Strengths and Weakness of Small Business. Reasons for the significance of the small sector, various forms of small-scale enterprises, Small Industries during various five-year Plans, Policies and measures for promoting small industries. Self-learning topics: Growth and Performance of Small-Scale Industries (SSI) in India, Problems for SSI.	7
4	Entrepreneurship Development and Government Role of Central Government and State Government in promoting Entrepreneurship - Introduction to various incentives, subsidies and grants - Export Oriented Units - Fiscal and Tax concessions available Role of following agencies in the Entrepreneurship Development - District Industries Centers (DIC), Small Industries Service Institute (SISI), Entrepreneurship Development Institute of India (EDII), National Institute of Entrepreneurship & Small Business Development (NIESBUD), National Entrepreneurship Development Board (NEDB) Self-learning topics: List out all the Central & State Government policies implemented for Entrepreneurship Development.	7

5	Marketing the Product or Service Small Business Marketing: Strategy and Research: Concept, Marketing Strategies, Market Research. Product: Heart of Marketing Mix, Purchasing, Selecting Suppliers, Managing and controlling Inventor. Place: Location Types, Layout & Design. Price and Promotion: Economics of Pricing, Break Even Analysis, Pricing-Setting Techniques, Credit Policies, Promotions. Self-learning topics: Role of Digital Marketing for an entrepreneur as promoting their product.	6
6	Growth and Development of the Venture & Social Responsibility Small Business Growth: Growing Firm, Transition to Professional Management, The Next Step: An Exit Strategy, Leadership in Action: Leadership Attributes, Negotiations, Delegation, Motivation Employees, HRM: Job Analysis, Recruitments, Selections, Trainings, Compensations, Introduction of Social Responsibility, Corporate Social Responsibility (CSR), Dimensions of CSR. Self-learning topics: Operation management responsibilities in managing Small Business	6

Reference Books:

Reference No	Reference Name
1	Barringer, Ireland, "Entrepreneurship: Successfully Learning New Ventures", Pearson, Latest Edition
2	Robert D Hisrich, Michael P Peters, Dean A Shepherd, Entrepreneurship, Sixth Edition, The McGraw Hill Company.
3	Pocket Mentor "Creating A Business Plan", Harvard Business School Press, Boston, Massachusetts
4	David Butler "Enterprise Planning Development- Small Business Start-up Survival and Growth", Butterworth-Heinemann
5	Entrepreneurship and Small Business Management by Dr. C L Bansal, HarAnand Publications Pvt. Ltd. New Delhi, 2012
6	Entrepreneurship by Lall, Madhurima. Sahai, Shikha. Excel Books, New Delhi, 2008, 2nd Edition
7	Strategic Entrepreneurship "A Decision-making approach to new venture creation and management" Philip A. Wickham, Pearson Education Society
8	"Small Business Management" Entrepreneurship and Beyond, 5 th Edition, Timothy S. Hatten
9	Vasant Desai, The Dynamics of Entrepreneurial Development and Management, 2015, Himalaya Publishing House.
10	Poornima Charantimath, Entrepreneurship Development- Small Business Enterprise, Pearson.
11	Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
12	Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi

Web References:

Reference No	Reference Name
1	http://niesbud.nic.in/
2	http://msme.gov.in/
3	http://ssi.nic.in/
4	www.womenentrepreneursindia.com
5	www.msmetraining.gov.in
6	https://www.startupindia.gov.in
7	https://www.makeinindia.com
8	https://mygov.in
9	www.dcmesme.gov.in
10	www.nsic.co.in

EM: Tutorials

Sr.No.	Detailed Contents	Hrs.
1	Entrepreneurial Tasks.	01
2	Entrepreneurship Development in rural areas (Agriculture/Allied Business)	01
3	Women Entrepreneurship Development. (Case Study)	01
4	Team Building Activities (Board of Members/ Employees)	01
5	Entrepreneurship in Service Sector.	01
6	Preparing Business Plan	01
7	Scenarios for fundraising in Entrepreneurship	01
8	E-Business Brainstorming Activities	01
9	Impact of Globalization and Liberalization on SSI.	01
10	Risk Management in Entrepreneurship.	01
11	Social Development through Entrepreneurship.	01
12	CSR Case Study.	01

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Term Work : 25 marks

The term work will be based on the Tutorial Performance

Course Code	Name of Course	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
NMCAL11	Python Programming Lab	02	01	25	30	20	75

Prerequisite: Knowledge of some programming language like C, Java

Course Objectives:-course aim to

Sr.No.	Course Objective
1	Understand basic concepts in Python programming.
2	Explore Object Oriented Programming using Python
3	Explore data structure using Python
4	Understand file handling in Python
5	Familiarize GUI and Database using Python
6	Understand Concepts of Threads, process and Synchronization.

Lab Course Outcomes:

Sr.No.	Outcome
CO1	To understand basic concepts, control statements, and functions in python.
CO2	To explore Object Oriented Programming using Python
CO3	To explore data structures Linked list, stack, Queues.
CO4	To understand basic concepts of file handling with Python.
CO5	To evaluate Graphical User Interface and database operations in python.
CO6	To analyze threading modules and synchronizing threads in Python.

Module	Detailed Content	Hours
1	Python basics	4
	Data types in python, Operators in python, Input and Output, Control statement, Arrays in python, String and Character in python,	
2	Modularization and Classes	4
	Functions, List and Tuples, Dictionaries, Exception Handling, Introduction to OOPs concepts: Classes, Objects, Interfaces, Inheritance	
3	Data Structure in Python	4
	Link List, Stack, Queues, Dequeues	
4	File Handling in Python	5
	File Handling: Opening file in different modes, closing a file, writing to a file, accessing file contents using standard library functions	
5	Python Integration Primer	3
	Graphical User interface, Python database connectivity	
6	Threads in Python	6
	Thread and Process, Starting a thread, Threading module, Synchronizing threads, Multithreaded Priority Queue	

Reference Books:

Reference No	Reference Name
1	Learn Python the Hard Way, 3 rd Edition, Zed Shaw's Hard Way Series
2	Laura Cassell, Alan Gauld, "Python Projects", Wrox Publication
Digital material:	
1	The Python Tutorial",http://docs.python.org/release/3.0.1/tutorial/
2	Beginning Perl.https://www.perl.org/books/beginning-perl/
3	http://spoken-tutorial.org
4	https://starcertification.org/Certifications/Certificate/python

Text References:

Reference No	Reference Name
1	Dr. R. Nageswara Rao, "Core Python Programming", Dreamtech Press
2	Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox Publication
3	Anurag Gupta, G. P. Biswas, "Python Programming", McGraw-Hill
4	E. Balagurusamy, "Introduction to computing and problem-solving using python", McGraw Hill Education
5	Dr. R. Nageswara Rao, "Core Python Programming", Dreamtech Press
	Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox Publication

Suggested experiments using Python:	
Sr.No.	Title of Experiments
1	Exploring basics of python like data types (strings, list, array, dictionaries, set, tuples) and control statements.
2	Creating functions, classes and objects using python.
3	Demonstrate inheritance and polymorphism.
4	Menu driven program for data structure using built in function for link list, stack and queue.
5	Python program to create, read and append data to existing file and display the file contents.
6	Write a Python program to understand different types of Exceptions
7	Creating GUI with Python containing widgets such as labels, textboxes, radio, checkboxes, and custom dialog boxes.
8	Creating applications for user login and registration.
9	Program to demonstrate CRUD (create, read, update and delete) operations on databases (SQLite/ MySQL) using Python.
10	Programs on Threading using Python.

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments
3	Mini Project based on the content of the syllabus (Group of 2-3 students)
4	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
5	Total 25 Marks (Journal: 20-marks, Attendance: 05-marks)

Term Work: 25 marks

The term work will be based on the Laboratory work

Course Code	Name of Course	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
NMCAL12	Java for Full Stack Development Lab	02	01	25	30	20	75

Prerequisite: 1. Basic understanding of Core Java Programming.
2. Basics of web technology.

Lab Course Objectives: Course is aim to

Sr.No.	Course Objective
1	Write programs based on Java Generics, Collection framework and Lambda expressions.
2	Develop web applications using JSP and JSTL.
3	Demonstrate Data Access with Spring.
4	Build an application using Spring Framework.
5	Develop Spring applications using Spring Boot
6	Develop Spring Boot RESTful Web Services.

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr. No.	Outcome
CO1	Demonstrate use of data structure and data manipulation concept using Java Collection Framework and Lambda expressions.
CO2	Build JSP web applications using standard actions, custom tags and JSTL Tags.
CO3	Develop applications using Spring Framework, Lightweight Containers and Dependency Injection with Spring.
CO4	Develop applications using Aspect Oriented Programming with Spring.
CO5	Build JDBC application with Spring using JdbcTemplate.
CO6	Develop Spring Boot Web Application and Spring Boot RESTful web services.

Description:

Module	Detailed Contents	Hrs
01	Introduction Java EE Programming: Programs based on JSP elements, Standard Actions, JSP Directives, Implicit objects, Error handling in JSP, Session tracking – Cookies and Session, Custom tags, JSTL tags. Self-Learning Topics: Simple Application using Servlet.	4
02	Spring Framework: Programs based on using Spring Framework, dependency injection. Self-Learning Topics: Bean Definition Profiles.	4
03	Aspect Oriented Programming: Programs based on Spring AOP – Before, After, Around, After Returning and After Throwing advice, PointCuts. Self-Learning Topics: AspectJ	4
04	JDBC Data Access with Spring using Oracle/ MySQL database: Programs based on Spring JDBC, JdbcTemplate, PreparedStatementCallback, ResultSetExtractor and RowMapper interface. Self-Learning Topics: Basic JDBC Program using DML operation.	4
05	Getting Started with Spring Boot: Programs based on Spring Boot. Self-Learning Topics: Understanding Transaction Management in Spring, RESTful Web Services with Spring Boot.	6
06	Getting Started with ReactJs: Introduction to ReactJs, understanding JSX, React components, react class, State and Props, event, conditionals, list and forms. Self-Learning Topics: Model-View Controller framework, Flux.	4

Reference Books:

Reference No.	Reference Name
1	Java 6 Programming Black Book, Wiley–Dreamtech
2	Web Enabled Commercial Application Development using java 2.0, Ivan Byaross
3	Java Server Programming java EE6, Black book, Dreamtech Press.
4	Core Servlets and Java Server Pages: Vol. I: Core Technologies 2/e , Marty Hall and Larry Brown, Pearson
5	Java Enterprise in a Nutshell, 3 rd Edition A Practical Guide, Jim Farley, William Crawford, O'Reilly
6	Java EE 6 Server Programming For Professionals, Sharanam Shah and Vaishali Shah, SPD
7	Spring in Action, Craig Walls, 3 rd Edition, Manning
8	Professional Java Development with the Spring Framework, Rod Johnson et al., John Wiley & Sons
9	Beginning Spring, Mert Caliskan and Kenan Sevindik, John Wiley & Sons
10	Spring Recipes A Problem Solution Approach, Gary Mak, Josh Long and Daniel Rubio, Apress

Web References:

Reference No	Reference Name
1	https://docs.oracle.com
2	https://spring.io/

Suggested List Of Experiments:

Sr.No.	Topics of Coverage
1	Program based on collections in java
2	Program based on Lambda and wildcard
3.	Program based on web application development using JSP
4.	Program based on Session Management
5	Program based on Spring Framework
6	Program based on Aspect Oriented Programming
7	Program based on Spring JDBC
8	Program based on ResultSetExtractor and RowMapper interface
9	Program based on Spring BOOT
10	Program based on ReactJS

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab of NMCAL12

Term Work: 25 marks

The term work will be based on the Laboratory work

Course Code	Name of Course	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
NMCAL13	Data Analytics Lab	02	01	25	30	20	75

Prerequisite: Database Management System, SQL.

Lab Course Objectives: The course aims to

Sr.No.	Course Objective
1	To understand methods and techniques to acquire data and apply various data preprocessing techniques.
2	To demonstrate various data visualization methods.
3	To demonstrate the processes and techniques used in diagnostic and prescriptive analytics.
4	To demonstrate various methods for predictive analytics.
5	To demonstrate the creation and analysis of business reports.
6	To apply various advanced operations for creating business dashboards.

Lab Course Outcomes: On successful completion of the course, the learner/student will be able to

Sr.No.	Outcome
CO1	Understand and apply various methods and techniques to acquire data and apply data preprocessing techniques.
CO2	Apply various data visualization methods.
CO3	Identify the processes and techniques used in diagnostic and prescriptive analytics.
CO4	Demonstrate and evaluate different various data predictive analytics techniques .
CO5	Demonstrate the create various business reports.
CO6	Apply various advanced operations for creating business dashboards

Description:

Module No	Detailed Contents	Hrs
1	Data Acquisition & Preprocessing : Data types and Objects, Reading and writing data, Operators, Conditional Statements, Using CSV files, Packages, attaching, and detaching data. Data preprocessing techniques in R- Naming and Renaming variables, adding a new variable, Dealing with missing data, and Dealing with categorical data, Data reduction using subsetting, Self-Learning Topics: Loops, Functions, Loading Data from Relational Databases, XML	6
2	Descriptive Analytics: Working with R Charts and Graphs: Histograms, Boxplots, Bar Charts, Line Graphs, Scatterplots, Pie Charts, Visualization With Ggplot2. Self-Learning Topics: Handling Outliers.	4
3	Diagnostic and Prescriptive Analytics: Correlation Plots, EDA, Market Basket Analysis, Normal and Binomial Distributions, Univariate and Bivariate Analysis. Self-Learning Topics: Themes and Transformation in Graphs, Multiple Graphs in a Single Figure.	4
4	Predictive Analytics with R: Supervised Learning - Linear Regression, Classification Models Naïve Bayesian classification, K-Nearest Neighbor, Decision Tree Algorithms -ID3, C4.5, and CART.. Unsupervised Learning - Clustering algorithms: K-Means, K-median and hierarchical clustering. Self-Learning Topics: GUI Development Using Rattle.	4
5	Visualization: Connect to data, Build Charts, plots, histograms, , pie charts, Treemap, Packed Bubble Chart, Analyze and Optimize Data, Highlight table,analyze geographic data to identify patterns and trends using maps and spatial visualizations Self-Learning Topics: Create Stories using Tableau	4
6	Advanced Operations - Data Analysis using inbuilt Operations Preparing Maps , Analysis of Reports , Preparing Dashboards Case Study : To Build a dashboard to analyze financial metrics such as revenue, expenses, and profit margins. Self Learning Topics - Tableau using web.	4

Reference Books:

Reference No	Reference Name
1	John M. Quick, "Statistical Analysis with R", PACKT Publishing, 2015 ISBN NO: 9781849512084, 9781849512084
2	G.K. Gupta, "Introduction to data mining with case studies", PHI Learning Publishing, ISBN: 9788120350021, 8120350022
3	Beginning Data Science in R_ Data Analysis, Visualization, and Modelling for the Data Scientist Thomas Mailund
4	Practical Tableau, by <u>Ryan Sleeper</u> , Released April 2018, Publisher(s): O'Reilly Media, Inc. ISBN: 9781491977316

Web References:

Reference No	Reference Name
1	http://cookbook-r.com
2	https://www.r-project.org/about.html
3	"Statistical Analysis with R - a quick start", Oleg Nenadic, Walter Zucchini, September 2004, http://www.statock.wiso.uni-goettingen.de/mitarbeiter/ogi/pub/r_workshop.pdf
4	https://www.rstudio.com/
5	http://www.r-project.org/doc/bib/R-books.html
6	Learning Tableau 2020: Create effective data visualizations, build interactive visual analytics, and transform your organization, Fourth Edition

Suggested List of Experiments:

Practical No.	Problem Statement
1	To implement following in R- Data acquisition, Install packages, Loading packages Data types, checking type of variable, printing variable and objects (Vector, Matrix, List, Factor, Data frame, Table)
2	To implement following in R- cbind-ing and rbind-ing, Reading and Writing data. setwd(), getwd(), data(), rm(), Attaching and Detaching data. Reading data from the consol. Loading data from different data sources.(CSV, Excel).
3	To implement following Data preprocessing techniques like, Naming and Renaming variables, adding a new variable. Dealing with missing data. Dealing with categorical data. Data reduction using subsetting
4	To implement different types of Charts and Graphs like Histograms, Boxplots, Bar Charts, Line Graphs, Scatterplots, Pie Charts,
5	Implement data Visualization with Ggplot2,
6	Implement commands for drawing various Correlation Plots and learn the process of EDA
7	Implementation of Normal and Binomial distributions, Univariate and Bivariate

	Analysis,
8	Implementation and analysis of Apriori Algorithm using Market Basket Analysis
9	Implementation and analysis of Linear regression and logistic regression through graphical methods.
10	Implementation and analysis of Classification algorithms like Naive Bayesian, K-Nearest Neighbor, ID3, C4.5
11	Implementation and analysis of clustering algorithms like K-Means and hierarchical clustering.
12	Implement various data visualization techniques .
13	Implement and analyze geographic data to identify patterns and trends using maps and spatial visualizations
13	Implementation and analysis of Reports & Dashboards using tableau
14	Implement various advanced functions in tableau.

Assessment:

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab of NMCAL13

Term Work: 25 marks

The term work will be based on Laboratory work.

Course Code	Name of Course	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
NMCAL14	Skill based Lab Course: User Interface & User Experience Lab	02	01	25	30	20	75

Prerequisite: Basic knowledge of Web Technologies and Software Engineering.

Lab Course Objectives: Course is aim to

Sr.No.	Course Objective
1	Understand the importance of User Interface Design (UI) Process.
2	Analyze how to design Effective and Efficient User Interfaces for intended users.
3	Learn techniques for Prototyping and Design.
4	Learn techniques for Evaluating User Experience.
5	Understand the concept of Good UI and User Experience (UX).
6	Understand the importance of testing application design before actual implementation

Lab Course Outcomes:

Sr.No.	Outcome
CO1	Interpret user needs and context of User Interface design Specification
CO2	Demonstrate the tools and techniques for designing informing models
CO3	Develop a high fidelity prototype for an end to end solution.
CO4	Apply best practices for evaluating user experience.
CO5	Apply the concept of Good UI and User Experience (UX).
CO6	Write test cases for application design

Description:

Module No	Detailed Contents	Hrs.
1	Introduction to UI life cycle and UI tools.	2
2	Requirement gathering (Choose the project) The project should be a web, desktop, or mobile interface. If the chosen project is a mobile application, note that it must at least be possible to simulate the project, since one of the prototypes will be such a simulation that can be evaluated.	2
3	Analysis Problem statement: Briefly state the problem(s) that the project will seek to solve. Take the user's point of view. Consider what the user's goals are, and what obstacles lie in the way. Output : ☐ Write up a user analysis, task analysis (identify three tasks of the chosen problem), and domain analysis clearly, concisely, and completely. ☐ A problem object model or entity-relationship diagram.	6
4	Design Creation of Scenario,Persona and Storyboard Write a scenario and story that involves all three of the tasks identified for the chosen project. ☐ Explain the Scenario,story ☐ Sketch the scenario and story (use any tool or hand sketches) ☐ Draw a mental model. Design persona as per the users of the application	6
5	Prototype Creating a Paper Prototype and High Fidelity prototype (Wire Frame)usingFigma tool. Output ☐ Paper prototype ☐ Wireframe.	6
6	Usability Evaluation of the Design Testing of User Interface from Third Party(Test scripts) Output ☐ Test Script	4

Reference Books:

Reference No	Reference Name
1	Norman, Donald , The Design of Everyday Things,Basic Books, ISBN 978-0-465-06710-7
2	Steve Krug, Don't Make Me Think, Revisited: A Common Sense, New Riders,ISBN ,Third edition, 978-0-321-96551-6
3	Golden Krishna,The Best Interface Is No Interface, New Riders, First Edition, ISBN 978-0-133-89041-9.
4	Theo Mandel, The Elements of User Interface Design, Wiley, First Edition, 978-0471162674
5	Wilbert O. Galitz, The Essential Guide to User Interface Design : An Introduction to GUI Design Principles and Techniques, Wiley , Second Edition, 978-8126502806
6	Rex Hartson and Pardha S Pyla, The UX Book, Morgan Kaufmann, 9780123852410

Web References:

Reference No	Reference Name
1	http://jig.net/ia/elements.pdf
2	http://www.bboxesandarrows.com
3	https://www.nngroup.com/articles/

List of Experiment: (Not Limited To The Specified List)

Study of Real life Scenario/website and explore all aspects of UXD

Assessment:

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab of NMCAL14

Term Work: 25 marks

The term work will be based on Laboratory work.

Course Code	Name of Course	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
NMCAL15	Web Application Technologies LAB	1T+2P	02	50	30	20	100

Prerequisite: Basic understanding of fundamentals of Web Technologies and JavaScript

Lab Course Objectives Course is aim to

Sr.No.	Course Objective
1	Understand concepts of REPL and Node.js Console.
2	Create simple websites based on Node.js features
3	Demonstrate database connectivity and operations
4	Make applications using Typescript concepts.
5	Construct Angular Forms using fundamentals of angular.
6	Create Single page applications using Angular.

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Outcome
CO1	Demonstrate the working of REPL and Node.js console.
CO2	Build simple websites making use of various Node.js features
CO3	Design a dynamic web application enabled with database connectivity
CO4	Use the fundamentals of Typescript to build web applications.
CO5	Build applications using Angular components.
CO6	Develop Forms with Single page applications (SPA)

Description:

Module No	Detailed Contents	Hrs
1	Introduction to Node.js: What is Node.js, Advantages of Node.js, Node.js Process Model, Traditional Web Server Model, Setup Development Environment: Installation of Node.js on Windows, Working in REPL, Node JS Console Node.js Modules, Events & Functions: Standard Callback Pattern, Event Emitter Pattern, Event Types, Event Emitter API, Creating an Event Emitter. Self-Learning Topics: W3C Architecture, Additional Events.	5
2	File Handling & HTTP Web Server: File Paths, fs Module, opening a file, reading from a file, writing to a file, Closing a file. HTTP request/response object, Headers, Piping, Shutting down the server. Self-Learning Topics: TCP server.	9
3	Databases: Connect and Communicate with a MySQL Database, adding data to the database, Reading data. Self-Learning Topics: Working with any other database.	7
4	Typescript: Overview, TypeScript Internal Architecture, TypeScript Environment Setup, TypeScript Types, variables and operators, Decision Making and loops, TypeScript Functions, TypeScript Classes and Objects, TypeScript Modules. Self-Learning Topics: Typescript Generics.	5
5	Introduction to Angular: Introduction to Angular, Setup for local development environment, Angular Architecture, Angular Components and directives, Data Binding. Self-Learning Topics: Styles Binding In Components.	7
6	Angular Forms and Modules: Template Driven Forms, Reactive Forms, Working with Pipes, Services in Angular, Angular Routing, Angular Modules, Single Page Applications. Self-Learning Topics: Custom Directives.	6

Reference Books:

Reference No	Reference Name
1	Powell TA, Powell TA. HTML & CSS: the complete reference. New York: McGraw-Hill; 2010. ISBN No. 9780071496292
2	Haverbeke M. Eloquent Javascript: A modern introduction to programming. No Starch Press; 2018. ISBN No. 9781593279509
3	Teixeira P. Professional Node.js: Building Javascript based scalable software. John Wiley & Sons; 2012. ISBN No. 9781118185469
4	Brown E. Web development with node and express: leveraging the JavaScript stack. O'Reilly Media; 2014. ISBN No. 9781491949306
5	Karpov V, Netto D. Professional AngularJS. John Wiley & Sons; 2015. ISBN No. 9781118832073
6	Dayley B. Learning AngularJS. Pearson Education; 2014. ISBN No. 9780134034546
7	Seshadri S, Green B. AngularJS: Up and Running: Enhanced Productivity with Structured Web Apps. O'Reilly Media; 2014. ISBN No. 9781548785710

Web Reference

Reference No	Reference Name
1	https://nptel.ac.in/courses/106106222/
2	https://learn.shayhowe.com/html-css/
3	https://www.w3schools.com/nodejs/
4	https://www.coursera.org/learn/server-side-nodejs
5	https://www.tutorialspoint.com/master-typescript-learn-typescript-from-scratch/index.asp
6	https://angular.io/docs
7	https://www.freecodecamp.org/news/want-to-learn-angular-heres-our-free-3-part-course-by-dan-wahlin-fc2ff27ab451/

Suggested list of experiments

Practical No	Problem Statement
1	Create an application to demonstrate Node.js Modules
2	Create an application to demonstrate various Node.js Events
3	Create an application to demonstrate Node.js Functions
4	Using File Handling demonstrate all basic file operations (Create, write, read, delete)
5	Create an HTTP Server and perform operations on it
6	Create an application to establish a connection with the MySQL database and perform basic database operations on it
7	Create an application using components of typescript.
8	Create an application to demonstrate directives and pipes

9	Demonstrate features of Angular forms with a program
10	Create an application to demonstrate SPA.

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 50 Marks (Experiments: 30-marks, Attendance Theory & Practical: 10-marks, Assignments: 10-marks)
Continuous assessment exam	
1	Based on the subject and related lab of NMCAL15

Term Work: 50 marks

The term work will be based on Laboratory work

Course Code	Name of Course	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Pract.	Oral	Total
NMCAFP11	Project Seminar (Real Life Problems based on Societal Issues)	02	01	50	-	--	50

Prerequisite: Concept of Project Development and Management

Lab Course Objectives: The course is aims to

Sr. No.	Course Objective
1	To understand and identify the problem statement
2	Acquaint students with the process of applying basic computer applications and providing solutions to the problems in various application domains..
3	Conceptualize knowledge with emphasis on critical thinking and problem-solving skills
4	Adapt to a rapidly changing environment by having learned and applied new skills.
5	To apply standard principles of project management and validate the project using appropriate evaluation measures
6	To inculcate the process of self-learning and research.

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr. No.	Course Outcome
CO1	Identify societal / research / innovation / entrepreneurship problems through appropriate literature surveys mapping with world sustainable goals
CO2	Use standard norms of engineering practices and project management principles during project work
CO3	Build small groups to work effectively in a team on medium scale computing projects and Develop interpersonal skills to work in a group
CO4	Design and evaluate solutions for complex problems
CO5	Communicate through technical report writing and oral presentation. The work may result in research / article / patent / research publication The work may result in business plan for entrepreneurship product created
CO6	Gain technical competency by participating in project competitions and Demonstrate capabilities of self-learning, leading to lifelong learning

Guidelines for Mini Project		
1	Mini project may be carried out in one or more form of following: Product preparations, prototype development model, fabrication of set-ups, laboratory experiment development, process modification / development, simulation, software development, integration of software (frontend-backend) and hardware, statistical data analysis, creating awareness in society / environment, research oriented and application areas, etc.	
2	Students shall form a group of 3 students, while forming a group shall not be allowed less than three or more than three students, as it is a group activity. Group will be the same till sem III project.	
3	Students should do surveys and identify needs, which shall be converted into problem statements for a mini project in consultation with project mentor / head of the department / internal committee of faculties.	
4	Students shall submit an implementation plan in the form of Gantt / PERT / CPM chart using state-of-the-art industry tools, which will cover weekly activity of mini projects	
5	A logbook may be prepared by each group, wherein the group shall record weekly work progress, project guide shall verify and record notes / comments.	
6	Students under the guidance of the mentor shall convert the best solution into a working model using various components of their domain areas and demonstrate.	
7	The solution to be validated with proper justification and report to be compiled in standard format. Software requirement specification (SRS) documents as per IEEE format, research papers, and competition certificates may be submitted as part of annexure to the report.	
8	With the focus on self-learning, innovation, addressing societal / research / innovation problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality be carried out in two semesters by all the groups of the students. i.e. Project Stage 1 in semesters I and II.	
Term Work		
The review / progress monitoring committee shall be constituted by the head of department. The progress of the mini project to be evaluated on a continuous basis, based on the SRS document and log file activities submitted. Minimum two reviews in each semester are mandatory.		
Distribution of Term work marks shall be as below:		Marks (25)
1	Marks awarded by project mentor based on logbook	10
2	Self-contribution and use of skill set in project	10
3	Timeliness of Project report	05
II. Project Internal Examination (25 Marks):		Marks (25)
1	Marks awarded by review committee/Examiner	15
2	Individual contribution/viva/ communication skills.	10

Review / progress monitoring committee may consider following points for assessment ba as mentioned in general guidelines

SEM I Project:

In the first semester through Literature survey , problem statements should be freezed and the entire theoretical solution shall be made ready, including components / system selection, cost, feasibility analysis, conceptual and Detailed design preferably with wire frame or skeleton of the modules. Two reviews will be conducted based on a presentation given by a student group.

- First shall be for finalization of problem
- Second shall be on finalization of the proposed solution of the problem.

Mini Project shall be assessed based on following point

1	Clarity of problem and quality of literature Survey for problem identification
2	Requirement Gathering via Software Requirement Specification (SRS) / Feasibility Study
3	Societal / Research impact
4	Novelty, Originality or Innovativeness of project
5	Effective use of skill set : Standard engineering practices and Project management standard
6	Contribution of an individual's as member or leader
7	Completeness of methodology implemented
8	Clarity in written and oral communication
9	Design, Analysis and Further Plan
10	Verification and validation of the solution / Test Cases using open source testing tools as per trends in industry
11	Full functioning of working model as per stated requirements

In first semester evaluation may be based on the first 8 criteria and remaining may be used for second semester evaluation of performance of students in mini projects.

Guidelines for Assessment of Mini Project Practical / Oral Examination

1	Report should be prepared as per the guidelines issued.
2	The Mini Project shall be assessed through a presentation by the student project group to a panel of Internal /External Examiners preferably from industry/ research organizations having experience of more than five years /academia having experience more than 10 years approved by the head of institution.
3	Students shall be motivated to publish a research paper / patent / participate in National / International conferences based on the work.



Vivekanand Education Society's Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai, Approved by AICTE & Recognised by Govt. of Maharashtra)

NAAC accredited with 'A' grade

Semester II

**CURRICULUM SCHEME FOR NEP POSTGRADUATE ACADEMIC PROGRAM
AT VESIT**

Branch: MCA Semester II

CURRICULUM SCHEME FOR NEP POSTGRADUATE ACADEMIC PROGRAM AT VESIT

Branch: MCA Semester II

Semester II Scheme									
Type of Course	Course Code	Name of Course	Teaching Scheme (Contact Hours)			Credits Assigned			
			Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
Major (Mandatory)	NMCA21	Combinatorial Algorithms for Problem Solving	3	--	1	3	--	1	4
Major (Mandatory)	NMCA22	Artificial Intelligence and Machine Learning	3	--	--	3	--	--	3
Major (Mandatory)	NMCA23	Research Methodology	3	--	1	3	--	1	4
Major (Elective)	NMCAE21X	Elective - 2	3	--	--	3		--	3
Major (Elective)	NMCAE22X	Elective - 3	3	--	1	3	--	1	4
Major (Mandatory)	NMCAL21	Artificial Intelligence and Machine Learning Lab	--	2	--	--	1	--	1
Major (Elective)	NMCALE21X	Elective - 2 Lab	--	2	--	--	1	--	1
Major (Mandatory)	NMCAL23	Soft Skill Development Lab	--	2	--	--	1	--	1
Major (Mandatory)	NMCAL24	Skill based Lab Course. DevOps Lab	--	4	--	--	2	--	2
Major (Mandatory)	NMCAL25	Skill based Lab Course Advanced Data Engineering with Cloud Lab	--	2	--	--	1	--	1
Field Project (OJT/FP)	NMCAFP21	Project Stage- 1	--	2	--	--	1	--	1
Total			15	14	3	15	7	3	25

Semester II Marks Scheme										
Type of Course	Course Code	Name of Course	Examination Scheme							
			Theory					Term Work	Pract & oral	Total
			Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
			MT	CA	Tot.					
Major (Mandatory)	NMCA21	Combinatorial Algorithms for Problem Solving	20	20	40	60	2	25	--	125
Major (Mandatory)	NMCA22	Artificial Intelligence and Machine Learning	20	20	40	60	2	--	--	100
Major (Mandatory)	NMCA23	Research Methodology	20	20	40	60	2	25	--	125
Major (Elective)	NMCAE21X	Elective – 2	20	20	40	60	2	--	--	100
Major (Elective)	NMCAE22X	Elective – 3	20	20	40	60	2	25	--	125
Major (Mandatory)	NMCAL21	Artificial Intelligence and Machine Learning Lab	--	--	--	--	--	25	50	75
Major (Elective)	NMCALE21X	Elective – 2 Lab	--	--	--	--	--	25	50	75
Major (Mandatory)	NMCAL23	Soft Skill Development Lab	--	--	--	--	--	50	--	50
Major (Mandatory)	NMCAL24	Skill based Lab Course. DevOps Lab	--	--	--	--	--	50	50	100
Major (Mandatory)	NMCAL25	Skill based Lab Course Advanced Data Engineering with Cloud Lab	--	--	--	--	--	25	50	75
Field Project (OJT/FP)	NMCAFP21	Project Stage- 1	--	--	--	--	--	50	--	50
Total			--	--	200	300	--	300	200	1000

Elective 2

Sr. No.	Course Code	Name of Course	Lab Course Code
1	NMCAE211	Internet of Things & Industrial Internet of Things	NMCALE211
2	NMCAE212	Design and Analysis of Algorithm	NMCALE212
3	NMCAE213	Software Testing & Quality Assurance	NMCALE213

Elective 3

Sr. No.	Course Code	Name of Course
1	NMCAE221	Cyber Security and Laws
2	NMCAE222	Design Thinking
3	NMCAE223	Risk Analysis Management

SEM II

Course Code	Name of Course	Teaching Scheme			Credits Assigned		
NMCA21	Combinatorial Algorithms for Problem Solving	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		1	3	1	4
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	MT	Total			
		20	20	40	25	60	125

Prerequisite: Basic knowledge of Mathematics and Statistics

Course Objectives: Course is aim to

Sr.No	Course Objective
1	Study the formulation of Linear programming problems and obtain the optimum solution using various methods.
2	Solve the transportation and obtain their optimal solution
3	Solve the assignment problems and obtain their optimal solution
4	Develop the abilities in project evaluation techniques.
5	Understand job sequencing and solve real world problems.
6	Understand simulation models and analyze their performance in real world systems

Course Outcomes: On successful completion of course learner/student will be able to

Sr. No.	Outcome
CO1	Formulate mathematical models for a broad range of problems in business and industry.
CO2	Apply mathematics and mathematical modelling to forecast implications of various choices in real world problems
CO3	Think strategically and decide the optimum alternative from various available options
CO4	Apply PERT/CPM in project evaluation.
CO5	To Minimize the cost or time of completion of a sequencing problem.
CO6	Evaluate performance parameters of a real system using simulation methods.

Module No	Detailed Contents	Hrs
01	Linear Programming Problem: Introduction, Formulation of linear programming problem and basic feasible solution: graphical method, Simplex method, artificial variables, Big M method, Two Phase method. Self-Learning Topics: special cases of LPP	10
02	Transportation Problem: Definition of Transportation Problem, Initial basic feasible solution: North-West Corner method, Least Cost method, Vogel's Approximation method, optimum solution: MODI method. Self Learning Topics: optimization using stepping stone method	6
03	Assignment Problem & Travelling Salesman Problem: Definition of assignment Problem : Hungarian method (minimization and maximization), Traveling Salesman Problem : Hungarian method. Self Learning Topics: Simple applications in daily life	6
04	PERT and CPM Time estimates, earliest expected time, latest allowable occurrence time, latest allowable occurrence time and slack time, Critical path, Probability of meeting scheduled date of completion of project, Calculation of CPM network , Various floats for activities. Self Learning Topics: Project crashing.	7
05	Sequencing Problem Two machines n jobs , three machines n jobs, n machines m jobs Self Learning Topics: Use of sequencing in real world problems	4
06	Simulation: Introduction to simulation, steps in simulation, advantages of simulation, limitations of simulation, applications of simulation, Monte-Carlo method: simple examples, single server queue model. Able Baker call center problem. Simulation of inventory system (Newspaper seller problem) Self Learning Topics: Generation of pseudo random numbers and their properties.	6

Reference Books:

Reference No	Reference Name
1	Hamdy A. Taha, University of Arkansas, "Operations Research: An Introduction", Pearson, 9th Edition, ©2011, ISBN-13: 9780132555937
2	Sharma, S.D. and Sharma, H. , "Operations Research: Theory, methods and Applications",KedarNath Ram Nath, 2010, 15, reprint
3	J. K. Sharma, "Operations Research : Theory And Applications" , Macmillan India Limited, 2006 (3 Edition),ISBN 1403931518, 9781403931511
4	S. C. Gupta, "Fundamentals of Statistics" – Himalaya Publishing House, 2017,7th edition, ISBN 9350515040, 9789350515044
5	Prem Kumar Gupta & D S Hira, S. Chand publications , Operations Research", 7/e, ISBN-13: 978-8121902816, ISBN-10: 9788121902816
6	A. Ravindran, Don T. Phillips, James J. Solberg, "Operations Research: Principles and Practice", 2nd Edition, January 1987, ISBN: 978-0-471-08608-6
7	Frederick S. Hillier, Gerald J. Lieberman, Introduction to Operations Research , McGraw-Hill, 2001, Edition7, illustrated, ISBN 0071181636, 9780071181631
8	Jerry Banks, John S. Carson, Barry L. Nelson, Contributor Barry L. Nelson "Discrete-event System Simulation",Prentice Hall, 1996, edition 2, illustrated, ISBN 0132174499, 9780132174497

Web References:

Reference No	Reference Name
1	Operations Research, Prof.Kusum Deep, IIT-MADRAS, https://nptel.ac.in/courses/111/107/111107128/
2	Introduction to Operations Research, Prof. G. Srinivasan, IIT-ROORKEE, https://nptel.ac.in/courses/110/106/110106062/
3	Fundamentals of Operations Research, Prof. G. Srinivasan, IIT-MADRAS, https://nptel.ac.in/courses/112/106/112106134/
4	Modeling and simulation of discrete event systems,Prof.P. Kumar Jha, IIT-ROORKEE, https://nptel.ac.in/courses/112107220/
5	Game Theory, Prof. K. S. MallikarjunaRao, IIT-BOMBAY, https://nptel.ac.in/courses/110/101/110101133/
6	Decision Modelling, Prof. BiswajetMahanty, IIT-KHARGPUR, https://nptel.ac.in/courses/110105082/
7	Karmarkar's Method: https://www.youtube.com/watch?v=LWXXhBIlj0o
8	Karmarkar's Method : https://en.wikipedia.org/wiki/Karmarkar%27s_algorithm

Tutorials:

Sr. No.	Topic	Hrs
1	Linear programming problem using graphical method	1
2	Linear programming problem using simplex method	1
3	Linear programming problem using Big M method	1
4	Finding the basic feasible solution using Vogel's Approximation Method	1
5	Finding the optimal solution using Modi Method	1
6	Assignment Problem using Hungarian method	1
7	Traveling salesman Problem using Hungarian method	1
8	Critical Path method and PERT	1
9	2 job sequencing and 3 job sequencing	1
10	Single server queue simulation	1

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Total 25 Marks

(Experiments/Tutorials: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)

Term Work: 25 marks

The term work will be based on the Tutorial Performance

Course Code	Name of Course	Teaching Scheme			Credits Assigned		
NMCA22	Artificial Intelligence And Machine Learning	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		--	3	--	3
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	MT	Total			
		20	20	40	--	60	100

Prerequisite: Basics of data mining and Mathematical foundations of computer science.

Course Objectives: Course is aim to

Sr.No.	Course Objective
1	Study Artificial Intelligence concepts and applications .
2	Elucidate knowledge of Artificial Intelligence techniques for problem solving.
3	Become familiar with Artificial neural networks and error correction methods in neural networks.
4	Become familiar with the fundamentals of machine learning algorithms, and the paradigms for forecasting and classification
5	Become familiar fundamentals of kernel machines and ensemble methods.
6	Study dimensionality reduction techniques for feature selection .

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

Sr.No.	Outcome
CO1	Understand Artificial Intelligence concepts and applications
CO2	Apply knowledge of Artificial Intelligence techniques for problem solving.
CO3	Understand Artificial neural networks and error correction methods in neural network
CO4	Analyze the fundamentals of machine learning algorithms, and the paradigms for forecasting and classification .
CO5	Apply fundamentals of kernel machines and ensemble methods.
CO6	Apply dimensionality reduction techniques for feature selection

Module	Detailed Contents	Hrs
1	Introduction: Definition of Artificial Intelligence, The Foundations of Artificial Intelligence, Applications of AI. Agent and its Representations: Introduction, Types of Agents, Environments, Architectures of Intelligent Agents, PEAS representation of an Agent, AI Problem Formulation. Agentic AI: Positioning in the AI landscape, concepts and goals, architectural design. Self-Learning topics: Applications of Agentic AI in industry	7
2	Search Strategies: Importance of searching through AI, Problem-Solving Agents, Uninformed Search Strategies: BFS and DFS; Heuristic Search Techniques: Generate and Test search, Hill Climbing, Greedy Best-First Search, A*Algorithm, AO*Algorithms; Adversarial Search Techniques: The minimax algorithm, Heuristic Alpha-Beta Tree Search. Self-Learning topics: Tabu search	8
3	Artificial Neural Networks: Introduction, Activation Functions, McCulloch-Pitts Neuron; Supervised Learning Networks: Perceptron, Adaline, Multiple Adaptive Linear Network and Backpropagation Algorithms Training Procedures, Optimization algorithm- Gradient descent; Unsupervised Learning Networks. Self-Learning topics: Fuzzy Logic	8
4	Introduction to Machine Learning: Machine Learning Basics, Types of Learning, Design Issues in Machine Learning, architecture of ML. Application of ML. Supervised Machine Learning models: Multiple and Non-linear regression, Logistic regression, Random Forest, Bayesian Belief networks, Bias/variance trade-off: Unsupervised Machine Learning models: Expectation-Maximization Algorithm, Model-Based Clustering, Self-Learning topics: Applications of ML in industry	6

5	Kernel Machines and Ensemble Methods Introduction, Optimal Separating Hyperplane, Separating data with maximum margin, Support Vector Machine (SVM); Finding the maximum margin, The Non-Separable case: Soft Margin Hyperplane, Kernel Trick. Ensemble Methods: Bagging, Stacking, Boosting, Implementing the AdaBoost algorithm, Classifying with AdaBoost, Bootstrapping, and Cross-Validation. Self-Learning topics: Kernel types	6
6	Dimensionality Reduction: Introduction, Feature Selection, Principal Component Analysis, Multidimensional Scaling, and Linear Discriminant Analysis. Self-Learning topics: SVD	4

Reference Books:

Reference No	Reference Name
1	George F Luger, Artificial Intelligence, Fifth Edition-2009, Pearson Education Publications, ISBN-978-81-317-2327-2
2	Stuart Russell, Peter Norvig, Artificial Intelligence – A Modern Approach, , Pearson Education / Prentice Hall of India, 3rd Edition, 2009 .ISBN- 13: 978- 0136042594
3	Elaine Rich, Kevin Knight, and S.B. Nair, Artificial Intelligence, 3rd Edition, Tata McGraw Hill-2008., ISBN 10: 0070087709 / ISBN 13: 9780070087705
4	Anandita Das ,Artificial Intelligence and Soft Computing for Beginners-,2 nd Edition, ShroffPublication, ISBN- 9789351106159
5	Nils J. Nilsson, Artificial Intelligence: A new Synthesis, Morgan Kaufmann Publishers, Harcourt Asia Pvt. Ltd., 2000, ISBN-1-55860-535-5
6	Kumar Satish ,Neural Networks, Second Edition, Tata McGraw Hill-,2013, 2013, ISBN 1259006166, 9781259006166
7	EthemAlpaydn, Introduction to Machine Learning, PHI, Third Edition, ISBN No. 978-81-203- 5078-6.
8	Peter Harrington, Machine Learning in Action . Manning Publications , April 2012, ISBN 9781617290183
9	Tom Mitchell, Machine Learning, Mcgraw-Hill, First Edition, ISBN No. 0-07- 115467-1.
10	Christopher M. Bishop, Pattern Recognition and Machine Learning, Mcgraw- Hill, ISBN No. 978-81-322-0906-5
11	ShaiShalev-Shwartz and Shai Ben David ,Understanding Machine Learning From Theory to Algorithms, Cambridge University Press, First Edition, ISBN No. 978-1-107-05713-5

Web References:

Reference No	Reference Name
1	nptel.ac.in-A first course in Artificial Intelligence-Deepak Khemani,
2	nptel.ac.in -Introduction to machine learning – BalaramanRavindran, IITMadras
3	Tutorial point.com/machine learning with python/index.htm

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment:-

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Course Code	Name of Course	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NMCA23	Research Methodology	03	---	01	03	---	01	04

Course Code	Name of Course	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NMCA23	Research Methodology	20	20	60	25	---	125

Course Prerequisite: Data Presentation / handling techniques, Reporting Tools

Course Objectives:

1	To cultivate a thorough grasp of Research Identification
2	To achieve proficiency in Research types and Research Design.
3	To learn diverse methods and procedures during research design.
4	To learn to apply research data collection methods and analysis.
5	To apply various concepts to Interpret and write Research Reports.

Course Outcomes:

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

1	Develop a comprehensive understanding of Research definition and defining research problems.
2	Acquire proficiency in Research types, Research Design and data sampling techniques
3	learn various methods for Research Design.
4	Understanding various methods and Techniques for research data collection and analysis
5	Applying various concepts to present a research report and interpret

Research Methodology (Theory)

Module	Contents	Hrs
1	Introduction to Definition of Research: Research Definition; Objective of research. Various functions that describe characteristics of research such as systematic, valid, verifiable, empirical and critical approach, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology. Defining the Research Problem: Identify Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem.	8
2	Types of Research: Pure and applied research. Descriptive and explanatory research. Qualitative and quantitative approaches. Formulating the Research Problem, Literature Review, Developing the objectives, Preparing the research design including sample Design, Sample size, Census and Sample Survey, Implications of a Sample Design, Steps in Sampling Design, Criteria of Selecting a Sampling Procedure	10
3	Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design-Dependent and independent variables, Extraneous variable, Control, Different Research Designs, Basic Principles of Experimental Designs- Important Experimental Designs, Informal experimental designs, Formal experimental designs.	08
4	Methods of Data Collection and Analysis: Observation Method, Collection of Primary Data, Interview Method, Collection of Data through Questionnaires, Some Other Methods of Data Collection, Collection of Secondary Data, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Processing Operations, Some Problems in Processing, Elements/Types of Analysis	07
5	Interpretation and Report Writing: Meaning of Interpretation, Why Interpretation? Technique of Interpretation: Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.	06

Textbooks:

1	Kothari, C.R., 1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
2	Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers' Distributors.

Reference Books:

1	Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd.ed), Singapore, Pearson Education.
2	Shrivastava, Shenoy & Sharma, Quantitative Techniques for Managerial Decisions, Wiley.
3	Goode WJ & Hatt PK, Methods in social research, McGraw Hill.
4	Basic Computer Science and Communication Engineering - R. Rajaram (SCITECH).

Online Resources:

1	https://www.bing.com/search?q=alison.com%0Ahttps%3A%2F%2Falison.com%2Ffree-learning%2Fdiploma-courses&form=IPRV10
2	https://researchmethod.net/methodology/
3	https://paperpal.com/blog/academic-writing-guides/what-is-research-methodology
4	https://www.educba.com/types-of-research-methodology/
5	https://www.researchprospect.com/research-methodology/
6	https://onlinecourses.nptel.ac.in/noc24_ge21/preview

Tutorials: Suggested Tutorial Topics/list but not limited to the following topics

Sr No	Topic
1	Developing a Research Plan : Identify, Literature Survey ,Design and Formulate a Research Problem
2	Understanding Research Ethics
3	Effect of Redundant publications: duplicate and overlapping publications
4	Importance of plagiarism in Research:Use of plagiarism software like Turnitin, Urkund and other open source software tools
5	Write a comprehensive note on the “Task of defining a research problem”
6	Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
7	Writing Complete Research Proposals

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.

Mid Term test is to be conducted when approx. 50% syllabus is completed.

Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation	05 Marks

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Course Code	Name of Course	Teaching Scheme	Credits Assigned		
NMCAE211	Internet of Things & Industrial Internet of Things	Contact Hours			
		Theory	Tutorial	Theory	Tutorial
		3	--	3	--
		Examination Scheme			
		Theory			Total
		CA	MT	Total	
		20	20	40	100

Prerequisite: 1. Knowledge of Computer Networks.
2. Basics of Cloud.

Course Objectives: Course is aim to

Sr.No.	Course Objective
1	Explain the basics of IoT, M2M, IoT enabling technologies, characteristics of IoT systems and IoT levels.
2	Explain different state of art IoT reference models and architectures as well as Architecture Reference Model (ARM) for IoT.
3	Explain the IoT protocols aspects and generic design methodology.
4	Explain the IoT security aspects and generic design methodology.
5	Discuss IoT applicability in various domains along with the concept of Web of Thing (WoT).
6	Discuss IoT applicability in various domains along with the concept of Cloud of Thing (CoT).

Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Outcome
CO1	Compare M2M and IoT; discuss applicability of IoT enabling technologies, characteristics of IoT systems and IoT levels.
CO2	Explain different state of art IoT reference models and architectures as well as Architecture Reference Model (ARM) for IoT
CO3	Analyze various protocols for IoT security aspects and generic design methodology
CO4	Analyze various protocols for IoT and generic design methodology
CO5	Develop a web based IoT Model for specific domains.
CO6	Develop cloud based IoT Model for specific domains.

Module	Detailed Contents	Hrs
1	Introduction to IoT and M2M • Introduction of Basic electronics and its components working • Definition & Characteristics of IoT Physical Design of IoT- Things in IoT • Logical Design of IoT- IoT Functional Blocks, IoT Communication Models, IoT Communication APIs • IoT Enabling Technologies- Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems • IoT Levels & Deployment Templates- IoT Level-1, IoT Level-2, IoT Level-3 • M2M to IoT – The Vision: Introduction • From M2M to IoT • A brief background, • M2M communication, • Differing characteristics • Self-Learning Topics: • IoT Level-4, IoT Level-5, IoT • Level-6 M2M to IoT – A Market Perspective M2M to IoT – An Architectural Overview	8

2	IoT Architecture: Introduction State of the Art • European Telecommunications Standards Institute M2M/oneM2M • International Telecommunication Union Telecommunication sector view • Internet Engineering Task Force architecture fragments • Open Geospatial Consortium Architecture. Architecture Reference Model • Introduction, • Reference model and architecture, IoT reference model • IoT domain model, Information model, Functional model, • Communication model, Safety, privacy, trust, security model • IoTReference Architecture • Introduction, Functional view, Information view, Deployment and operational view Self-Learning Topics: Other relevant architectural views	11
3	IoT Protocols and Security: • IoT Protocols : • Protocol Standardization for IoT Efforts, M2M and WSN Protocols, SCADA and RFID Protocols, Issues with IoT Standardization, Unified Data Standards, Protocols – IEEE 802.15.4, BACnet Protocol, Modbus, KNX, Zigbee Architecture, Network layer, APS layer. • IoT Security: Need for IoT Security, IoT Vulnerabilities, Elements of IoT Security, IoT • Security best practices, Threat Modeling an IoT system Self Learning Topics: Basics of Internet Protocols, Basic understanding of cryptography	6
4	IoT Platform Design Methodology: • Purpose and requirement specification Process specification • Domain model specification Information model specification Service specifications • IoT level specification Functional view specification Operational view specification • Device and component integration Application development Self Learning Topics: Basics of DFD, UML Modeling	4

5	Domain Specific IoTs: Home Automation - Smart Lighting & Smart Appliances/Intrusion Detection & Smoke/Gas Detectors - Cities/Smart Parking & Smart Lighting/Smart Roads & Structural Health Monitoring/Surveillance & Emergency Response Environment/Weather Monitoring - Air Pollution Monitoring - Noise Pollution Monitoring - Forest Fire Detection - River Floods Detection Energy - Smart Grids - Renewable Energy Systems - Prognostics Retail - Inventory Management - Smart Payments - Smart Vending Machines Agriculture - Smart Irrigation - GreenHouse Control Industry - Machine Diagnosis & Prognosis. - Indoor Air Quality Monitoring Self Learning Topics: Case Study on Logistics and Health & Lifestyle	6
6	IIOT and Cloud of Things: Role of IIOT in Manufacturing Processes, Wireless sensor network (WSN) and Internet of Things (IoT), Business models: Saas, Paas, Iaas., big-data analytics infrastructures Self Learning Topics: Basics of Web and Cloud.	4

Reference Books

Reference No	Reference Name
1	From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Aves and Stamatis Karnouskos, David Boyle, ELSEVIER
2	Vijay Madiseti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1 st Edition, VPT, 2014
3	IoT Security for Dummies, Lawrence Miller, John Wiley & Sons Ltd.
4	Practical Internet of Things Security, Brian Russell, Drew Van Duren, PACKT publishing

5	The Internet of Things in the Cloud: A Middleware Perspective, By Honbo Zhou
6	Rethinking the Internet of Things A Scalable Approach to Connecting Everything, Francis daCosta, Apress
7	Getting Started with the Internet of Things, Cuno Pfister
8	The Internet of Things: Connecting Objects, Hakima Chaouchi

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed. Duration of the mid term test shall be one hour.

Continuous Assessment:-

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Course Code	Name of Course	Teaching Scheme			Credits Assigned		
NMCAE212	Design and Analysis of Algorithm	Contact Hours					
		Theory	Tutorial	Theory	Tutorial	Total	
		3	--	3	--	3	
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		C A	M T	Total			
		20	20	40	--	60	100

Prerequisite: Basics of data mining and Mathematical foundations of computer science-MCA11

Course Objectives: Course is aim to

Sr.No.	Course Objective
1	Analyze asymptotic notations.
2	Analyze various Divide and conquer problem solving techniques
3	Analyze greedy algorithm strategies.
4	Analyze dynamic programming strategies.
5	Analyze backtracking, branch and bound and string matching algorithm.
6	Interpret approximation algorithms.

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

Sr.No.	Outcome
CO1	To analyze the time and space complexity of various algorithms.
CO2	To construct and analyze divide and conquer strategies.
CO3	To construct and analyze greedy algorithm strategies.

CO4	To develop and analyze dynamic programming strategies.
CO5	To analyze backtracking, branch and bound and string matching algorithms.
CO6	Explain NP hard NP complete problem.

Module	Detailed Content	Hrs
1	Module: Introduction : Notion of an Algorithm , Fundamentals of Algorithmic Problem Solving, Fundamentals of the Analysis of Algorithmic Efficiency, Asymptotic Notations and their properties. Analysis Framework, Mathematical analysis for Recursive and Non-recursive algorithms, Substitution method and growth of function. Self-Learning topics: algorithms based on their worst-case, best-case, or average-case time or space complexities	4
2	Module: Divide And Conquer: Divide and Conquer Methodology, Binary Search, Merge sort, Quick sort, Heap Sort, Multiplication of Large Integers, Closest- Pair and Convex- Hull Problems Self Learning Topics: Optimal storage on tape	7
3	Module: Greedy Technique: Introduction, Control Abstraction for Greedy Algorithms, Fractional knapsack, Minimum cost spanning tree(Kruskal, Prims) , Single source shortest path (Dijkstra's algorithm) Self Learning Topics: Huffman Coding	8
4	Module: Dynamic Programming: Introduction, Control Abstraction for Dynamic Programming, Knapsack (0/1), Matrix chain multiplication, Longest common subsequence, All pair shortest path (Floyd Warshall) Self Learning Topics: DFS and BFS	8

5	Module: Backtracking And Brach And Bound, String Matching: Introduction to Backtracking, n-Queen problem, Graph colouring problem, Hamiltonian cycle. Branch and Bound, LIFO Search and FIFO search, Least cost search, 15 puzzles, Travelling Salesman Problem. Naïve string-matching Algorithms Rabin Karp algorithm , Knuth-Morris-Pratt algorithm Self Learning Topics: Subset Sum Problem	10
6	Module: Approximation Algorithms: NP Hard and NP –complete problem, set covers, Natural algorithms Self Learning Topics: Study of open ended problems	2

Reference Books:

Reference No	Reference Name
1	Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein,—Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2012 ISBN 978-0-262-03384-8.
2	AnanyLevitin, —Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012 ISBN 978 0 13 231681 1
3	Ellis Horowitz, SartajSahni and SanguthevarRajasekaran - Computer Algorithms/ C++, Second Edition, Universities Press, 2007 ISBN: 9788173716126
4	S. Sridhar —Design of Algorithms and Analysis, Oxford university press, 2014.
5	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, —Data Structures and Algorithms, Pearson Education, Reprint 2006
6	Harsh Bhasin, —Algorithms Design and Analysis, Oxford university press, 2016.
7	Parag H. Dave, Himanshu B. Dave, “Design and Analysis of Algorithms”, 1 st Edition, 2008, ISBN: 8177585959, Pearson Education.

Web References:

Reference No	Reference Name
1	nptel.ac.in- Design and analysis of algorithms - Prof. Madhavan Mukund,
2	nptel.ac.in - Design and Analysis of Algorithms – Prof. Abhiram G Ranade, Prof. Ajit A Diwan, Prof. Sundar Viswanathan

3	nptel.ac.in- Design and Analysis of algorithms-- By Dr. Faheem Syeed Masoodi University of Kashmir
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Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed. Duration of the midterm test shall be one hour.

Continuous Assessment:-

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme			Credits Assigned		
NMCAE213	Software Testing & Quality Assurance	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		-	3	-	3
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	MT	Total			
		20	20	40	-	60	100

Prerequisite: Software Engineering

Course Objectives: Course is aim to

Sr.No.	Course Objective
1	To provide a comprehensive knowledge of software testing concepts, principles, process models, and various testing techniques.
2	To have an in-depth understanding of various static testing strategies.
3	To acquire knowledge of dynamic software testing methodologies.
4	To learn test management and incident management procedures.
5	To acquire fundamental knowledge of the test automation and testing tools.
6	To gain thorough knowledge of software quality, measurement, and metrics.

Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Outcome
CO1	Understand fundamental concepts, principles, process models, and various software testing techniques.
CO 2	Apply various static testing strategies.
CO 3	Apply various dynamic testing methodologies.
CO 4	Understand and apply the procedure for test management and incident management.
CO5	Adapt essential knowledge of test automation and testing tools effectively.
CO6	Evaluate software quality using ISO standards, measurements and metrics.

Module	Detailed Contents	Hrs
1	Basics of Software Testing Testing & Debugging, Principles of Testing, Test Metrics, Verification and Validation, The General V-Model, W-Model, Component Test, Integration Test, System Test, Acceptance Test, Generic types of Testing- Functional, Non Functional, Testing software structure, Regression Testing, Agile Testing, Web based testing Self-Learning Topic: Tool used for different types of testing	8
2	Static Testing Structured Group Examinations - Reviews, Static Analysis - Control Flow Analysis & Data Flow Analysis, Tools for Static Testing. Self-Learning Topic: Continuous Integration and Continuous Testing, Security Testing	4
3	Dynamic Testing Black Box Testing- Equivalence Class Partitioning, Boundary Value Analysis, State Transition Test, Cause Effect Graphing and Decision Table Technique, User Documentation Testing, Domain Testing White Box-Statement Coverage, Branch Coverage, Test of Conditions, Path Coverage, Data Flow testing, Mutation testing. Self-Learning Topic: Agile Testing	8
4	Test Management Test organization, structure and of testing group, detailed test design and test Specification, Test Planning, Test Process, Test Reporting, Incident Management – Test Log, Incident Reporting, Classification, Status Self-Learning Topic: Case studies on optimizing the test process	5
5	Test Automation Design and Architecture for Automation, Test Automation Design and Architecture for Automation, Generic Requirements for test Tool/Framework, Criteria for selecting test tools, Testing of Object Oriented Systems	7

	Study of testing tools: JIRA, Bugzilla, TestDirector and IBM Rational Functional Tester, Selenium etc. Self-Learning Topic: Automation testing frameworks and TDD	
6	Software Quality, Software Measurement & Metrics Five Views of software quality, ISO 9126 Quality Characteristics, ISO 9000:2000 & Latest Software Quality Standards, SQA Planning: SQA plan Organizational Level Initiatives. Measurement during Software Life Cycle Context, Defect Metrics, Metrics for software Maintenance & Requirements, Measurement Principles. Self-Learning Topic: McCall's Quality Model, Boehm's Quality Model, CMMI, Six Sigma	7

Reference Books:

Reference No	Reference Name
1	Software Testing Foundations, Andreas Spillner, Tilo Linz, Hans Schaefer, Shoff Publishers and Distributors
2	"Foundations of Software Testing", by Aditya P. Mathur – Pearson Education custom edition 2000.
3	"The ART of Software Testing", by Glenford J. Myers, Wiley India, Second Edition
4	"Software Testing: Principles and Practices", by Srinivasan D and Gopalswamy R, Pearson Ed, 2006.
5	"Software Testing & Quality Assurance Theory & Practice" By Kshirasagar Naik & Priyadarshi Tripathi, Wiley Student Edition.
6	"Software Quality Assurance Principles & Practice", by Nina S. Godbole, Narosa Stephan H.Kan,

Web References:

Reference No	Reference Name
1	https://www.softwaretestinghelp.com/
2	https://www.guru99.com/software-testing.html
3	https://www.softwaretestingcertificationcourses.com/
4	https://www.geeksforgeeks.org/software-testing-vs-quality-assurance/
5	https://onlinecourses.nptel.ac.in/noc22_cs61/preview

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and a Continuous Assessment of 20 marks.

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in an event/workshop/talk/competition followed by a small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Course Code	Course Name	Teaching Scheme			Credits Assigned		
NMCAE221	Cyber Security and Laws	Contact Hours					
		Theory		Tutorial	Theory	Tutorial	Total
		3		1	3	1	4
		Examination Scheme					
		Theory			Term Work	End Sem Exam	Total
		CA	MT	Total			
		20	20	40	25	60	125

Prerequisite: NIL

Course Objectives: Course is aim to

Sr.No.	Course Objective
1	Understand the basics of cyber security
2	To have an overview of various cryptographic techniques and network protocols
3	Acquire knowledge of various cybercrimes and tools used in cybercrime
4	Learn the fundamentals of security policies, risk assessment, and compliance
5	Acquire fundamental knowledge of cyber laws
6	Understand different aspects of Indian IT Act 2008 and its latest amendments

Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Outcome
CO1	Demonstrate understanding of basic concepts in cyber security
CO 2	Apply various cryptographic techniques and network protocols
CO 3	Have in-depth knowledge of various Cybercrime and methods used in cybercrime
CO 4	Understand the core principles of security policies, risk assessment, and compliance
CO5	Adapt essential understanding of Cyberspace
CO6	To gain insight into and apply IT law in various legal issues

Module	Detailed Contents	Hrs
1	Introduction to Cyber Security, Compliance and Governance: Cybercrime and origins of the word, Cybercrime and information security, Classifications of cybercrime. Cyber security increasing threat landscape, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker, Non-state actor Self-learning Topic: Ethical aspects related to new technologies- AI/ML, IoT, Blockchain	6
2	Basics of Cryptography and Network Security: Concepts of encryption and decryption, Symmetric and asymmetric cryptography, Cryptographic algorithms and their applications; Fundamentals of network security, Network protocols and vulnerabilities, Firewalls, IDS, and IPS Self-learning Topic: Digital signatures, Public Key Infrastructure (PKI)	6
3	Cybercrimes & Tools How criminals plan attacks, Industrial Spying/Industrial Espionage, Hacking, E-Mail Spoofing, Spamming, data diddling, salami attacks, Cyber defamation, Internet Time Theft, Social Engineering, Cyber stalking, Botnets, Cloud computing, Password Cracking, Keyloggers and Spywares, Virus, worms and trojans, APTs, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Identity Theft (ID Theft) Proliferation of Mobile and Wireless Devices, Trends in Mobility, Attacks on Wireless Networks, Security Challenges Posed by Mobile Devices Self-learning Topic: Threat Intelligence	7
4	Cyber Security Management: Cyber security Plan- cyber security policy, cyber crisis management plan., Business continuity, Risk assessment, Types of security controls and their goals, Cybersecurity audit and compliance. Self-learning Topic: National cyber security policy and strategy.	6
5	Cyberspace: E-Commerce, The Contract Aspects in Cyber Law, The Security Aspect of Cyber Law, The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law, The Criminal Aspect in Cyber Law, Global Trends in Cyber Law, Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking, The Need for an Indian Cyber Law	7

	Self-learning Topic: SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI	
6	Indian IT Act: Cyber Crime and Criminal Justice : Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments Self-learning Topic: Critical IT and National Critical Infrastructure	7

Reference Books:

Reference No	Reference Name
1	Nina Godbole, SunitBelapurCyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives –, Wiley India Publications Released: April 2011
2	Anthony Reyes, The Best Damn Cybercrime and Digital Forensic Book Period,Jack Wiles
3	Investigating Network Intrusions and Cybercrime EC-Council Press
4	Computer Forensic investing Network Intrusions and cybercrime by Course Technology
5	Michael Gregg & David Kim, Inside Network Security Assessment: Guarding Your IT Infrastructure, Pearson Publication
6	Suresh T. Vishwanathan-The Indian Cyber Law; Bharat Law House New Delhi
7	B.B. Gupta, D.P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335,2018
8	Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
9	Introduction to Cyber Security, Chwan-Hwa(John) Wu, J. David Irwin, CRC Press T&F Group

Web References:

Reference No	Reference Name
1	Cybersecurity and Infrastructure Security Agency. (n.d.). Cybersecurity overview. Retrieved July 15, 2024, from https://www.cisa.gov/cybersecurity-overview https://www.cisa.gov/cybersecurity-considerations-businesses
2	Infosec. (2023). Cybersecurity threats: Types, prevention and examples. Retrieved July 15, 2024, from https://www.infosecinstitute.com/cybersecurity-threats-types-prevention-examples
3	Khan Academy. (n.d.). Cryptography. Retrieved July 15, 2024, from https://www.khanacademy.org/computing/computer-science/cryptography
4	Cisco. (n.d.). Network Security Basics. Retrieved July 15, 2024, from

	https://www.cisco.com/c/en/us/products/security/network-security-basics.html
5	National Institute of Standards and Technology (NIST). (2022). Cybersecurity Framework. Retrieved July 15, 2024, from https://www.nist.gov/cyberframework
6	ISACA. (n.d.). Cybersecurity Management. Retrieved July 15, 2024, from https://www.isaca.org/resources/cybersecurity-management
7	Symantec. (n.d.). Internet Security Threat Report. Retrieved July 15, 2024, from https://www.symantec.com/security-center/threat-report
8	International Association of Privacy Professionals (IAPP). (n.d.). Privacy Basics. Retrieved July 15, 2024, from https://iapp.org/resources/article/privacy-basics/
9	European Union Agency for Cybersecurity (ENISA). (n.d.). Data Protection and Privacy. Retrieved July 15, 2024, from https://www.enisa.europa.eu/topics/data-protection-and-privacy

TUTORIAL :

Sr.No	Detailed content	Hrs.
1	Given a list of cases, identify whether it falls under the category of virus, worms, or trojans.	1
2	Cyber Laws of other countries	1
3	Movies, Web Series, and other videos on Cyber Crime	1
4	Case Study: Darknet, Social media, Cyber terrorism, Cyberwarfare	1
5	Two real-life case studies related to data diddling, salami attacks, and social engineering. Also, explain what precautions need to be taken for these attacks.	2
6	Any real-life cases that were booked under the following sections: 1. Section 65 2. Sections 66A,66B,66C,66D,66E,66F	1
7	SQL injection technique. Make a presentation slide and demonstrate.	1
8	Take any 2 cyber crimes(Online scams & Frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion), and explain them in detail as a presentation. Also, download its related video to demonstrate it in class.	2
9	Prepare a case study on any one of these topics: Debit/ credit card fraud, Online payment fraud, Pornographic Offenses	1
10	Screen lock bypassing techniques and different of password-cracking methods	1
11	Study and summarize few research papers on : Cyberbullying, Cybersquatting, Cyber grooming, Pharming, Cyber café and Cybercrimes,	1



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Internal Assessment:

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Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

Continuous Assessment: -

Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following: -

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more: - NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	Assignment/Tutorials Based on Syllabus	10 marks
7.	Participation in an event/workshop/talk/competition followed by a small report and certificate of participation relevant to the subject (in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Term Work: 25 marks

The term work will be based on the Tutorial Performance



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Course Code	Name of Course	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NMCAE222	Design Thinking	03	---	01	03	---	01	04

Course Code	Name of Course	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NMCAE222	Design Thinking	20	20	60	25	---	125

Course Prerequisite: NA

Course Objectives:

1	To cultivate a thorough grasp of Design Thinking's definition, principles, and practical applications.
2	To achieve proficiency in Design Thinking methodologies and processes, encompassing the 5-stage approach and various implementation strategies.
3	To learn diverse methods and tools during the Empathize and Design phases of product development within the framework of Design Thinking.
4	To learn to apply design thinking tools and methods in ideation stage
5	To comprehend different prototype methods and learn the importance of testing.
6	To apply Design Thinking principles through case studies and real-world scenarios, fostering practical understanding and proficiency in problem-solving and innovation.

Course Outcomes:

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

1	Develop a comprehensive understanding of Design Thinking's definition, principles, and applications
2	Acquire proficiency in Design Thinking methodologies and processes, encompassing the 5-stage approach and diverse implementation strategies.
3	learn various methods/tools for Empathize and Design phases in product development through Design Thinking.

4	Tackle idea generation challenges by employing techniques such as brainstorming, mind mapping, and ideation tools, prioritizing visualization and empathy prior to generating ideas.
5	Understanding various prototype types and methods, implementing focused experiments, exploration maps, and minimum viable products.
6	Applying interdisciplinary collaboration, ethics, culture, global perspectives, and technology integration in real-world scenarios.
Learning Outcomes:	
1	To identify opportunities, empathize with users, generate innovative solutions, and prepare effective design briefs.
2	Students will learn to use design thinking resources, principles, and the 5-stage process to solve case studies effectively.
3	Students will learn to apply various methods and tools for the empathize and design phases, finalize problem statements, and use design thinking for product development.
4	Students will learn to apply various methods and tools for the empathize and design phases, finalize problem statements, and use design thinking for product development.
5	Students will learn to create and test various prototypes, collect feedback, and iterate to improve ideas.
6	Gain insights into the impact of cross-disciplinary collaborations, ethical considerations, cultural sensitivity, global perspectives, and technology integration on real-world business and societal challenges.

Design Thinking (Theory)

Module	Contents	Hrs
1	Introduction to Design Thinking	05
	<u>Design Thinking Background:</u> Definition, Importance, Origin, Design Vs Design Thinking, Problem Solving and Need, Principles of Design Thinking, Business Uses, Variety within the Design Thinking Discipline <u>Design Thinking Approach:</u> Empathy, Ethnography, Divergent Thinking, Visual Thinking, Assumption Testing and Prototyping <u>Activities for Tutorials</u> Identify an Opportunity and Scope of the Project Explore the possibilities and prepare a design brief	
2	Design thinking process and methodology.	08
	<u>Design Thinking Resources:</u>	

	Organization , People, Place, Material <u>Principles of Design Thinking</u> <u>Design Thinking Processes</u> <u>Design Thinking Methodology</u> The 5 Stages of the Design Thinking Process- Empathize, Define (the problem), Ideate, Prototype, and Test. <u>Activities for Tutorials</u> Identify design thinking process and methodology which will be useful for your case study and also identify the important applicable principles.	
3	Empathize and Design	07
	<u>Methods and Tools for Empathize and Design phases</u> Ask 5 Why (5W+H Questions), Stakeholder and Empathy Map Peer Observation, Trend Analysis, Data Gathering methods, Observation, Focus Graph, Interview, Q&A, Design Thinking Application, Design Thinking Applied to product development. <u>Activities for Tutorials</u> Apply the methods of empathizing and Define Phases Finalize the problem statement.	
4	Design Thinking in Practice	07
	<u>Visualisation and Ideation</u> Challenges in idea generation, Visualize, Empathize, and Ideate method, Importance of visualizing and empathizing before ideating. Ideation Tools: How Might We? (HMW), Storyboard, Mind mapping, Brainstorming, Affinity diagram. <u>Activities for Tutorials</u> Apply the methods of Ideate Phase: Generate Lots of Ideas.	
5	Prototyping and Testing	08
	<u>Prototyping</u> Types of Prototype, Methods of prototyping, focused experiments, exploration map , minimum viable product, Testing prototypes with users <u>Activities for Tutorials</u> Apply the Methods of the Prototype Phase: Create prototypes for selected ideas. Collect feedback, iterate and improve the ideas.	
6	Case Studies/Real World Application	04

	<u>Case Studies and Real World Applications</u> Important considerations: Cross Disciplinary Collaborations, Ethical consideration, cultural sensitivity and global perspective, technology integration. <u>Activities for Tutorials</u> Find out any one use case considering the above discussed factors that have impacted the real world business/society.	
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Tutorials
Student have to study a case study of any area of interest i.e Healthcare, Aviation, Insurance etc, and perform the above mentioned tutorials.

Textbooks:	
1	Idris Mootee, —Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School, Wiley, 2017. (e-book) https://www.aitskadapa.ac.in/e-books/CSE/DESIGN%20THINKING/Design%20Thinking%20for%20Strategic%20Innovation_%20What%20They%20Can_t%20Teach%20You%20at%20Business%20or%20Design%20School%20(%20PDFDrive%20).pdf
2	Tim Brown, “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”.(e-book) http://hozekf.oerp.ir/sites/hozekf.oerp.ir/files/kar_fanavari/manabe%20book/Thinking/Change%20by%20Design_%20How%20Design%20Thinking%20Transforms%20Organizations%20and%20Inspires%20Innovation%20.pdf
3	Christian Müller-Roterberg, “Handbook of Design Thinking”, Kindle Direct Publishing ISBN:978-1790435371, November 2018 (https://www.researchgate.net/publication/329310644_Handbook_of_Design_Thinking).
Reference Books:	
1	Gavin Ambrose, Paul Harris, “Basics Design - 8: Design Thinking”, illustrated, reprint, AVAPublishing, 2010
2	Christine Charyton, Creative Engineering Design Assessment, Springer
3	Warren K Wake Wake, Design Paradigms: A Sourcebook for Creative Visualization, John Wiley & Sons
Online Resources:	
1	https://www.gasq.org/files/content/gasq/downloads/certification/Design%20Thinking/DesignThinking_Syllabus_0-6-3_EN.pdf

2	https://www.cuelogic.com/blog/core-principles-of-design-thinking
3	https://www.uxuiopen.com/trial/ux_fundamentals/design_process/
4	https://digitalleadership.com/blog/design-thinking/
5	https://www.interaction-design.org/literature/topics/design-thinking
6	https://www.pvpsiddhartha.ac.in/dep_it/lecture%20notes/FDLD_21/UNIT-1.pdf
7	https://aim.gov.in/pdf/Mentor-DesignThinking.pdf
Access to software and virtual labs: NA	
Industry articles and case studies:	
1	MJV Tecnologia Ltda, "Design Thinking_business innovation" e-book
2	https://theaccidentaldesignthinker.com/2017/09/16/40-design-thinking-success-stories/
3	https://voltagecontrol.com/blog/8-great-design-thinking-examples/
4	https://online.hbs.edu/blog/post/design-thinking-examples
5	https://www.theknowledgeacademy.com/blog/design-thinking-case-study/
Any other (Access to AI tools / Data driven insights (if applicable) or any other):	
1	User Research and Sentiment Analysis Tools:CrystalKnows, MonkeyLearn, Clarabridge
2	User Interviews and Surveys:Affectiva, SurveySparrow
3	Data Analysis Tools:Tableau, IBM Watson Analytics
4	Insight Extraction:Sift
5	Brainstorming and Idea Generation:Miro, Ideaflip, Writeseer
6	Prototyping Tools:Figma,Sketch2Code, Uizard
7	User Testing and Feedback:UserTesting, Lookback,Optimal Workshop
8	Automated Documentation and Note-Taking:Otter.ai,Notion
9	Collaboration Tools:Slack, Microsoft Teams

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.

Mid Term test is to be conducted when approx. 50% syllabus is completed.

Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:



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Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation the marks can be left blank (with discretion of faculty)	05 Marks

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five needs to be solved.

Term Work: 25 marks

The term work will be based on the Tutorial Performance



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Course Code	Name of Course	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NMCAE223	Risk Assessment and management	03	---	01	03	---	01	04

Course Code	Name of Course	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NMCAE223	Risk Assessment and management	20	20	60	25	---	125

Course Prerequisite: Concepts of Software Engineering and Software Project Management

Course Objectives:

1	To study fundamental concept of Risk Analysis
2	Identify characteristics of Risk Management strategy and various approaches to Risk Management.
3	In-depth understanding of the fundamentals of risk assessment and management
4	To understand risk response and its strategies.
5	To identify the risk mitigation strategies.
6	Understand risk monitoring and control strategies.

Course Outcomes:

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

1	Illustrate the fundamentals of Planning and Identifying Risk
2	Identify various Qualitative and Quantitative Risk Analysis Technique
3	describe methods for risk analysis, evaluation and management,
4	Applying various strategies for Planning Risk Response
5	Apply risk mitigation techniques to avoid risk.
6	Make Use of different techniques for Monitoring and Controlling Risk

Module	Contents	Hrs
1	Risk Management Process	05
	Risk and its Nature, Types of Risk, Process of Risk Management Importance of Risk Management, Risk Management, Perspectives Elements of Software Risk. <u>Activities for Tutorials</u> Identify Type of Project Risks Develop Risk Management Plan	
2	Risk Identification and Planning	08
	Identify Software Risk and Risk Taxonomy, Plan Risk Management, Tools and techniques for Planning Risk Management, Common Software Project Risk, Inputs for Identifying Risk, Tools for Risk Identification, Techniques for Risk Identification <u>Activities for Tutorials</u> Identify Techniques for Risk Identification	
3	Risk Analysis and Assessment	07
	Objectives and Goals of Risk Analysis and Risk Assessment, Qualitative vs Quantitative Risk Analysis, Techniques for Qualitative and Quantitative Risk Analysis, Tools used for Qualitative and Quantitative Risk Analysis, Methods for Risk Assessment <u>Activities for Tutorials</u> Perform Qualitative Risk Analysis. Perform Quantitative Risk Analysis Analyze Risk Assessment method	
4	Risk Responses	07
	Strategies for Risk Response, Response strategy for Threats Response Strategy for Opportunities, Response, Output of Plan Risk Response <u>Activities for Tutorials</u> Identify Response Risk Strategy for Given case study	

5	Risk Mitigation Strategies	08
	Best practice in risk planning, Risk mitigation strategies: Avoidance strategies, Risk management tools: Expert tools in risk management, Formulating and implementing risk management plans	
6	Monitoring and Controlling Risk	04
	Tools for Implementing Risk, Techniques for Implementing Risk Developing a process for Monitoring Risk, formulating a Project Risk Register, Managing and Tracking Risk, Role of Risk Governance and Culture. <u>Activities for Tutorials</u> Perform Risk Monitoring activity Formulate Risk in Project Risk Register Perform Risk Audit	

Tutorials

Students have to study a case study of any area of interest i.e. Healthcare, Aviation, Insurance etc., and perform the above mentioned tutorials.

Textbooks:

- | | |
|---|--|
| 1 | John Mc Manus "Risk Management in Software Development Projects", Routledge, September 2016. |
| 2 | David Hillson and Peter, "Practical Project Risk Management: The ATOM Methodology", Management Concepts, 2nd Edition, 2012 |

Reference Books:

- | | |
|---|--|
| 1 | A guide to Project Management Book Of Knowledge", Project Management Institute, Sixth, 2016. |
| 2 | Project Risk Analysis and Management Guide", Association for Project Management, Second, October 2015. |

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.

Mid Term test is to be conducted when approx. 50% syllabus is completed.

Duration of the midterm test shall be one hour.



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Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks

End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Term Work: 25 marks

The term work will be based on the Tutorial Performance

Course Code	Name of Course	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
NMCAL21	Artificial Intelligence & Machine Learning Lab	2	1	25	30	20	75

Prerequisite: Basic understanding of mathematical, data mining concepts and any programming Language

Lab Course Objectives: Course Aims to

Sr.No.	Course Objective
1	Understand the problem solving concepts of Artificial Intelligence.
2	Impart a thorough understanding of basic machine learning algorithms and its applications.
3	Demonstrate dimensionality reduction techniques for feature extraction and selection.
4	Build a model using appropriate machine learning algorithms for real world problems.
5	Build a model using appropriate advanced machine learning algorithms for real world problems
6	Deployment of model to be learned

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

Sr.No.	Outcome
CO1	Demonstrate the basic concepts of Artificial Intelligence and Machine Learning using various libraries in Python.
CO2	Implement basic Supervised and unsupervised machine learning algorithms and their applications.
CO3	Analyze dimensionality reduction techniques for feature extraction and selection.
CO4	Develop models using Support Vector machines and kernels for real world problems.
CO5	Develop models using appropriate advanced machine learning algorithms for real world problems.
CO6	Deploy the machine learning model for real world problems.

Description:

Module	Detailed Contents	Hrs
1	Introduction to Python Programming: Learn the different libraries - NumPy, Pandas, SciPy, Matplotlib, and Scikit Learn. Self Learning Topic: - Milk, Shogun.	6
2	Supervised Learning: Apply different machine learning algorithms for prediction like Linear Regression, Logistic Regression, Apriori Classification, KNN-classification. Understand the usage of Confusion Matrix, Precision, Recall Self Learning Topic: - Evaluation metrics like MSE, Accuracy, ROC curve.	4
3	Unsupervised Learning: K-Means Clustering Algorithm, K-Medoid Clustering Algorithm Self Learning Topic: Other Clustering Algorithms.	2
4	Classifying data using Support Vector Machines (SVMs): SVM-RBF kernels. Self Learning Topic: -SVM-Kernels-Polynomial Kernel	2
5	Bagging & Boosting Algorithm: Decision Tree, different ensemble techniques like bagging, boosting, stacking, and voting, Random Forest- bagging, Attribute bagging; and voting for class selection. , AdaBoost, Stochastic Gradient Boosting, Voting Ensemble Self Learning Topic: - Extra Trees, AdaBoost as a Forward Stage .	6
6	Dimensionality Reduction: Features Extraction, Feature selection, Normalization, Transformation, and Principal Components Analysis-visualizations of complex datasets. Self Learning Topic: - LDA (Linear Discriminant Analysis).	6

Reference Books:

Reference No	Reference Name
1	Aurelian Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition.
2	Paul J. Deitel, Python Fundamentals.
3	Stuart Russell, Peter Norvig, Artificial Intelligence – A Modern Approach, Pearson Education / Prentice Hall of India, 3rd Edition, 2009.
4	Ethem Alpaydn, Introduction to Machine Learning, PHI, Third Edition, ISBN No. 978-81-203- 5078-6.

5	Peter Harrington, Machine Learning in Action. Manning Publications, April 2012 ISBN 9781617290183.
6	Introduction to Computer Programming using Python, John V Guttag
7	Core Python Programming, R. NageswaraRao

Web References:

Reference No	Reference Name
1	https://talentsprint.com/pages/artificial-intelligence-machine-learning-iiit-h-program/program-details.pdf
2	https://learning.oreilly.com/library/view/learning-robotics-using/9781783287536/cover.html
3	http://www.qboticslabs.com
4	https://subscription.packtpub.com/book/big_data_and_business_intelligence
5	https://scikit-learn.org/0.16/modules/generated/sklearn.lda.LDA.html
6	https://machinelearningmastery.com/ensemble-machine-learning-algorithms-python-scikit-learn/
7	https://www.coursera.org/learn/machine-learning#syllabus
8	https://data-flair.training/blogs/python-ml-data-preprocessing/

A suggested list of experiments

Practical No	Problem Statement
1	Introduction to Python Programming: Implementation of NumPy,
2	Implementation of Pandas for data preprocessing
3	Implementation of SciPy and Scikit Learn. for machine learning algorithms
4	Implementation of Matplotlib for data visualization
5	Implementation of Linear Regression, Logistic regression, KNN- classification.
6	Implementation of dimensionality reduction techniques: Features Extraction and Selection, Normalization, Transformation, Principal Components Analysis.
7	Implementation of K-Means and K-medoid clustering algorithm.
8	Implementation of classifying data using Support Vector Machines (SVMs).
9	Implementation of Bagging Algorithm: Decision Tree, Random Forest.
10	Implementation of Boosting Algorithms: AdaBoost, Stochastic Gradient Boosting, Voting Ensemble.



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Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
5	Based on the subject and related lab of NMCAL21

Term Work: 25 marks

The term work will be based on the Laboratory work



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Course Code	Name of Course	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
NMCALE211	Internet of Things & Industrial Internet of Things Lab	02	01	25	30	20	75

Prerequisite: 1. Knowledge of C and C++ Programming.

2. Basics of Cloud.

Lab Course Objectives: Course is aim to

Sr.No.	Course Objective
1	Learn basic electronic components and to get familiar with arduino software/hardware.
2	Learn basic electronic components and get familiar with arduino simulators.
3	Interface various I/O devices with arduino.
4	Interface various sensors with arduino.
5	Interface IoT device with cloud.
6	Develop skills required to build real-life IoT based projects.

Lab Course Outcomes:

Sr.No.	Outcome
CO1	Identify basic electronic components and make use of arduino software/hardware.
CO2	Identify basic electronic components and make use of arduino simulators.
CO3	Experiment with various I/O devices with Arduino.
CO4	Experiment with various sensors with Arduino.
CO 5	Build IoT applications using Cloud.
CO 6	Develop IoT based projects.

Description:

Module	Detailed Contents	Hrs
1	Introduction to Basic Components : Detail working of all the electronics components (resistor ,capacitors,transistor & IDE software Familiarization with Arduino and perform necessary software installation. Breadboard Basics Programming the Arduino o Arduino, circuits, and code: Bringing everything together Self Learning Topics: Basic electronic components such as LED, resistors, battery etc.	4
2	Switches, LEDs, and More: Programs based on interfacing LEDs, Switches/push buttons and Speakers/Buzzer, LCD/ Seven Segment Display with Arduino Self Learning Topics: Basics of Switches /push buttons , LED, Speakers/Buzzer, LCD/ Seven Segment Display.	4
3	Analog Values Programs based on interfacing LEDs, Potentiometer, Photoresistor with Arduino Programs using PWM pins of Arduino Programs using Serial Monitor of Arduino Programs based on interfacing DHT11 temperature sensor Programs based on interfacing Passive infrared sensors (PIR), Ultrasonic of Arduino Self Learning Topics: Basic of Analog values, PWM concepts	6
4	Servo Motors: Programs based on interfacing LEDs, Servo Motor, Potentiometer with Arduino Self Learning Topics: Basics of servo motors, potentiometer	2
5	IoT in Cloud: Interfacing IoT device with Cloud Self Learning Topics: Computer Network and Cloud Concepts	4
6	Mini Project: Mini projects such as Home automation, Robots, Wearable projects, art projects etc.(Remove) Self Learning Topics: Real life problem statement	6

Reference Books:

Reference No.	Reference Name
1	Make: Learn electronics with Arduino, Jodi Culkin and Eric Hagan, Maker Media
2	Programming Arduino: Getting started with sketches, Simon Monk , TMH
3	Getting Started with Arduino: A Beginners Guide, Brad Kendal,
4	Make: Getting Started with Arduino, Massimo Banzi, Michael Shiloh, Makermedia
5	Make: Getting Started with Sensors, KimmoKarvinen, TeroKarvinen, Makermedia
6	Learn Electronics with Arduino, Don Wilcher, Apress
7	From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Jan Holler VlasiosTsiatsis Catherine Mulligan Stefan Aves and Stamatiskarnouskos David Boyle
8	VijayMadiseti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition,VPT, 2014
9	The Internet of Things in the Cloud:A Middleware Perspective,By Honbo Zhou
10	Rethinking the Internet of Things A Scalable Approach to Connecting Everything, Francis daCosta, Apress

Web References:

Reference No	Reference Name
1	http://www.tinkercad.com
2	https://www.arduino.cc/
3	https://www.makerspaces.com/15-simple-arduino-uno-breadboard-projects/
4	https://thingspeak.com/

Suggested list of experiments:

All Programs to be done using Simulation Tool like Tinkercad or any other simulation tool.
Interfacing IoT devices with the cloud using any cloud platform like ThingSpeak, AWS etc.

Practical No	Problem Statement
1	Program to blink Arduino onboard LED and To interface external LED with Arduino and write a program to turn ON LED for 1 sec after every 2 seconds.
2	To interface 5 LED's with Arduino and write a program to blink 6 LEDs, one at a time, in a back and forth formation.
3	To interface Push button with Arduino and write a program to turn ON LED when push button is pressed.
4	To interface Push button, Speaker/buzzer with Arduino and write a program to turn ON LED and generate a note or tone when push button is pressed.
5	To interface 2 Push buttons, a Speaker with Arduino and write a program to turn ON LED and generate 2 different notes on a two button keyboard.
6	To interface Seven Segment Display (SSD) with Arduino and write a program to blink SSD.
7	To interface Seven Segment Display (SSD) with Arduino and write a program to print numbers from 1 to 4 on SSD.
8	To interface LCD, push button, potentiometer with Arduino and write a program to display a message on the LCD when the push button is pressed.
9	To interface LCD, push button, potentiometer with Arduino and write a program to display the no. of times (count) the push button is pressed on the LCD.
10	To interface LEDs, potentiometer with Arduino and write a program to turn on or off more of the LEDs by turning the potentiometer knob.
11	To interface LED, Photoresistor (LDR) with Arduino and write a program to increase and decrease the brightness of the LED based on the amount of light present.
12	To interface LEDs with Arduino and write a program to show the fading effect on LED's.
13	To interface DHT11 sensor with Arduino and write a program to display temperature and humidity data on serial monitor.
14	To interface PIR/ Ultrasonic sensor with Arduino and write a program to turn on and off LED depending on motion detection/sound detection.
15	To interface servo motor/DC motor with Arduino and write a program to sweep a

	servo back and forth through its full range of motion/ to control a DC motor.
16	To interface LED with Arduino and write a program to send sensor data to the cloud using ThingSpeak/ AWS and receive notification.
17	To interface Temperature sensor with Arduino and write a program to send sensor data to the cloud using ThingSpeak/ AWS and receive notification.
18	To build a mini project based on interfacing any combination of sensors with Arduino and cloud.

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)

Term Work: 25 marks

The term work will be based on the Laboratory work



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Course Code	Name of Course	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
NMCALE212	Design and Analysis of Algorithm Lab	2	1	25	30	20	75

Prerequisite: Basic understanding of mathematical, data mining concepts and any programming Language.

Lab Course Objectives: Course Aims to

Sr.No.	Course Objective
1	To introduce the methods of designing and analyzing algorithms
2	Design and implement efficient algorithms for a Divide and Conquer application
3	Design and implement efficient algorithms for a Greedy approach and Dynamic Programming
4	Design and implement efficient algorithms for backtracking, branch and bound and string matching algorithms.
5	Strengthen the ability to identify and apply the suitable algorithm for the given real-world problem.
6	Analyze worst-case running time of algorithms and understand fundamental algorithmic problems.

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

Sr.No.	Outcome
CO1	Implement the algorithms using different approaches.
CO2	Implement and Analyze the complexities of various algorithms of Divide and Conquer approach
CO3	Implement and Analyze the complexities of Greedy approach and Dynamic Programming
CO4	Implement and Analyze the complexities of backtracking and branch and bound.
CO5	Implement and Analyze the complexities string matching algorithm
CO6	.Compare the complexity of the algorithms NP hard Np complete problem

Description:

Module	Detailed Contents	Hrs
1	Introduction Selection sort, Insertion sort	4
2	Divide and Conquer Approach Merge sort, Quick sort, Binary search	4
3	Greedy Method Approach Single source shortest path- Dijkstra, Minimum cost spanning trees-Kruskal and Prim's algorithm	5
4	Dynamic Programming Approach Single source shortest path- Bellman Ford, All pair shortest path- Floyd Warshall, 0/1 knapsack, Longest common subsequence	5
5	String Matching Algorithms The Naïve string-matching Algorithms, The Rabin Karp algorithm The Knuth-Morris-Pratt algorithm	4
6	Backtracking and Branch and bound N-queen problem, Graph coloring	4

Reference Books:

Reference No	Reference Name
1	Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein,—Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2012 ISBN 978-0-262-03384-8.
2	AnanyLevitin, —Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012 ISBN 978 0 13 231681 1
3	Ellis Horowitz, SartajSahni and SanguthevarRajasekaran - Computer Algorithms/ C++, Second Edition, Universities Press, 2007 ISBN: 9788173716126
4	S. Sridhar —Design of Algorithms and Analysis, Oxford university press, 2014.
5	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, —Data Structures and Algorithms, Pearson Education, Reprint 2006
6	Harsh Bhasin, —Algorithms Design and Analysis, Oxford university press, 2016.
7	Parag H. Dave, Himanshu B. Dave, “Design and Analysis of Algorithms”, 1 st Edition, 2008, ISBN: 8177585959, Pearson Education.



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Web References:

Reference No	Reference Name
1	https://www.javatpoint.com/daa-tutorial
2	https://www.codechef.com/learn/course/college-design-analysis-algorithms
3	https://www.geeksforgeeks.org/design-and-analysis-of-algorithms/

A suggested list of experiments

Practical No	Problem Statement
1	Introduction to Python Programming: Learn the different libraries - NumPy, Pandas, SciPy, Matplotlib, Scikit Learn.
2	Implementation of Linear Regression, Logistic regression, KNN- classification.
3	Implementation of dimensionality reduction techniques: Features Extraction and Selection, Normalization, Transformation, Principal Components Analysis.
4	Implementation of K-Means and K-medoid clustering algorithm.
5	Implementation of classifying data using Support Vector Machines (SVMs).
6	Implementation of Bagging Algorithm: Decision Tree, Random Forest.
7	Implementation of Boosting Algorithms: AdaBoost, Stochastic Gradient Boosting, Voting Ensemble.

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)

Term Work: 25 marks

The term work will be based on the Laboratory work



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Course Code	Name of Course	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
NMCALE213	Software Testing & Quality Assurance Lab	02	01	25	30	20	75

Prerequisite: Core Java, Web Technologies like HTML, CSS, XML, XPATH, DOM and JavaScript.

Lab Course Objectives: The Course is aim to

Sr.No.	Course Objective
1	Understand the basic concepts in Software Testing.
2	Understand the need for automation
3	Understand the essential characteristics, requirements and usage of Selenium Web Driver.
4	Understand the advanced Automation command.
5	Understand TestNg and automation framework basics.
6	Understand the basic concepts of software quality assurance.

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Outcome
CO1	Apply manual software testing techniques to test a software application
CO2	Implement Selenium tool to perform automation testing.
CO3	implement the essential characteristics, requirements and usage of Selenium Web Driver.
CO4	Demonstrate the advanced Automation command.
CO5	Demonstrate TestiNg and automation framework basics.
CO6	implement the basic concepts of software quality assurance.

Description:

Module	Detailed Contents	Hrs
1	Testing Basics : Study of Review, Construction of Control Flow Graph & Writing Test Cases with case studies. Unit Testing, Integration Testing & System Testing. Self Learning Topics: Requirement analysis and derive test scenarios Review of Project Document, Case Study.	2
2	Introduction to Selenium : Introduction to automation Testing, Selenium latest version, Installation, Selenium WebDriver First Script. Self Learning Topics: Record and run a test case in Selenium IDE	2
3	Selenium Web Driver Commands : Implementing Web Drivers on Multiple Browser (chrome, Firefox), handling multiple frames Browser command, navigation Commands and find element command with Example. Self Learning Topics: Implementation of web driver on safari	6
4	Advanced automation Commands : Locator (id, css selector, Xpath), synchronization in selenium, Handling Alerts using selenium web driver, types of alerts. Action Classes in selenium , Handling Drop Down, List Boxes, Command Button, radio buttons & text boxes. Waits command in selenium. Self Learning Topics: Implementation in safari	6
5	TestNg Framework : What is testNg? Installing Testng, TestNg Test, writing test cases using testNg, testNg annotation, Testing .xml Self Learning Topics: Parameters and dependencies from xml	8
6	Quality Assurance : Introduction to software quality assurance, Validation checks and Regression Testing Self Learning Topics: Audits, ISO, QMSCase study	2

Reference Books:

Reference No	Reference Name
1	Software Testing Foundations, 4th Edition: A Study Guide for the Certified Tester Exam (Rocky Nook Computing) Fourth Edition, Andreas Spillner, Tilo Linz and Hans Schaefer.
2	Selenium WebDriver, Pearson, Rajeev Gupta, ISBN 9789332526297.
3	Selenium WebDriver Practical Guide - Automated Testing for Web Applications Kindle Edition, Satya Avasarala, ISBN-13: 978-1782168850
4	Testng Beginner's Guide, Packt Publishing Ltd. Varun Menon, ISBN 1782166017, 9781782166016

Web References:

Reference No	Reference Name
1	https://www.toolsqa.com/selenium-tutorial/
2	https://www.guru99.com/selenium-tutorial.html
3	https://www.techlistic.com/p/selenium-tutorials.html

Suggested list of experiments

Practical No	Problem Statement
1	Take a review and write test cases for any known application.
2	Implement Web Drivers on Chrome & Firefox Browsers.
3	Demonstrate handling multiple frames in selenium
4	Implement Browser command and navigation Commands.
5	Implement the find element command
6	Demonstrate the Locator(id,css selector, path)
7	Demonstrate synchronization in selenium
8	Demonstrate different types of alerts

9	Demonstrate : ☐ Handling Drop Down, ☐ List Boxes
10	Demonstrate ☐ Command Button, ☐ Radio buttons & text boxes. ☐ Waits command in selenium
11	Demonstrate action classes in Selenium
12	Installation of TestNg , running testNg and TestNg annotations
13	Demonstrate Validation testing
14	Perform regression testing

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Based on the subject and related lab of NMCALE213

Term Work: 25 marks

The term work will be based on the Laboratory work

Course Code	Name of Course	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
NMCAL23	Soft Skills Development Lab	02	01	50	--	--	50

Prerequisite: Decent working knowledge of the English language (including Grammar) is a must, keeping in mind that most business/management transactions in India and internationally are conducted in the English language

Lab Course Objectives: Course aims to

Sr. No.	Course Objective
1	Inculcate the essential skills that professionals need to distinguish themselves and make a positive impact on their work and social lives
2	Provide better understanding of corporate culture and to improve their etiquettes, interpersonal skills and professional image
3	Develop holistically and ensure comprehensive learning.
4	Awareness and etiquettes of Written communication skills
5	Inculcate the skills of facing Interview , group discussion
6	Provide understanding and ways of Effective Public speaking

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr.No.	Outcome
CO1	Develop interpersonal skills that help in communication, teamwork, leadership and decision making.
CO2	Methodically study, formulate and interpret different facets of organizational behavior and understand the Intercultural sensitivities .
CO3	Develop holistic leaders and technocrats helping in individual and organizational growth.
CO4	Students will be able to demonstrate Presentation Skills
CO5	Develop Business communication and etiquettes of written communication
CO6	Develop public speaking skills which help in building confidence.

Description:

Module	Detailed Contents	Hrs
1	Soft Skills Introduction: Soft-Skills Introduction What are Soft Skills? Significance of Soft-Skills – Soft-Skills Vs. Hard Skills - Selling Soft- Skills – Components of Soft Skills – Identifying and Exhibiting Soft-Skills Self Learning Topics: Types of Soft, Hard Skills	02
2	Communication : Concept and meaning of communication, methods of communication, verbal and non-verbal communication, techniques to improve communication. Communication in a business organization: Internal (Upward, Downward, Horizontal, Grapevine). External Communication, 7 C's of communication. Active Listening, Differences between Listening and Hearing, Critical Listening, Barriers to Active Listening, Improving Listening, Intercultural sensitivities, Business etiquette when dealing with people from different nationalities Practical (Role plays, case studies) Self Learning Topics :Problems/Barriers in communication	03
3	Written/ Business Communication : Written Communication: Principles of Correspondence, language and style in official letter (full block format, modified block format), Business letters (enquiry to complaints and redressal), Application letter, CV writing, , E- mail etiquette, Documentation of Meetings, Notice, Agenda, Minutes of Meetings. Practical (Practice on CV, Business Letters, Applications, Notice, Agenda, Minutes of Meetings) Self Learning Topics: Impact of modern Technology on Business Communication the paperless office, use of modern devices	04

4	Presentation Skills: Presentation techniques, Planning the presentation, Structure of presentation, Preparation, Evidence and Research, Delivering the presentation, handling questions, Time management. Visual aids. Practical - Presentation by students in groups of maximum 3 on Organizational Behavior topics allocated by faculty. Topics have to cover – 1. Personality: Meaning, Personality Determinants, Traits, Personality types and its, impact on career growth, 2. Individual / Organizational Decision Making. 3. Attitude: Meaning, Components of Attitude, changing attitude and its impact on career growth 4. Perception and Values. 5. Motivation and Leadership: Concept, Importance. 6. Goal setting: SMART (Specific, Measurable, Attainable, Realistic, Timely) Goals, personal and professional goals 7. Time and Self-Management. 8. Learning in a group, Understanding Work Teams, Dynamics of Group Behavior, Techniques for effective participation 9. Etiquette- General & Business Etiquette, Body language 10. Emotional intelligence of self and SWOC 11. Threats v/s Challenges 12. Dos and Don'ts of a presentation/ meetings Online & offline.(presenter & members) Self LearningTopics : Voice modulation,Tone, Pitch,Knowledge and self confidence	08
5	Effective Public Speaking : Public Speaking, Selecting the topic for public speaking, Understanding the audience, Organizing the main ideas, Language and Style choice in the speech, Delivering the speech,Voice Clarity. Practical (Extempore) Self LearningTopics : Preparation, Attire, Posture and Delivery techniques	03
6	Group Discussions: Group Discussion Skills, Evaluation components, Do's and Don'ts. Practical (Group Discussions)	03

	Self Learning Topics: --Ethics of group Discussion and Debates	
7	Interview Techniques: Interview Techniques, Pre-Interview Preparation, Conduct during interview, Verbal and non-verbal communication, common mistakes. Preparation of CV. Practical (Role plays, mock interviews, Telephonic Interviews, Body Language, Facial Expression) Self Learning Topics : Sample communications and exercises, audio-visual presentations	03

Reference Books:

Reference No	Reference Name
1	Business Communication (Revised Edition), Rai & Rai , Himalaya Publishing House.
2	Soft skills: an integrated approach to maximise Personality, Chauhan & Sharma, Wiley India publications.
3	Business Communication: A practice oriented approach, Kalia and Shailja Agarwal.
4	Business Communication – Meenakshi Raman, Prakash Singh, Oxford Publication
5	Stephen Robbins & Judge Timothy: Organization Behavior, Pearson Education
6	K. Aswathappa – Organizational Behavior: Text, cases & games, Himalaya Publishing House.
7	Pareek, Udai, Understanding Organizational Behaviour, Oxford University Press, New Delhi.
8	Taylor & Chandra, “Communication for Business: A Practical Approach,” Pearson
9	Doctor & Doctor, “Business Communication,” Sheth Publishers.

Suggested list of experiments

Practical No	Problem Statement
1	Role Plays
2	Management Activities/Games
3	Case Studies
4	Presentations
5	Extempore Public Speaking
6	Group Discussions
7	Mock Interviews

Term Work:	
1	Term work should consist of experiments based on business letters, Email etiquettes, written .
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 50 Marks (Experiments/Assignments: 20-marks, Group Presentation :20 Marks Attendance Theory & Practical: 10-marks)
Continuous assessment exam	
1	Based on the subject and related lab of NMCAL23

Term Work: 50 marks

The term work will be based on the Laboratory work



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Course Code	Name of Course	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
NMCAL24	DevOps Lab	04	02	50	30	20	100

Prerequisite: Operating System, Linux Administration, Java /Web Application Programming, and Software Engineering

Lab Course Objectives:

Sr.No.	Course Objective
1	To understand DevOps practices that aim to simplify the Software Development Life Cycle.
2	To be aware of different Version Control tools.
3	To familiarize with Jenkins build & test software Applications.
4	To understand Docker to build, ship, and run containerized images.
5	To familiarize with the concept of Software Configuration Management.
6	To familiarize with the concept of Continuous Monitoring.

Lab Course Outcomes:

Sr.No.	Outcome
CO1	To understand the fundamentals of DevOps engineering and be fully proficient with DevOps terminologies, concepts, benefits, and deployment options
CO2	Understand the concepts of different version control tools
CO3	Apply Jenkins to Build, Deploy, and Test the Software Applications
CO4	Analyze & Illustrate the Containerization of OS images and deployment of applications over Docker
CO5	Deploy and Examine the Software Configuration management using Ansible.
CO6	Examine the Software Continuous monitoring using Nagios

Description:

Sr. No.	Detailed Content	Hours
1	Introduction to Devops Concept of DevOps with related technologies which are used to Code, Build, Test, Configure & Monitor the Software Applications. Self-Learning Topics: Scrum, Agile	06
2	Version Control using GIT GIT Installation, Version Control, working with remote repositories, GIT Cheat sheet, Create and fork repositories in GitHub, apply branching, merging and rebasing concepts, implement different Git workflow strategies in real-time scenarios, Understand Git operations in IDE Self-Learning Topics: AWS Codecommit	08
3	Working with Jenkins and Testing using Selenium Introduction to Jenkins (With Architecture), Jenkins Management- Adding a slave node to Jenkins, Build the pipeline of jobs using Jenkins, create a pipeline script to deploy an application over the tomcat server using Jenkins, Integrate Selenium with Jenkins and TestNG Self-Learning Topics: GitLab, AWS CodePipeline	10
4	Continuous Deployment: Containerization with Docker Introduction to Docker with Microservices, Docker Architecture and Container Life Cycle, understanding images and containers, Create and Implement Docker images using Docker file, Container Lifecycle and working with containers, To Build, deploy and manage web or software application on Docker Engine, Publishing image on Docker Hub. Self-Learning Topics: Docker Compose, Docker Swarm.	10
5	Software Configuration Management Introduction to Software Configuration Management Introduction to Ansible, Installation, Environment, Roles, Commands Self-Learning Topics: Puppet, Saltstack	09
6	Software Continuous Monitoring Introduction to Continuous Monitoring Introduction to Nagios, Installing Nagios, Nagios Plugins (NRPE) and Objects Nagios Commands and Notification Self-Learning Topics: Splunk, Snort, Tenable	09



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Reference Books:

Reference No	Reference Name
1	Prem Kumar Ponuthurai, Jon Loeliger, Version Control with Git, 3rd Edition, O'Reilly Media.
2	Mastering Jenkins by Jonathan McAllister, Packt Publishing
3	Sanjeev Sharma and Bernie Coyne, "DevOps for Dummies", Wiley Publication
4	John Ferguson Smart, "Jenkins, The Definitive Guide", O'Reilly Publication.
5	Karl Matthias & Sean P. Kane, Docker: Up and Running, O'Reilly Publication.
6	Russ McKendrick, Learn Ansible, Pakt Publication
7	Learning Nagios, Packt Publishing

Web References:

Reference No	Reference Name
1	https://www.javatpoint.com/devops
2	https://git-scm.com/docs/gittutorial
3	https://www.jenkins.io/doc/tutorials/
4	https://www.softwaretestinghelp.com/integration-of-jenkins-with-selenium-webdriver/
5	https://docs.docker.com/get-started/
6	https://docs.ansible.com/ansible/latest/getting_started/index.html
7	https://www.guru99.com/nagios-tutorial.html

Suggested list of experiments

Practical No	Problem Statement
1	To understand DevOps: Principles, Practices, and DevOps Engineer Role and Responsibilities.
2	To implement Version control for different files/directories using GIT, install git and create a GitHub account.
3	To implement version control using GITHUB to sync local GIT repositories and perform various related operations using GIT Cheat-Sheet
4	To deploy and test Java/web/Python application on Jenkins server
5	To implement Jenkins pipeline using scripted/declarative pipeline
6	To use Jenkins to deploy and run test cases for Java/Web application using Selenium/TestNG
7	To implement Jenkins Master/Slave architecture
8	To understand Docker with Microservices, Docker Architecture and Container Life Cycle, install Docker and execute docker commands to manage images and interact with containers.
9	To learn Dockerfile instructions, build an image for a sample web application using Dockerfile.
10	To implement continuous deployment using Ansible
11	To implement continuous monitoring using Nagios



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Term Work:	
1	Term work should consist of 10 experiments.
2	The journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 50 Marks (Experiments: 30-marks, Attendance Theory & Practical: 10-marks, Assignments: 10-marks)
Continuous assessment exam	
1	Based on the subject and related lab of NMCAL24

Term Work : 50 marks

The term work will be based on the Laboratory work



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Course Code	Name of Course	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
NMCAL25	Advanced Data Engineering with Cloud Lab	02	01	25	30	20	75

Prerequisite: Basic Understanding of SQL, Java Programming and Python

Lab Course Objectives: -Course is aim to

Sr.No.	Course Objective
1	Understand various components of AWS and identify the problem solution
2	Understand AWS Sagemaker fundamentals for data labeling, bounding boxes and Semantic Segmentation.
3	Study various data exploration techniques for Data Preprocessing and deploy models after fine tuning..
4	Build computer vision model for facial recognition
5	Build a bot using Natural Language Processing
6	Apply ChatGPT for the usage of code generation, optimization and debugging

Lab Course Outcomes:

Sr.No.	Outcomes
CO1	Apply various components of AWS for problem solutions.
CO2	Apply AWS Sagemaker fundamentals for data labeling, bounding boxes and Semantic Segmentation
CO3	Apply various data exploration techniques for Data Preprocessing and deploy models after fine tuning.
CO4	Apply various computer vision techniques for facial recognition.
CO5	Apply various NLP techniques to create a bot
CO6	Apply ChatGPT for the usage of code generation, optimization and debugging

Description:

Module No	Detailed Contents	Hrs.
1	AWS sign up and Service Legal Agreement: Introduction to real-world problems for project-based Learning, Introduction to AWS sagemaker (Signup, free tier, billing, & IAM), AIML components in AWS, Simple Storage Service (S3) and Elastic Computing Cloud (EC2) Cloudwatch, Billing Alarm. Self-Learning Topics: Machine Learning challenges.	4
2	AWS SageMaker: Data Labeling in AWS Sagemaker Ground Truth, Labeling Text, Bounding Boxes and Semantic Segmentation in Ground Truth. Self-Learning Topics: Machine Learning pipeline implementation.	4
3	Data Visualization: Collecting and securing data, Data Exploring using Amazon SageMaker, evaluating your data, Visualizing Data, Feature engineering Encoding Categorical Variables, training a Model Using Amazon SageMaker, Splitting Data and Training a Model using XGBoost, Hosting and using the model Evaluating the accuracy of the model, Hyperparameter and model tuning. Self-Learning Topics: Select and Train an algorithm.	8
4	Forecasting: Processing time series data using Amazon Forecast-Creating a Forecast with Amazon Forecast, Managed Services for Forecasting. Self-Learning Topics: Case studies for Forecasting	2
5	Computer Vision : Analyzing image and video, Introducing Amazon Rekognition, Preparing custom datasets for computer vision- Labeling images with Amazon Ground Truth, Facial Recognition. Self-Learning Topics: Computer Vision Applications.	4
6	Natural Language Processing: Introduction to Amazon Polly, Amazon Comprehend, Amazon Translate, Create a bot to schedule appointments. Self-Learning Topics: Amazon CodeWhisperer	4

Reference Books:

Reference No	Reference Name
1	Learning Amazon Web Services (AWS): A Hands-On Guide to the Fundamentals of AWS Cloud by Mark Wilkins 1st Edition, Kindle Edition.
2	AWS for Beginners: The Complete Beginner's Guide to Learn and Understand Amazon Web Services and Its Future in the Modern World by Vick Middleton .
3	Mastering AWS Cloud Formation: Plan, develop, and deploy your cloud infrastructure effectively using AWS Cloud Formation by Karen Tovmasyan.

Web References:

Reference No	Reference Name
1	https://aws.amazon.com/
2	https://aws.amazon.com/sagemaker
3	https://aws.amazon.com/getting-started/ha
4	https://aws.amazon.com/sagemaker/da

Suggested list of experiments

Practical no.	Problem Statement
1	Introduction to Project Based Learning and understand the problem statements.
2	Create login credential and understand SLA, EC2, S3 of AWS.
3	Introduction to Sagemaker -Labeling data and text and bounding boxes.
4	Implementation of Exploratory Data Analysis (EDA).
5	Implementation of Linear and Multiple Linear Regression Analysis.
6	Implementation of Sagemaker XGBoost Algorithm
7	Implementation of Optimization strategy
8	Implementation of Regularization Techniques
9	Implementation of Classification Algorithms
10	Study of ChatGPT and Deployment of projects.

Term Work:	
1	Term work should consist of 10 experiments.
2	Journal must include at least 2 assignments.
3	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4	Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Continuous assessment exam	
1	Class Project – Select and Train an algorithm

Term Work: 25 marks

The term work will be based on the Laboratory work

Course Code	Name of Course	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Pract.	Oral	Total
NMCAFP21	Project Stage- 1	02	01	50	-	--	50

Prerequisite: Concept of Project Development and Management

Lab Course Objectives: The course is aimed to

Sr. No.	Course Objective
1	To understand and identify the problem statement
2	Acquaint students with the process of applying basic computer applications and providing solutions to the problems in various application domains..
3	Conceptualize knowledge with emphasis on critical thinking and problem-solving skills
4	Adapt to a rapidly changing environment by having learned and applied new skills.
5	To apply standard principles of project management and validate the project using appropriate evaluation measures
6	To inculcate the process of self-learning and research.

Lab Course Outcomes: On successful completion of course learner/student will be able to

Sr. No.	Course Outcome
CO1	Identify methodology for solving the above problem and apply engineering knowledge and skills to solve it and Use standard norms of engineering practices.
CO2	Validate, Verify the results using test cases/benchmark data/theoretical/inferences/experiments/simulations
CO3	Analyze and evaluate the impact of solution / product / research / innovation / entrepreneurship towards societal / environmental / sustainable development
CO4	Design and evaluate solutions for complex problems
CO5	Communicate through technical report writing and oral presentation. The work may result in research / article / patent / research publication

	The work may result in business plan for entrepreneurship product created
CO6	Gain technical competency by participating in project competitions and Demonstrate capabilities of self-learning, leading to lifelong learning

Guidelines for Mini Project		
1	Mini project may be carried out in one or more form of following: Product preparations, prototype development model, fabrication of set-ups, laboratory experiment development, process modification / development, simulation, software development, integration of software (frontend-backend) and hardware, statistical data analysis, creating awareness in society / environment, research oriented and application areas, etc.	
2	Students shall form a group of 3 students, while forming a group shall not be allowed less than three or more than three students, as it is a group activity. Group will be same till sem III project.	
3	Students should do surveys and identify needs, which shall be converted into problem statements for a mini project in consultation with project mentor / head of the department / internal committee of faculties.	
4	Students shall submit an implementation plan in the form of Gantt / PERT / CPM chart using state-of-the-art industry tools, which will cover weekly activity of mini projects	
5	A logbook may be prepared by each group, wherein the group shall record weekly work progress, project guide shall verify and record notes / comments.	
6	Students under the guidance of the mentor shall convert the best solution into a working model using various components of their domain areas and demonstrate.	
7	The solution to be validated with proper justification and report to be compiled in standard format. Software requirement specification (SRS) documents as per IEEE format, research papers, and competition certificates may be submitted as part of annexure to the report.	
8	With the focus on self-learning, innovation, addressing societal / research / innovation problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality be carried out in two semesters by all the groups of the students. i.e. Project Stage 1 in semester II.	
Term Work		
The review / progress monitoring committee shall be constituted by the head of department. The progress of the mini project to be evaluated on a continuous basis, based on the SRS document and log file activities submitted. Minimum two reviews in each semester		
Distribution of Term work marks shall be as below:		Marks (25)
1	Marks awarded by project mentor based on logbook	10

2	Self-contribution and use of skill set in project	10
3	Timeliness of Project report	05
II. Project Internal Examination (25 Marks):		Marks (25)
	Marks awarded by review committee/Examiner	15
	Individual contribution/viva/ communication skills.	10
Review / progress monitoring committee may consider following points for assessment project as mentioned in general guidelines		
SEM II Project:		
In the second semester expected work shall be procurement of component's / systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.		
• First review is based on readiness of building working prototypes to be conducted. • Second review shall be based on poster presentation cum demonstration of working model in the last month of the said semester.		
Mini Project shall be assessed based on following point		
1	Clarity of problem and quality of literature Survey for problem identification	
2	Requirement Gathering via Software Requirement Specification (SRS) / Feasibility Study	
3	Societal / Research impact	
4	Novelty, Originality or Innovativeness of project	
5	Effective use of skill set : Standard engineering practices and Project management standard	
6	Contribution of an individual's as member or leader	
7	Completeness of methodology implemented	
8	Design, Analysis and Further Plan	
9	Clarity in written and oral communication	
10	Verification and validation of the solution / Test Cases using open source testing tools as per trends in industry	
11	Full functioning of working model as per stated requirements	
In the second semester evaluation may be based on the above criteria and evaluation of performance of students in mini projects.		



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Guidelines for Assessment of Mini Project Practical / Oral Examination	
1	Report should be prepared as per the guidelines issued.
2	The Mini Project shall be assessed through a presentation and demonstration of the working model by the student project group to a panel of Internal /External Examiners preferably from industry/ research organizations having experience of more than five years and academia having experience more than 10 years approved by the head of Institution.
3	Students shall be motivated to publish a research paper / patent / participate in National / International conferences based on the work.



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CURRICULUM SCHEME FOR NEP POSTGRADUATE ACADEMIC PROGRAM AT VESIT

Branch: MCA Bridge Course

For the graduates, not having graduation in Computer Science/Information Technology
/ Computer Application, need to complete the bridge course
along with the MCA regular course

Bridge Course Scheme									
Course Code	Name of Course	Group	Teaching Scheme			Credits Assigned			
			(Contact Hours)						
			Theory	Pract.	Tut.	Theory	Pract.	Tut	Total
NMCABR1	Object Oriented Methodology with JAVA	ICT	NPTEL/ Udemy Course#	2		--	--	--	---
NMCABR2	1.Data Structure with Java 2.SQL/PLSQL	ICT	NPTEL/ Udemy Course#	2		--	--	--	--
	Total			04	--	--	--	--	--

Bridge Course Marks Scheme									
Course Code	Name of Course	Group	Examination Scheme						
			Theory					Pract	
			Internal Assessment			End Sem.	Exam. Duration	Pract	Oral
			CA	MT	Tot.		In Hrs		
NMCABR1	Object Oriented Methodology with JAVA	ICT	Assessment will be according to the NPTEL/Udemy Course weighted for 60 Marks and Performance in Laboratory work.					40	–
NMCABR2	1.Data Structure with Java 2.SQL/PLSQL	ICT	Assessment will be according to the NPTEL/Udemy Course weighted for 60 Marks and Performance in Laboratory work.					40	–
	Total								200

#Course will be Suggested By the Subject Teachers



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Course Code	Name of Course	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
NMCABR1	Object Oriented Methodology with JAVA	2	–	–	40	–	40

Reference

1. The complete reference JAVA2, Herbert schildt. Tata McGraw Hill
2. Programming with Java A Primer, E.Balagurusamy Tata McGraw Hill
3. Core Java for beginners, Sharanam Shah and vaishali shah, SPD
4. Java 6 Programming Black Book, Wiley –Dreamtech
5. Java 6 Programming, Black Book, Dreamtech Press.

Resource

- 1) NPTEL: Programming In Java By Prof. Debasis Samanta | IIT Kharagpur,
https://onlinecourses.nptel.ac.in/noc22_cs47/preview
- 2) Udemy Java Tutorial for Complete Beginners,
<https://docs.google.com/document/d/1VaCdwUhuoa8wnVxYNbAP65LwjPw6j4TN/editUdemy>
- 3) Udemy: Eclipse IDE for Beginners: Increase Your Java Productivity,
<https://www.udemy.com/course/luv2code-eclipse-ide-for-beginners/>

A suggested list of experiments

Practical No	Problem Statement
1	Create a simple Java class (e.g., Person) with attributes (name, age) and methods (display details). Instantiate objects and display their details.
2	Implement constructors in the Person class, including parameterized and default constructors. Demonstrate constructor overloading.
3	Create a base class Vehicle with derived classes Car and Bike. Show how inheritance allows sharing of methods and properties.
4	Extend the Vehicle class and override a method in Car and Bike. Use the super keyword to call the base class method.
5	Create an abstract class Shape with abstract methods calculateArea() and calculatePerimeter(). Implement these methods in subclasses Circle and Rectangle.
6	Define an interface Animal with methods sound() and eat(). Implement this interface in classes Dog and Cat.
7	Demonstrate method overriding and polymorphism by creating a reference of the Animal interface and assigning it to objects of Dog and Cat.
8	Create a class BankAccount with private fields for account number, balance, and methods to deposit, withdraw, and display balance. Use getter and setter methods.
9	Write a program that demonstrates handling of different exceptions like ArrayIndexOutOfBoundsException, NullPointerException, and ArithmeticException.
10	Use ArrayList to store a collection of Student objects. Demonstrate adding, removing, and iterating over the list.
11	Implement a generic class Box that can store objects of any type. Demonstrate its usage with different types (e.g., Box<Integer>, Box<String>).



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Course Code	Name of Course	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
NMCABR2	Data Structure with Java	2	–	–	40	–	40

Reference:

1. Data Structures and Algorithm Analysis in Java" by Mark Allen Weiss
2. Java Data Structures and Algorithms" by Robert Lafore
3. Data Structures and Algorithms in Java" by Robert Sedgewick and Michael T. Goodrich
4. Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein
5. Java Software Structures: Designing and Using Data Structures" by John Lewis and Joseph Chase

Resource:

1. 'Data Structure And Algorithms Using Java" By Prof. Debasis Samanta | IIT Kharagpur.
https://onlinecourses.nptel.ac.in/noc22_cs92/preview
2. "Data Structures and Algorithms in Java" by Tim Buchalka
<https://www.udemy.com/course/data-structures-and-algorithms-deep-dive-using-java/?couponCode=IND21PM>
3. Data Structures and Algorithms Specialization,
<https://www.coursera.org/specializations/data-structures-algorithms>

Sr.No	Topics of Coverage
1	Implementation of different sorting techniques. Bubble Sort, Insertion Sort, Selection Sort, Shell Sort, Radix Sort, Quick Sort
2	Implementation of searching algorithms Linear Search and Binary search
3	Stack Array implementation, Linked List implementation.
4	Implementation of Stack Applications like: Postfix evaluation Balancing of Parenthesis
5	Simple Queue implementation using Linked List Circular Queue implementation using Linked List Double ended Queue implementation using Linked List
6	Demonstrate application of queue (e.g., Priority Queue, Breadth First Search)
7	Implementation of all types of linked List Insert, Display, Delete, Search, Count Reverse operation on • Singly Linked Lists: • Circular Linked List • Doubly Linked Lists
8	Binary Search Tree Creation and Traversal Operation on BST • Largest Node • Smallest Node • Count number of nodes
9	Find the minimum spanning tree (using any method Kruskal's Algorithm for Prim's Algorithm)
10	Implementation of Graph traversal. (DFS and BFS)
11	Implementation of Min Heap and Max Heap Application : Heap Sort
12	Demonstrate application of linked list (eg. Polynomial addition, Sparse matrix)



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Course Code	Name of Course	Contact Hours	Credits Assigned	Examination Scheme			
				Term Work	Practical	Oral	Total
NMCABR2	SQL/PLSQL	2	–	–	40	–	40

Reference

1. Joel Murach, “Murach’s oracle PL/SQL” Joel Murach’s publication Murachs and Associates
2. Sharnam shah, Vaishali Shah, “Oracle for Professionals” Publication SPD-Shroff
3. Publishers and Distributors 2021
4. Rajshekhar Sundaram, “Oracle 10g Programming: A Premier”, Publication Pearson
5. Education 2009
6. Peter Rob and Coronel, “Database Principals fundamentals of Design, Implementation and Management”, Publication Cengage Learning 2021.

Resource

- 1) Coursera, Oracle SQL Databases Specialization,
<https://www.coursera.org/specializations/oracle-sql-databases>
- 2) NPTEL: Database Management Systems, Prof. Partha Pratim Das, Department of Computer Science & Engineering, Indian Institute of Technology, Kharagpur
- 3) Udemy SQL Foundations, <https://www.udemy.com/course/sql-essentials-for-beginners/>
- 4) Udemy Introduction to Databases and SQL Querying,
<https://www.udemy.com/course/introduction-to-databases-and-sql-querying/>

Sr.No	Topics of Coverage
1	Data Definition Language: Create, Alter, Drop, Rename, Truncate Data Manipulation Language: Insert, Update, Delete, Select
2	Not Null, Unique Key, Primary Key, Foreign Key, Check, adding and Dropping a Constraint
3	Grant, Revoke, Roles, Commit, Rollback, Savepoint
4	Column Alias, Concatenation Operator, Arithmetic Operators, Comparison Conditions, Logical Conditions, ORDER BY Clause
5	Single Row Functions, Character Functions, Number Functions, Date Functions, Conversion Functions, Aggregate functions Subquery: Types of Subquery, Group by and Having Clause
6	Equijoins, Non-Equijoins, Self Joins, Left Outer Joins, Right Outer Joins, Full Outer Joins, Natural Joins
7	Programming: Variables, Identifiers, Comment, PL/SQL Block Structure IF Statements: Simple IF Statements, Compound IF Statements IF-THEN-ELSE Statements Loop: Basic Loop, WHILE Loop, FOR Loop
8	Cursor: Types of Cursor, Explicit Cursor Attributes Trigger: Trigger, Statement Trigger, Row Trigger
9	Create Function, Function with Arguments, Executing Function, Procedures: Block Structure of Subprogram, Types of Subprograms, Procedure with Parameters, Executing Procedures, Dropping Procedures
10	Packages: Package Specification, Package Body, Creating Package, Execution, Dropping Package